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INŽENJERSTVO, TEHNOLOGIJA I MATERIJALI
ENGINEERING, TECHNOLOGY AND MATERIALS

ARSENIC (V) REMOVAL FROM WATER USING MAGNETITE NANOPARTICLES BIO-LINKED WITH APPLE PEEL WATER EXTRACT

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ABSTRACT:

The presence of arsenic in groundwater is a threat to human health if that water is used for water supply. In this work, suitability of bio-linked magnetite nanoparticles as adsorbent for arsenic removal from water was investigated. The bio-linked magnetite nanoparticles were synthesized from Fe (II) and Fe (III) sulfate salts by co-precipitation method in the presence of apple peel water extract. Using XRD technique it was confirmed that the product is magnetite. Using 5 g/L of adsorbent almost all content of As (V) was removed after 24 h of water treatment. The residual concentration of arsenic in the water after treatment was 2.57 µg/L, thus it can be concluded that, in terms of arsenic content requirements for drinking water, quality standard has been satisfied.

Keywords: *bio-linked magnetite nanoparticles, apple peel water extract, arsenic removal, water treatment, adsorption*

1. INTRODUCTION

Groundwaters in the Pannonia region often contain significant amounts of arsenic, which is a serious problem if water is used for water supply. The main concern regarding the presence of arsenic in groundwater is its high toxicity and carcinogenicity, which can lead to a number of health problems. Therefore, the World Health Organization (WHO) has prescribed a maximum concentration for arsenic allowed in drinking water of 10 µg/L [1]. One adsorbent which has attracted a lot of attention for applications with arsenic contaminated waters is magnetite in the form of nanoparticles (MNPs). The performance of magnetite nanoparticles could be significantly improved if their synthesis is performed in the presence of some volume of plant extracts, which contain various bioactive components (such as polyphenols, flavonoids, etc.). Bioactive components could be attached on the surface of magnetite leading to their functionalization, thus, the bio-synthesis of nanoparticles has been proposed as promising approach for the production of

valuable nanomaterial. Furthermore, the use of plant residues from food industry (bio-waste material) as a raw material for bio-synthesis of magnetite reduces production costs and further contributes to sustainability.

In this work suitability of bio-linked magnetite nanoparticles as adsorbent for arsenic removal from water was investigated. The synthesized magnetite nanoparticles were characterized using X-ray diffraction (XRD) technique and then used in water treatment.

2. MATERIALS AND METHODS

2.1. Chemicals

The chemicals: $\text{Fe}_2\text{SO}_4 \times 7\text{H}_2\text{O}$ (Merck), $\text{NH}_4\text{Fe}(\text{SO}_4)_2 \times 12\text{H}_2\text{O}$ (Sigma Aldrich) and sodium hydroxide were analytical grade and used without further purification.

The apple extract was prepared from apple (*Malus domestica*) peel with ultra pure deionized water as a „green“ solvent. Primarily chopped apple peel was subjected to extraction according to the procedure given in *Mashjoor et al. [2]*.

2.2. Synthesis of bio-linked MNPs

The bio-linked MNPs were prepared by co-precipitation of 0.1 M Fe (II) and 0.2 M Fe (III) sulphate salts in alkaline conditions at 80°C in the presence of apple peel water extracts, according to the procedure given in *Mashjoor et al. [2]* and *Rizk and El-Hefny [3]* with slight modification.

2.3. Characterization of bio-linked MNPs

The crystallographic structure of the MNPs was analyzed by X-ray diffraction (XRD) using Rigaku MiniFlex 600 diffractometer ($\text{CuK}\alpha$ radiation, $\lambda = 1.5406 \text{ \AA}$) in 2θ range 20–70° with a scan rate of 0.03°/s.

Surface functional groups were detected by Fourier transform infrared spectroscopy (FTIR) (Bruker Vertex 70) at a spectral range of 4000 cm^{-1} to 400 cm^{-1} with a resolution of 8 cm^{-1} .

2.4. Arsenic (V) removal using bio-linked MNPs as adsorbent

Adsorption experiments were conducted with synthetic As (V) water solution in concentration of 1099 $\mu\text{g/L}$. For the kinetic experiments, 40 mL water samples were added to 100 mL glass Erlenmeyers containing 0.2 g of synthesized MNPs (concentration 5.0 g/L). The suspensions were shaken on an orbital shaker (150 rpm, 25°C) for certain periods of time (15, 30, 45, 60, 75, 90, 105, 120, 240, 1440 min). Afterwards the supernatants were separated from the adsorbents using an external magnet and filtered through 0.45 μm membrane filter. Residual arsenic concentrations in the samples were analyzed by inductively coupled plasma mass spectrometry (ICP-MS) as explained below.

The amount of arsenic adsorbed by a unit mass of adsorbent was calculated using the following equation (1):

$$q_e = \frac{(C_0 - C_e) \cdot V}{m} \quad (1)$$

where C_0 and C_e are the initial and equilibrium As (V) concentrations in solution ($\mu\text{g/L}$), V is the volume of solution (L) and m the mass of sorbent applied during the experiment (g).

The results of the adsorption kinetic experiments were analyzed using three models: the Lagergren pseudo-first-order (equation 2) [4], the pseudo-second-order (equation 3) [4] and the Weber-Morris intraparticle diffusion (equation 4) [5], where q_e [$\mu\text{g/g}$] is the equilibrium amount of adsorbed As (V) ions, q_t [$\mu\text{g/g}$] is the amount of As adsorbed after time t [min], k_1 [$\mu\text{g/g min}$] and k_2 [$\text{g/min } \mu\text{g}$] is the adsorption rate constants for first- and second-order models, respectively, and k_i [$\mu\text{g/g min}^{1/2}$] is the intraparticle diffusion rate constant.

$$\ln(q_e - q_t) = \ln q_e - k_1 \cdot t \quad (2)$$

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e} t \quad (3)$$

$$q_t = k_i \cdot t^{1/2} + C \quad (4)$$

2.5. Analytical methods

Total arsenic concentrations were analyzed by ICPMS (7700 Series, Agilent Technologies, Tokyo, Japan) and arsenic speciation analyses were carried out on the same system coupled with high performance liquid chromatography (1260 Infinity, Agilent Technologies, Germany) [6, 7].

3. RESULTS AND DISSCUSSION

3.1. Characteristics of bio-linked MNPs

The X-ray diffraction pattern of the bio-linked MNPs synthesized by Fe(II) and Fe(III) sulfate salts in the presence of plant extract is shown on Fig. 1. The diffraction peaks appeared at 2θ values of 30.3° , 35.6° , 43.2° , 53.7° , 57.2° and 62.9° correspond to the (220), (311), (400), (422), (511) and (440) planes of the inverse spinel structured magnetite (JCPDS card, Ref. Code 96-900-5840). The crystallite size of bio-linked MNPs is 14 nm, which is slightly higher value compared to the chemogenic MNPs synthesized at the same reaction conditions without plant extract (11 nm) [8].

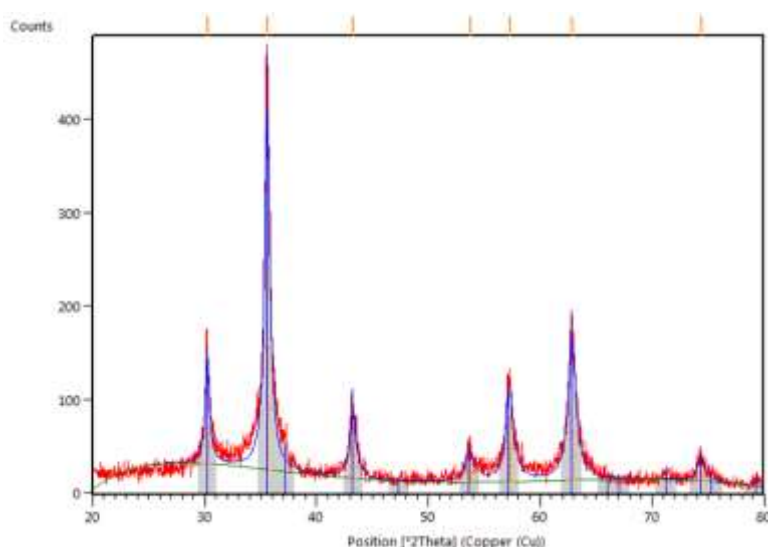


Fig. 1. XRD spectra of bio-linked MNPs

FTIR analysis was performed to exhibit the characteristic bands for bio-MNPs synthesized using apple peel water extract (Fig. 2). The characteristic IR bands for the bio-MNPs are Fe-O stretching modes around 634 cm^{-1} and 598 cm^{-1} [9]. Sample also has a peak at 2360 cm^{-1} (with a shoulder around 2340 cm^{-1}) which corresponds to symmetric and asymmetric C=O modes which is associated with gas phase CO_2 [10]. The broad band from $1300\text{--}1700\text{ cm}^{-1}$ are accountable to stretching of C=C bond in the aromatic rings ($\sim 1585\text{--}1600\text{ cm}^{-1}$ and $\sim 1400\text{--}1500\text{ cm}^{-1}$), axial bending of C-O bond in -COOH ($1210\text{--}1320\text{ cm}^{-1}$) [11], to C-O stretching in acid, alcohol, phenol, ether, and/or ester groups ($\sim 1400\text{--}1000\text{ cm}^{-1}$) [12]; and the region from $3600\text{--}4000\text{ cm}^{-1}$ can be assigned to O-H stretching vibrations from the water molecules [13].

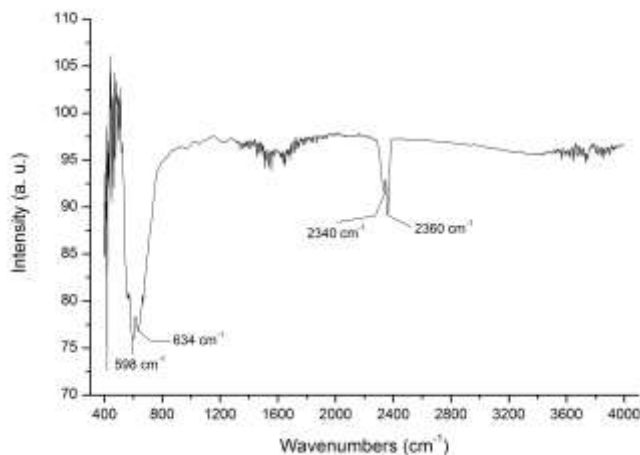


Fig. 2. FTIR spectra of bio-linked MNPs

3.2. Arsenic removal from water using bio-linked MNPs

The efficiency of As (V) removal using bio-linked MNPs as adsorbents was shown on Fig. 2. The adsorption on MNPs was conducted with initial As (V) concentration of 1099 $\mu\text{g/L}$ during 24 h.

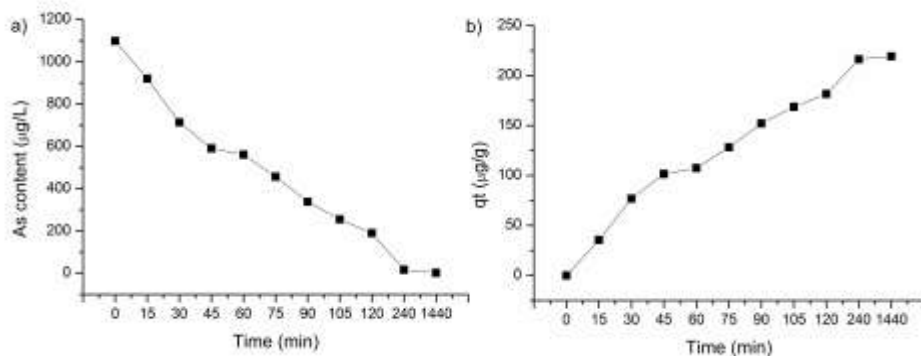


Fig. 2. Removal of As (V) from water using bio-linked MNPs a) concentration of As (V) vs. time and b) capacity of adsorbent vs. time

During the process, the efficiency of removing arsenic from water was in the range of 16-100%. The efficiency of the process increases over time and reaches 98% removal only

after 4 h, when the concentration of arsenic in the treated water was 17.5 µg/L. After 24 h, the content of arsenic in the water was 2.57 µg/L, which is in accordance with the water quality requirements prescribed by the regulations of the Republic of Serbia for content of arsenic in drinking water (< 10 µg/L). The maximal capacity of bio-linked MNPs in removing arsenic was 219 µg/g (Fig. 2b).

The experimental results show that arsenic was adsorbed rapidly within the first 120 min suggesting the presence of enough adsorption sites on bio-linked MNPs (Fig. 2a). After that the process has slowed down, because of the gradual saturation of adsorption sites. Considering that around 4 h was necessary to achieve the adsorption equilibrium, it can be suggested that specific adsorption (which involves the formation of inner surface complexes) of arsenic occurs on this material. In contrast, the adsorption achieved only by electrostatic interactions is usually very fast (in the order of seconds) [14].

To obtain more in-depth information about the mechanism of arsenic adsorption onto the synthesized bio-MNPs, the kinetic data were fitted to pseudo-first-order, pseudo-second-order, and intraparticle diffusion (Weber–Morris) kinetic models. The parameters of these models are presented in Table 1. Evaluation of the kinetic models is based on the values of the square of the correlation coefficient (R^2) and the best-fit linear graph followed the pseudo-first-order kinetic model. The pseudo-first-order or Lagergren model considers that the rate of adsorption sites occupation is proportional to the number of unoccupied sites [15].

The intraparticle diffusion model was also applied to the kinetic data to elucidate the diffusion mechanism. According to the obtained parameters, it can be suggested that the intraparticle diffusion model was not appropriate to fit the experimental data, due to relatively low value of R^2 (0.9369). Therefore, the arsenic sorption on bio-MNPs was probably mainly governed by external diffusion [16, 17].

Table 1 Kinetic model parameters of As (V) adsorption by bio-linked MNPs

Kinetic model	Parameter	Value
Pseudo-first-order	R^2	0.9771
	k_1 [µg/g min]	0.018
	q_e [µg/g]	298.87
Pseudo-second-order	R^2	0.9677
	k_2 [g/min µg]	$3.05 \cdot 10^{-5}$
	q_e [µg/g]	317.46
Intraparticle diffusion model	R^2	not appropriate fitting
	k_i [µg/g min ^{1/2}]	
	C [µg/g]	

The obtained results reveal good applicability of these bio-linked MNPs in the abovementioned adsorption process, demonstrating a new low-cost material with high efficiency.

4. CONCLUSION

Based on available information from studies and scientific peer-reviewed papers, this research is one of the unique in the field of synthesis of novel materials with high adsorption rate in order to reduce the concentration of arsenic in water. Results revealed that adsorption rate initially increased rapidly, and the optimal removal efficiency was reached within about 4 h. Using 5 g/L of adsorbent almost all content of As (V) was removed after 24 h of water treatment. The kinetics of adsorption on bio-linked MNPs was best described by the pseudo-first-order model.

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RATIONALIZATION OF ILLUMINATION UNIFORMITY FOR LED LIGHT FITTING AT THE WORKPLACE USING THE DIGITAL SOFTWARE SOLUTION

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ABSTRACT:

Rationalization is a set of complex activities, which are supposed to ensure the most advantageous arrangement of the work process with the continuity of increasing the level of technique, technology, work organization, production, and management. The goal of rationalization in the production area is to increase the effectiveness of the work procedure, product, or work environment, based on rationalization measures in partial steps of the implemented activities. In order to achieve efficient production, it is not only important to properly implement machines, tools, materials, technologies, and positions, but also to ensure suitable working conditions. It is necessary to constantly monitor, analyze and ensure their improvement at all levels of production. The correct setting of working conditions (elimination of noise, elimination of dust, lighting and technical conditions, etc.) leads not only to well-being at the workplace but also to the reduction of error rates, the growth of economic efficiency, and the continuity of the production process. The presented article is focused on a comprehensive assessment of uniformity in the workplace with the subsequent presentation of a rationalization solution for its improvement using specialized digital technologies. The conclusion provides a comprehensive summary of the obtained results and describes the possibilities of further solving the problem. This research was supported by grants VEGA 1/0431/21 and KEGA 028TUKE-4/2021.

Keywords: uniformity, digital ergonomics, rationalization, lighting

1. INTRODUCTION

In the work area, rationalization is aimed at creating conditions in which workers can focus on their tasks, work with high performance and at the same time save their labour. In all cases, it is based on economic calculation, it aims at profitability and economy. An important feature of rationalization is its practical orientation. It is a tool not only for the further development of knowledge but a tool for verifying and applying all practical changes. [1]

The following basic tools are most often used for the creation of rationalization solutions: Optimization of the execution of work operations, Ergonomics of the workplace (arrangement and equipment of the workplace), Technical modifications of workplaces (fixtures, holders, mechanisms), Technology of construction, Organization of workplaces. [2]

Each rationalization task can be implemented in accordance with the following sequence [3]:

- Preparatory – there are many activities of an analytical and synthetic nature, the result of which is the decision to solve the given task.
- Planning – the general goal and the project team's composition are determined, and the project plan is prepared.
- Analytical – the current situation is analysed, deficiencies are looked for, and new requirements are formulated.
- Design – variants of possible solutions are proposed.
- Selective – the most advantageous variant is selected (by a multi-criteria evaluation) in terms of technical, economic and environmental aspects.
- Implementation – the selected solution is implemented.
- Evaluation – the implemented benefit of the solution is evaluated.

The result of the rationalization study is the production organism modelling at different levels of the production system, i.e. starting with a workplace or a group of workplaces and ending with the highest organizational unit. [4]

The goal of the solution is to propose an indicative solution for the production system based on the rationalization of the organization, technology, material handling, material flows and other related activities. [5]

2. RATIONALIZATION OF ILLUMINATION UNIFORMITY AT THE WORKPLACE

Rationalization of the illumination uniformity was realized with a model solution created in Dialux Evo. Before creating alternatives to the assessed state, it is necessary to

determine the main attributes of the workplace to ensure the correct assessment of suggested uniformity at the model workplace.

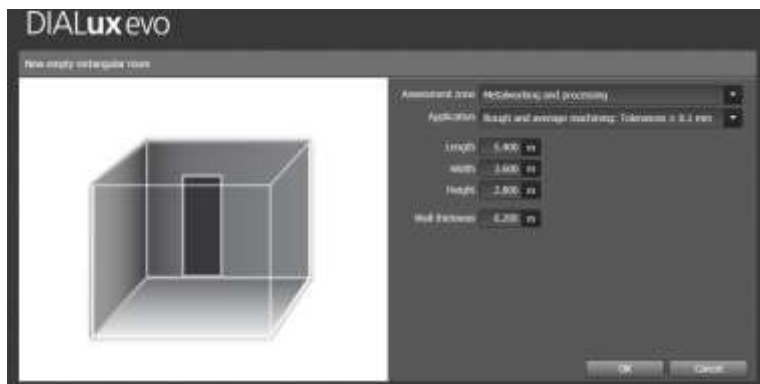


Fig. 1. Main attributes determining

These basic attributes are necessary for subsequently assessing the achieved results with normative requirements. Based on the main attributes determined above, a model (Fig. 2) was built for the implementation of all subsequent rationalization solutions.

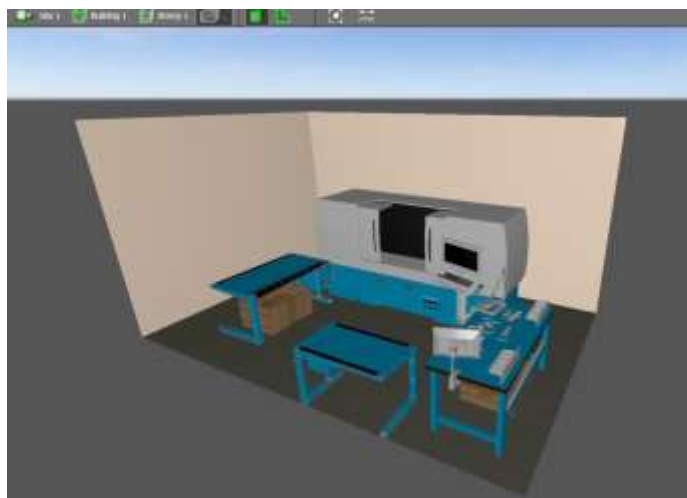


Fig. 2. Created model in Dialux Evo

In accordance with the layout solution, basic calculation objects were determined, which were placed in front of each important part of the workplace (Fig. 4). Measuring grid for each calculation object was determined automatically via software.

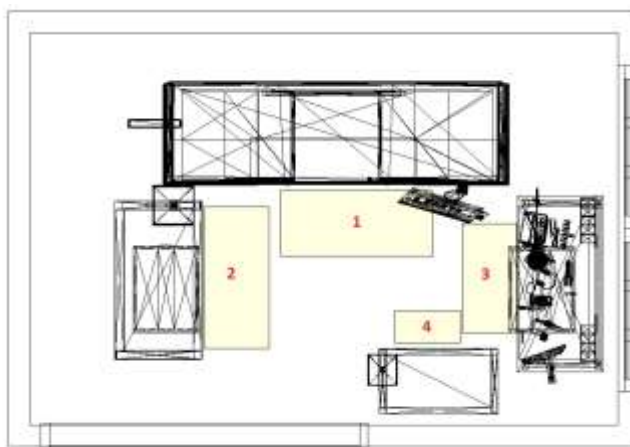


Fig. 3. Identification of calculation objects

For each calculation object, calculation parameters (perpendicular illuminance, unified glare rating, daylight factor) were set with respect to the considered type of lighting and the subsequently assessed variables. To ensure the possibility of subsequent comparison of the achieved results, the same input settings were set in all alternatives.

2.1. Identification of alternatives for rationalization

For analysis, assessment and overall rationalization, four basic models were created with the modification of light fitting mounting height and type of illumination. A summary of the individual alternatives is given in the following table.

Table 1. Identification of model alternatives

<i>Alternatives</i>	1	2	3	4
Parameter/ light fitting	BY100P LED100S/840 WB PSU	BY120P G5 LED105S/840 WB PSU	BY100P LED100S/840 WB PSU	BY120P G5 LED105S/840 WB PSU
Colour temperature	4000 K	4000 K	4000 K	4000 K
Luminous Flux	10500 lm	10500 lm	10500 lm	10500 lm
CRI	80	80	80	80
Power	77 W	67 W	77 W	67 W
Source	LED100S/840	LED105S/840	LED100S/840	LED105S/840

Mounting height	2 800 mm	2 800 mm	2 600 mm	2 600 mm
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For each of the above-mentioned alternatives, simulation models (Fig. 4) were processed, from which the necessary results, their analysis and comprehensive assessment were obtained.

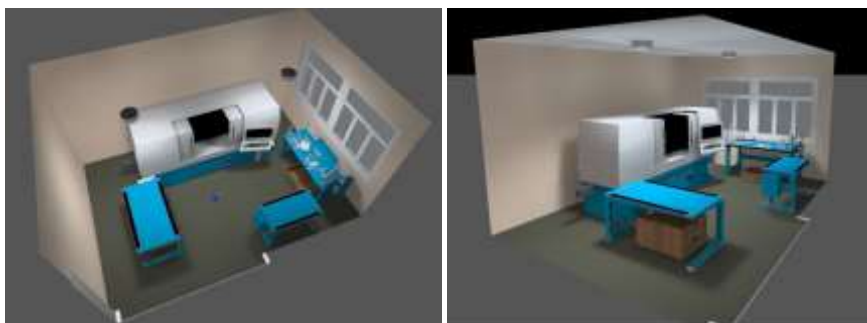
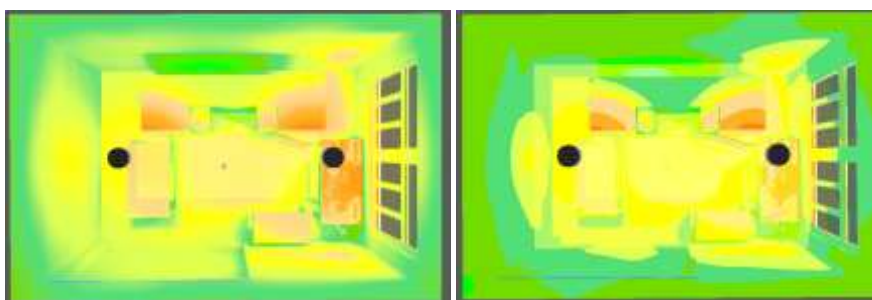


Fig. 4. Illustration of created simulation model alternatives for uniformity rationalization

3. RESULTS AND DISCUSSION

From each simulation model (Fig. 5) the results of uniformity were obtained as an authoritative investigated parameter, which was first of all assessed with valid normative requirements. In addition to the comparison with normative requirements, a comparison was also made with other model solutions. Through individual comparisons, the most suitable rationalization solution was chosen.



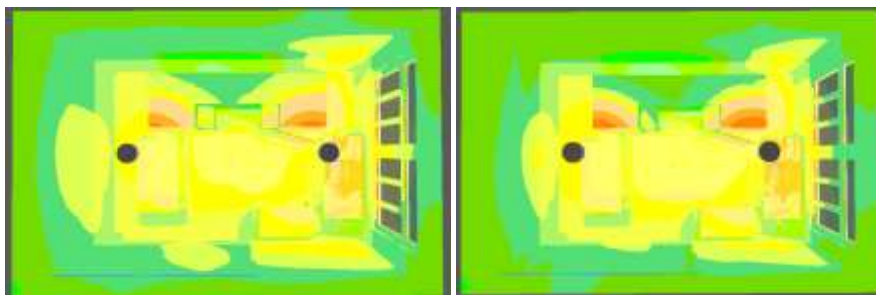


Fig. 5. Illustration of realised simulation for all alternatives – on top left -alternative 1, on the top right – alternative 2, down left – alternative 3, down right – alternative 4

Table 2. Results from Alternative 1 in comparison to EN 12 464-1

	Alternative 1	EN 12 464 -1	Difference
Calculation object 1	0.84	0.6	+ 1.40
Calculation object 2	0.74		+ 1.23
Calculation object 3	0.86		+ 1.43
Calculation object 4	0.86		+ 1.43

In the comparison of the achieved results obtained from the model solution of the first alternative, a satisfactory state of lighting uniformity can be stated for all calculation objects. In all points, the difference is more than +1.23, which is an acceptable upper limit value.

Table 3. Results from Alternative 2 in comparison to EN 12 464-1

	Alternative 2	EN 12 464 -1	Difference
Calculation object 1	0.88	0.6	+ 1.46
Calculation object 2	0.73		+ 1.26
Calculation object 3	0.82		+ 1.36
Calculation object 4	0.87		+ 1.45

When assessing the results achieved from the model solution of the second alternative, it is also possible to state compliance within the framework of the need to achieve normative regulations. In the second alternative, a difference of more than +1.26 arises in the assessed points, which is again considered satisfactory.

Table 4. Results from Alternative 3 in comparison to EN 12 464-1

	Alternative 3	EN 12 464 -1	Difference
Calculation object 1	0.79	0,6	+ 1.32
Calculation object 2	0.67		+ 1.11
Calculation object 3	0.80		+ 1.33
Calculation object 4	0.84		+ 1.40

Within the framework of the achieved results from the model solution of the third alternative, compliance with normative requirements is also noted at every point. Within the second calculation object, the value exceeds the limit in each of the analyzed points.

Table 5. Results from Alternative 4 in comparison to EN 12 464-1

	Alternative 4	EN 12 464 -1	Difference
Calculation object 1	0.82	0,6	+ 1.37
Calculation object 2	0.65		+ 1.08
Calculation object 3	0.79		+ 1.32
Calculation object 4	0.83		+ 1.38

As part of the assessment of the last simulation model, it is also possible to state that the normative requirements have been met, even if the result in the second calculation object is very close to the minimum requirement.

Concerning the analyzes carried out above, which determine the fulfilment of all normative requirements in each alternative and each of the specified points, a comparison of individual alternatives was subsequently carried out to determine the most suitable solution with regard to the determined requirements.

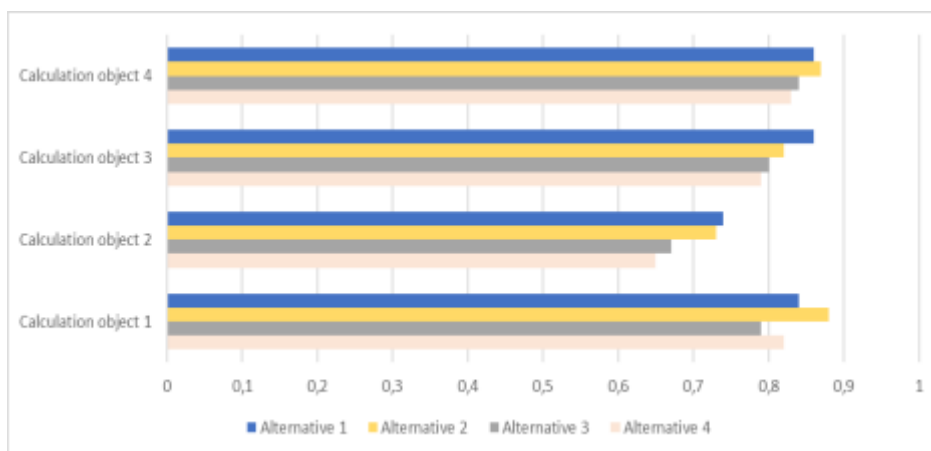


Fig. 6. Comprehensive comparison of uniformity results

As part of the summary analysis, it can be concluded that the least suitable rationalization solution is the application of the fourth alternative, which has an LED fitting light with a mounting height of 2,600 mm and a power of 67 W. Based on all the results, the solution from the second alternative, which has lighting uniformity is the highest on the two monitored calculation objects, while on the other two, it is in the second position and is, therefore, most suitable for application to this type of workplace. This alternative solution includes 67 W power and an installation height of 2,800 m. In this alternative, the same type of lamp is applied as in the alternative that was determined to be the least suitable. Based on this result, it is possible to confirm that the uniformity of lighting is not only influenced by the lighting source itself but also by its location and mounting height.

4. CONCLUSION

Greater and more demanding requirements are placed on rationalization. Possibilities are being sought to increase the efficiency of the workplace, office, plant, enterprise and the entire production system. The presented article presents one of the possibilities of how to effectively, economically and flexibly apply rationalization in the workplace from the perspective of an ergonomic system. The article presents the possibilities of rationalization of illumination uniformity for led light fitting at the workplace using the digital software solution. Based on the simulations of four alternative model solutions, it was found and confirmed that the lighting uniformity is influenced not only by the lighting source itself but also by its location and mounting height. In future research tasks, it is possible to use software solutions and means of digitalization to assess other qualitative lighting parameters, in a single workplace, or to carry out verifications of existing research with an extension to assess uniformity specifically for a production hall or a production complex.

ACKNOWLEDGEMENT

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TEMPERATURE CONDITIONS INFLUENCE ON THE CHANGE IN THE INITIAL VELOCITY OF THE 6.5 MM GRENDEL PROJECTILE

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ABSTRACT: *In this paper, the experimental method and mathematical procedure of measuring the 6.5 mm Grendel projectile's initial velocity at different temperatures, were analyzed. A mathematical model of external ballistics has been defined, that is, a mathematical calculation of the projectile's initial velocity has been made for the given conditions. The aim was to perform a comparative analysis at different temperatures based on the obtained results (analysis of the experiment and the mathematical model of external ballistics). The goal of this paper was to determine, based on experimental testing and mathematical calculations, whether the gunpowder for the Grendel 6.5 mm projectile is thermostable.*

Keywords: *initial velocity, 6.5 mm Grendel projectile, experiment*

1. INTRODUCTION

Small-caliber bullets are intended for the destruction and incapacitation of unshielded and poorly shielded manpower, lightly armored and unarmored motor vehicles, and other technical material assets, especially at distances up to 100 m. It is crucial to shield the troops within motor vehicles from the effects of projectiles since the troops transported by such vehicles are an extremely easy group target. Paper [1] investigates with FEM (Finite element method) the minimum thickness of ballistic plates in order to protect the troops and military equipment. Small-caliber projectiles do not contain any destructive charges, instead, they operate by transmitting their kinetic energy to the target. Small-caliber projectiles present an object of interest and research, beginning with testing the resistance of the ballistic plate made of steel 1.3964 to the penetration of a 7.62 mm bullet [2]. In papers [3,4] optimal design and optimization of the head shape of a small-caliber supercavitating projectile were developed. Modern small-caliber bullets generally have a jacket and a core. The jacket is most often made of tombac (a brass alloy with high copper

content and 5–20% zinc content). Paper [5] deals with the mechanical characterization of rings directly extracted from the jackets of small-caliber ammunition. In addition to tombac, the jacket is also made of mild steel coated with a thin layer of copper or some copper alloy. The core is made of lead with 10% antimony to increase strength. Given that weapons, as well as ammunition, are used in different weather conditions, it is very important to determine the thermostability of gunpowder. In paper [6], a TES (thermal energy storage) system is developed to examine the stability of expanded graphite and solar salts ($\text{KNO}_3/\text{NaNO}_3$) at high temperatures. This thermal reaction accelerates the start of the exothermic reaction of the TES system while being substantially comparable to the thermal responses of the gunpowder.

The aim of this paper is to determine the influence of atmospheric temperature change on the 6.5 mm Grendel projectile initial velocity change. All the experimental data will be presented in the paper.

A 6.5 mm Grendel bullet was used for the experiments and it is shown in Fig. 1.

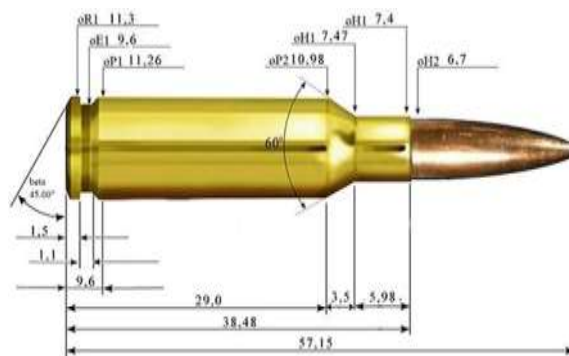


Fig.1. 6.5 mm Grendel bullet

2. EXPERIMENT

The aim of the experiment is to examine the effect of changing temperature conditions on the initial velocity of a 6.5 mm ammunition projectile. Based on the results, a comparative analysis will be performed with the mathematical model of external ballistics and experimental testing.

In this paper, a method based on measuring the time it takes for a projectile to travel between two points whose distance is known is used to determine the initial velocity of the projectile. The procedure is as follows: in two points of the path (Fig.2), detectors are placed and connected to the stopwatch (H). The detector at point A is starting the

stopwatch, and the detector at point B is turning it off. Thus, the stopwatch registers the time required for the bullet to travel from point A to point B.

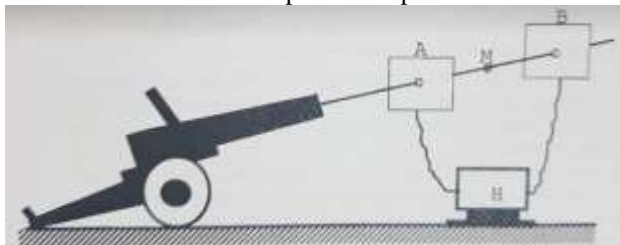


Fig. 2. Method for measuring the projectile's initial velocity [7]

Photocells or square frames (velocity barriers) through which current flows are used as detectors so that when a magnetized projectile passes, an electromagnetic field is induced and the possibility of receiving an impulse to start or stop the stopwatch is created. The average projectile velocity between points A and B is determined as [8]:

$$v = \frac{\overline{AB}}{t} \quad (1)$$

If points A and B are close, the projectile velocity corresponds to point M, which is in the middle of AB. If the length of the base is x , and the measured time is t , then, given the length of the base, the projectile velocity at the point in the middle of the base M is [8]:

$$v_M = \frac{x}{t} \quad (2)$$

The decrease in projectile velocity from the muzzle of the barrel to point M is determined by the path calculation method in external ballistics and is defined as [8]:

$$\Delta v_0 = \frac{id^2\delta}{m\delta_0} D(v)x_M \quad (3)$$

where are: i - the projectile shape coefficient, d - caliber, m - projectile mass, δ - air density in shooting conditions, δ_0 - air density at standard conditions, $D(v)$ - function of dependence on the adopted resistance law, and x_M - the distance from the muzzle of the barrel to point M.

Accordingly, the projectile's initial velocity is [8]:

$$v_0 = v_M + \Delta v_0 \quad (4)$$

If the experiment is conducted at a certain angle of elevation, then the loss of projectile initial velocity due to the action of the earth's gravity is also calculated [8]:

$$\Delta v_q = \frac{gtg\theta_0}{V_M} x_h \quad (5)$$

where are: g - the acceleration of the Earth's gravity, and x_h - horizontal distance of the center of the base from the muzzle of the barrel.

In that case, the projectile initial velocity is [8]:

$$v_0 = v_M + \Delta v_0 + \Delta v_q \quad (6)$$

In practice, the projectile initial velocity is measured for the entire group of bullets, and then the average value of the initial projectile velocity for the entire group is determined. The accuracy of the measurement depends on the accuracy with which the base length \overline{AB} and projectile flight time are measured. The base measurement error is 0.05%, so the projectile's initial velocity is obtained with an accuracy of 0.05%. To rule out possible measurement mistakes, the initial velocity is measured with two stopwatches. The average value is taken from the two values obtained if they do not differ from each other by more than: $3 \frac{\text{m}}{\text{s}}$ for the projectile's initial velocity up to $600 \frac{\text{m}}{\text{s}}$ and 0.5% for the velocity over $600 \frac{\text{m}}{\text{s}}$ [8].

2.1. Measuring equipment used in the experiment

Measuring equipment used in the experiment is: **velocity barriers A and B**, in which detectors are placed and connected to the stopwatch; **"VÖTSCH" cooling and heating chamber** which is used for cooling and heating the ammunition with frames and rifle, which can operate in the temperature range from -42 to +100 °C (Fig.3), and **device for measuring projectile initial velocity "EPVAT"**. The tasks of this system are to provide: Graph and maximum pressure value in the chamber, graph and maximum port pressure value, velocity (any combination, from the muzzle barrel, two optical gates, and target), action time (and generally all time intervals), X and Y coordinates of the shot in the target system, terminal projectile velocity and projectile energy.



Fig. 3. "VÖTSCH" chamber

2.2 Procedure of experimental testing

During the experimental testing, the ammunition and the rifle itself will be exposed to different ambient temperatures. Heating and cooling are done in the "VÖTSCH" chamber (shown in Fig.3). Ammunition and the rifle are inserted into the chamber, and when they reach the appropriate temperature, they are removed from the chamber and assembly of the ammunition frame and the rifle that is used during experimental testing is carried out. The temperatures at which the experimental testing was performed are: -30°C , normal conditions $20 - 24^{\circ}\text{C}$, and $+50^{\circ}\text{C}$. The firing is carried out in the tunnel, and with the "EPVAT" system projectile initial velocity is measured. For all three temperature cases, 10 bullets were fired.

2.2.1 Projectile initial velocity measurement at a temperature of -30°C

Testing begins with turning on the chamber and setting the thermostat to a temperature of -30°C . It takes 1 hour to reach the specified temperature.

When the chamber reaches temperature the ammunition frame and the rifle are inserted (Fig.4 – left). After 2 hours of cooling, the rifle with the frame reaches the set temperature (Fig. 4 – right).



Fig.4. Inserted ammunition frame and the rifle into the chamber – left, frame ammunition and rifle after reaching the temperature of -30 °C

The projectile's initial velocity is measured by shooting through the barrier as shown in Fig.5 – left. After firing, the barrel of the rifle is heated, and the ice begins to melt, as shown in Fig. 5 – right.



Fig.5. Shooting through the velocity barrier, set at 10m, after reaching -50 °C – left, heating of the rifle barrel and the ice melting – right

In the table 1 are presented measured projectile initial velocities at a temperature of -30 °C and the average projectile initial velocity v_{10} (10 bullets fired for each experiment) of

$$665.257 \frac{\text{m}}{\text{s}} .$$

Table 1. Projectile initial and average velocity measured at a temperature of -30 °C

Round	Time [ms]	Projectile initial velocity [m/s]
1	1.5219	657.087
2	1.4943	669.223
3	1.5008	666.315
4	1.5077	663.240
5	1.4942	669.250
6	1.5015	666.021
7	1.4899	671.189
8	1.5038	664.976
9	1.5040	664.888
10	1.5143	660.377
Avg.	1.5032	665.257

2.2.1.1 External ballistics mathematical model for a temperature of -30 °C

Based on the mathematical model projectile initial velocity can be calculated. v_0 represents projectile initial velocity and can be calculated as:

$$v_0 = v_{10} + \Delta v_0 \quad (7)$$

and Δv_0 can be calculated as:

$$\Delta v_0 = \frac{10Cx_{10}}{D(v_{10})} = 6.147 \frac{\text{m}}{\text{s}} \quad (8)$$

where are: v_{10} - the measured average projectile initial velocity at the center of the base, x_{10} - the distance from the muzzle of the barrel to the center of the base, Δv_0 - the projectile initial velocity drop from the muzzle of the barrel to x_{10} , C - the ballistic coefficient for Siacci's law of resistance, $D(v_{10})$ - the velocity function, whose values are given in table 2 (based on table 2 the value is 45.39).

Table 2. The velocity function [8]

$v_{10} \text{ [m/s]}$	$D(v_{10})$
400	77
450	65
500	57
550	53
600	49
650	46
700	44
750	44
800	41

$$C = \frac{id^2}{m} \cdot 10^3 = 2.79 \quad (9)$$

where are: C - the ballistic coefficient of the projectile, m - the projectile mass, d - bullet grain diameter – caliber, i - projectile shape coefficient.

Based on the previous calculation, the projectile initial velocity is:

$$v_0 = v_{10} + \Delta v_0 = 665.257 + 6.147 = 671.404 \frac{\text{m}}{\text{s}} \quad (10)$$

2.2.2 Projectile initial velocity measurement at normal conditions (20 °C - 24 °C)

In the table 3 are presented measured projectile initial velocities at a temperature of 20 °C - 24 °C and the average projectile initial velocity v_{10} (10 bullets fired for each experiment) of $696.77 \frac{\text{m}}{\text{s}}$.

Based on the previous calculation presented in chapter 2.2.1.1 calculated projectile initial velocity is:

$$v_0 = v_{10} + \Delta v_0 = 702.917 \frac{\text{m}}{\text{s}} \quad (11)$$

Table 3. Projectile initial and average velocity measured at a temperature of 20°C–24°C

Round	Time [ms]	Projectile initial velocity [m/s]
1	1.4217	703.401
2	1.4388	695.010
3	1.4421	693.447
4	1.4391	694.878
5	1.4333	697.668
6	1.4308	698.902
7	1.4297	699.445
8	1.4348	696.965
9	1.4375	695.665
10	1.4444	692.323
Avg.	1.4352	696.770

2.2.3 Projectile initial velocity measurement at a temperature of 50 °C

In the table 4 are presented measured projectile initial velocities at a temperature of 50 °C and the average projectile initial velocity v_{10} (10 bullets fired for each experiment) of $729.759 \frac{\text{m}}{\text{s}}$.

Table 4. Projectile initial and average velocity measured at a temperature of 50 °C

Round	Time [ms]	Projectile initial velocity [m/s]
1	1.3765	726.499
2	1.3600	735.306
3	1.3677	731.140
4	1.3653	732.450
5	1.3605	735.015
6	1.3689	730.536
7	1.3752	727.145
8	1.3790	725.164
9	1.3794	724.947
10	1.3710	729.386
Avg.	1.3703	729.759

Based on the previous calculation presented in chapter 2.2.1.1 calculated projectile initial velocity is:

$$v_0 = v_{10} + \Delta v_0 = 729.759 + 6.147 = 735.905 \frac{\text{m}}{\text{s}} \quad (12)$$

From the diagram in the Fig. 6 it can be noticed that with an increase in temperature for the ammunition frame and a rifle, the time required for the projectile to travel from the velocity barrier A to velocity barrier B decreases.

The time required for the projectile to travel from velocity barrier A to velocity barrier B (Fig. 2 and Fig. 5 – left) for three experiments is shown in the diagram in Fig. 6. Each projectile velocity for three experiments is shown in the diagram in Fig. 7.

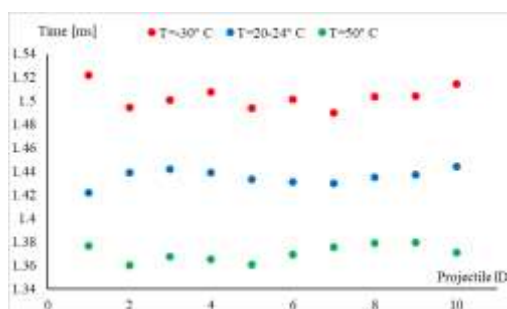


Fig. 6. Time required for the projectile to travel from velocity barrier A to velocity barrier B

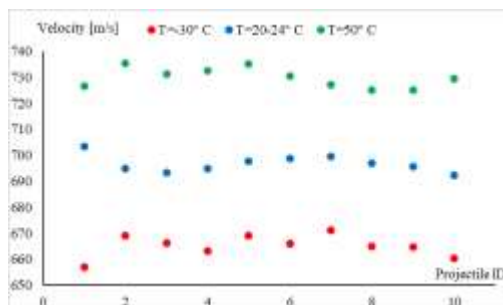


Fig. 7. Projectile velocity

It can be noticed that with an increase in temperature for the ammunition frame and a rifle, the velocity of the projectile increases.

3. CONCLUSION

Based on the obtained results, it can be concluded that the influence of the temperature change is significant because there is a greater oscillation of the projectile initial speed in the temperature range from -30 to 50 °C. Velocity change in relation to the average value of the measured projectile initial velocities values is $64.502 \frac{\text{m}}{\text{s}}$, which represents a deviation of 9.26% from the average initial velocity in normal conditions ($T = 20 - 24^{\circ}\text{C}$). Experimental testing showed that the initial speed of the projectile under normal conditions is $696.77 \frac{\text{m}}{\text{s}}$. At a temperature of -30 °C, the projectile initial velocity decreases by 4.52%, while at a temperature of 50 °C, the projectile initial velocity increases by 4.73%. The conclusion is that the change in atmospheric temperature affects the firing process. These deviations lead to undershoots or misfires when shooting at the target. The temperature has the main influence on the combustion of gunpowder, which causes a change in the pressure of gunpowder gases, thus leading to a change in the projectile initial velocity.

Based on the experimental and theoretical testing, and comparative analysis it can be concluded that the gunpowder for the 6.5 mm Grendel bullet is not thermostable.

For the purpose of further research, the influence of the gas devices (flash suppressor and muzzle brake) on the change in the projectile's initial velocity should be tested. Also, an analysis of the change in the projectile's initial velocity on the shooting cadence can be performed.

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MATERIALS IN 3D PRINTING

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ABSTRACT:

3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced cross-section of the object. Depending on the technology used, one of the factors that significantly affect 3D printing is the material that will be used. In this paper, the materials used in 3D printing will be presented, as well as their advantages and disadvantages

Keywords: 3D printing, Materials, Tehnology, Additive manufacturing

1. INTRODUCTION

3D printing or additive manufacturing is a relatively new way of producing parts. Unlike subtractive technologies, in which material is removed from parts, in additive manufacturing, material is added layer by layer to obtain a finished part. 3D printing of highly complex parts is generally a faster, cheaper and easier solution than many other part manufacturing technologies. It enables the production of models of parts and assemblies from several different materials, with different mechanical and physical properties. With this technology, models can be produced that faithfully imitate the appearance, impression and functionality of the product. In addition to 3D printing technologies, one of the factors that have the greatest impact on the quality of parts are the materials used, which are primarily different types of thermoplastic and metal materials

2. MATERIALS IN 3D PRINTING

In 3D printing, one of the factors that have the greatest impact on the quality of printed parts is certainly the material in use. Depending on the technology we use to print, it also depends on which materials we can use. Metal materials had a share of 39.4%, which is

less than plastic, whose share is 46.5%, mainly because the industrialization of metal printing is in a phase of rapid expansion, and the growth of equipment is ahead of the growth of material consumption. Metal-free 3D printing usually uses plastic, resin materials, etc., and metal 3D printing usually uses various alloy powders and wires [1].

2.1. Material properties, advantages and disadvantages

In FDM 3D printing technology, one of the most common materials is PLA plastic. This plastic is one of the most sought-after materials for 3D printing. The special feature of PLA is, first of all, that it is an environmentally acceptable material (biodegradable). It is made from sugar cane or sugar beet pulp, corn, cassava [2]. Compared to other thermoplastics, PLA has low impact strength, reduced temperature during production, as well as a relatively small production cycle. Commercial PLA polymer blends mainly consist of poly(L-lactic acid) (PLLA). However, a small amount of poly(D-lactic acid) (PDLA) is added to lower the melting point to increase the production cycle. This leads to a significant decrease in crystallinity. PLA is also hydrophobic and has a slow decomposition rate. Due to its biodegradability, high strength and elastic modulus, PLA is a commercially available bio-based polymer used in various applications [4]. PLA is used in commercial products not only because of its degradability nor because it is made from renewable resources, but also because it works efficiently, but above all because it provides excellent properties at a reasonable price [5]. There are two different ways to synthesize PLA from lactic acid monomers. Polymers can be synthesized by direct polycondensation (DP) or by ring-opening polymerization (ROP) using a suitable catalyst [3, 4]. Direct polycondensation of lactic acid involves dehydration of lactic acid, simultaneous esterification of monomers and release of water for each added acid unit [6]. A polymer with a high molar mass is difficult to obtain due to the rapid reaction between water and the formed oligomers [7]. Therefore, lactide ring-opening polymerization (ROP) is widely used for the synthesis of PLA in the industrial sector. ROP occurs when cyclic monomers are propagated by different types of ions [6]. In certain and specific fields of application, the thermal properties of PLA material played a very important role. For example, semi-crystalline or amorphous PLAs have substrate temperatures (T_g) and melting temperatures (TMs) of about 55 °C and 180 °C. In addition, depending on its composition and molecular weight (stereoisomer content), PLA can have different thermal properties [8].

The main advantage of using PLA is that it will degrade into water, carbon dioxide and a small amount of non-toxic excess material when exposed to conditions that include a combination of moisture, oxygen and naturally occurring microbes [9, 10].

Acrylonitrile butadiene styrene (ABS) is one of the most common materials in 3D printing. Good mechanical properties and extrudability make it a preferred choice in the use of recycled or biodegradable filaments [12]. In most cases, ABS contains 15% to 35% acrylonitrile, 5% to 30% butadiene, and 40% to 60% styrene. However, these proportions do not have to be like this, because in a fairly wide range of uses of ABS, changes may occur depending on the purpose of use. An atom or small molecule represents a monomer,

which will be attached to alternative identical molecules to create a polymer [13]. Typically, ABS is a product of the systematic polymerization of monomers, namely, acrylonitrile, butadiene, and styrene. There are two phases of ABS terpolymerization: a continuous phase of styrene-acrylonitrile (SAN) and a dispersed phase of polybutadiene. With commercially available types of ABS, surface gloss can be both low and high, thermal distortion properties are high [14]. ABS polymers show high toughness (even in cold conditions), adequate stiffness, good thermal stability and high resistance to chemical attacks and cracking under environmental stress. Other notable properties of ABS include cheapness, durability and low coefficient of thermal expansion. The ease of molding enables the production of dimensionally stable ABS parts with superior surface quality. No other thermoplastic material exhibits such a wonderful combination of technically important properties [15].

ABS or ABS-like parts can be produced using AM technologies. The nomenclature "ABS-like" is followed due to the fact that they exhibit mechanical properties similar to conventional ABS but different chemical properties [16].

Polyethylene terephthalate glycol (PETG), a copolyester-based polymer derived from polyethylene terephthalate (PET), has recently attracted considerable attention due to its promising potential in FDM fabrication. It contains added glycol and, unlike PET, does not exhibit strain-induced crystallization [17, 18].

In engineering applications, PETG has been one of the polymer materials used to print components using the FDM process. The main intention of using PETG was because of its low cost and higher strength than other polymer filaments. In order to improve the mechanical and thermal behavior of PETG filament, some of the reinforcements such as glass fibers, carbon nanotubes and carbon fibers are mainly used [5]. PETG is an excellent material for high impact mechanical parts that may be exposed to moderate heat loads. This material is more abrasion and impact resistant than ABS, while still being very cost effective for manufacturing applications [19,20].

Polyamide or nylon is a vital class of thermoplastic material that possesses very good mechanical properties. However, FDM products manufactured from pure nylon have problems associated with bending, distortion, and lack of shape stability. These disadvantages limit the use of nylon in FDM 3D printing. The continuous filling of the polymer with crystallinity leads to an untimely contraction of the volume, and thus the arrangement of the molecular chain disparagingly increases the distortion and shrinkage of the volume. Consequently, bending of nylon in FDM can be prevented by interfering with the systematic molecular chain formation and molecular chain formation. fading possibilities of crystallization. 3D printed parts with FDM can be custom made by changing printing factors such as layer thickness, print orientation (angle, horizontal and vertical), screen angle and width, and air gap. [21, 22, 23]

Aliphatic polyamides are much more common and are produced on a much larger scale. During injection molding, they are amorphous or slightly crystalline. The two most common and important aliphatic polyamides are polycaprolactam (nylon 6) and poly(hexamethylene adipamide) (nylon 6,6). Both have good mechanical properties such as high flexibility, high tensile strength, low creep, high impact strength (toughness) and

good elasticity. Both have good mechanical properties at elevated temperatures due to their high glass transition temperature and melting temperature of 260 - 283 °C [24].

The main disadvantage of nylon 6 and nylon 6.6 is that they are sensitive to moisture, which leads to a decrease in mechanical properties. Moisture/water acts as a plasticizer and can reduce tensile strength by over 50%. An aliphatic polyamide that has better moisture resistance is nylon 6,12. It is less hydrophilic than nylon 6 and nylon 6.6 due to the higher number of methylene groups. Unfortunately, the properties that come into play are the degree of crystallinity, melting point and mechanical properties [25].

Polypropylene (PP) is a thermoplastic obtained from propene, which is a relatively inexpensive by-product of the petroleum refining process. Besides being cheap, PP is a very versatile thermoplastic with numerous applications due to its good mechanical and biological properties, chemical resistance and inertness. These properties make PP a good candidate for manufacturing products by additive manufacturing (AM) techniques, such as material extrusion-based AM (ME-AM) and powder bed fusion [26].

Polycarbonate, better known by the acronym PC, is a material known in the 3D printing market for its impact resistance and transparency. It is a lightweight yet strong thermoplastic, ideal for a wide range of professional applications. It is not as easy to print as PLA or PETG because it requires a relatively high extrusion and plate temperature to build. However, 3D printing with polycarbonate allows the production of complex heat-resistant parts with FDM technology [27].

Different types of metal materials are processed by metal 3D printing. These include pure metals (gold, copper, niobium, tantalum, titanium), alloy powders (aluminum-based, cobalt-based, copper-based, iron-based, nickel-based and titanium-based) and powder mixtures (copper-compositions based on iron and graded compositions such as Ni-Al, Ti-Ni, Ti-Mo and Ti-V). A wide range of nickel-based superalloys, titanium alloys [28].

Stainless steel powder used for 3D printing comes in a variety of grades and alloys, including 316L, 304L, 630, 410, 420, 254, 17-4 PH, 15-5PH, PH1, and GP1. Of these, 316L is the most commonly used grade in metal 3D printing. It has a composition of 66-70% iron enhanced with 16-18% chromium, 11-14% nickel, 2-3% molybdenum and less than 0.03% carbon. This 3D printing material is known for its ductility and good corrosion resistance [29].

As the name suggests, this grade of steel is used for a variety of manufacturing tools. Everything on the production line that cuts, stamps, molds or shapes is probably made of tool steel. Tool steels can withstand such harsh conditions because of their high hardness and excellent resistance to high temperatures and wear. Because of these properties, tool steels are very difficult and expensive to machine, making them ideal candidates for 3D printing. Popular powders and filaments include A2, D2 [30].

3. CONCLUSION

3D printing, although it is a newer method of production, already occupies an important place in industrial applications. One of the biggest advantages of 3D printing is certainly the wide range of materials that are in use. 3D printing is a unique process, because the

characteristics of produced parts are different, even when using a nearly identical plastic or alloys. To achieve design goals, materials must be well-suited for the application. The properties of any material become increasingly important as a product progresses.

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A DETECTION OF CHANGES IN THE IMAGE USING FRACTAL ANALYSIS

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ABSTRACT:

The goal of this paper is to present a model for decision-making for the case of changes made to images by deliberately changing their content using a method copy/move forgery detection. The model uses multiple methods to achieve the best possible results. In the analysis of the image itself, we used the fractal dimension in order to obtain as few parameters as possible for the analysis of the image, without losing the quality of detection. The images used were from publicly available databases. The entire system is written in Python programming language.

Keywords: *copy/move forgery detection, image analysis, fractal, clustering*

1. INTRODUCTION

Copy/move forgery detection (CMFD) is one of the most well-known methods for the detection of deliberately induced changes in image content. This implies that the part of the picture copies and pastes to another part within the same image (copy move) or with two or more images make one new image (image merging). The goal of these changes in images is to cover or duplicates certain image content to convey false information. Such changes are hard to detect because parts are copied and pasted from the same image, so parameters like which are color temperature, lighting, noise components, etc. match the code of the original image and changed parts. Copy/move changes on images become even more difficult if combined with geometric transformations and post-processing operations.

In the last decade, many methods have been developed for the detection of deliberately induced changes in the content of the image, especially those dealing with copy/move changes, CMFD. These methods can be divided into two categories: keypoint-based and block-based. In this research we used the second methods, block-based.

This work is divided into several parts. We will first present a literature review of the method we have chosen. After that, we will present the methodology which used in this work. In section three we will give the results we obtained with the proposed model, as well as the conclusion at the next section.

2. LITERATURE REVIEW

A block-based method was proposed in [3] based on DWT and DCT. After preprocessing, the image is divided into overlapping blocks. To extract block features, we use DWT. After applied DWT, subsequently DCT is applied in order to reduce the dimensionality of the characteristic vector. Blocks are then compared on the basis of correlation coefficients, and in this way similar ones are found blocks. A block-based method based on the application of LBP and DCT is described in [1]. The image of interest is first translated from RGB to the YCbCr color system and then divided into overlapping blocks. To extract the characteristic vectors, the blocks are first applies LBP and then DCT. For feature vector matching and detection forgery, a Support Vector Machine (SVM) is used.

In [5], a block-based method based on a local fractal was proposed dimension (Local Fractal Dimension - LFD). The image is first divided into fixed blocks dimension, and for each block a local fractal dimension is calculated, as a characteristic of the block. In order to reduce complexity, the features are organized according to the B+ tree. For pairing feature and counterfeit detection, we use SVD. Fractal-based method coding is described in [4]. The image of interest is divided into overlapping blocks. For every block is calculated characteristic vector consisting of four parameters: multifractal dimensions, mean, variance and central moment. The characteristic vectors are compared based on the Euclidean distance, and in this way similar or the same blocks are determined. In [2] is described a block-based method based on the polar exponential transformation (Polar Complex Exponential Transform - PCET) and approximately the closest 20 to the neighbor (Approximate Nearest Neighbor - ANN). The image of interest is divided into overlaps circular blocks. For each block a characteristic vector is calculated based on the application PCET. The ANN algorithm is used for feature matching and forgery detection, on the base LSH.

3. METHODOLOGY

The aim of the proposed work is to develop an improved method for copy/move forgery detection by using local fractal dimension for image segmentation and estimating the distance of block pair in each segmented region to localize the forged region. The framework within which the algorithm proceeds is shown in Fig 1. Main objectives of the work are:

- Identify the portion of the image where copy-move forgery has been done.

- Use local fractal dimension for efficient texture segmentation of image.

Algorithm which we proposed in this paper and which is described in picture one can be described in more detail as follows steps:

- First we upload images, both the original and the modified one.
- Divide the images into blocks of different dimensions 8x8, 16x16, 32x32.
- Calculate the fractal dimension for each of those blocks, separately for each image.
- At the end we observe the parameters calculated in this way for both the original image and the modified one and apply the clustering algorithm.

In this research using the most basic method to determine fractal dimension is box-counting theorem. Let A be the matrix representing the image. Let the space R^2 be covered by closed square boxes of side length $1/2^n$. Let $N(A)$ denote the number of boxes which intersect A . Then the box counting theorem states that the fractal dimension D of A can be obtained as

$$D = \lim_{n \rightarrow \infty} (\log N(A) / \log 2^n).$$

For an object with deterministic self-similarity, its FD is equal to its box-counting dimension. We used k means for the clustering algorithm.

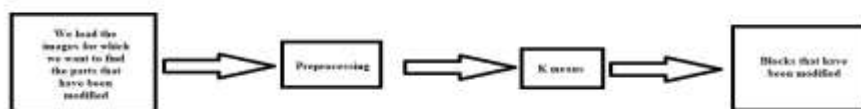


Fig. 1. Algorithm description

4. RESULTS

In this research, we used a publicly available database from website <https://www5.cs.fau.de/research/data/image-manipulation/>. The images on which the proposal of our algorithm was tested are shown in Fig. 2. For each image, a different transformation was done during the change. When we applied the algorithm described above for each cluster, we obtained the results presented in Table 1. By the percentage of clustering success, we mean the success rate that represents that each block belonged to its cluster. At the beginning, we marked the blocks that did not undergo modification and those that did. So we classified into two groups.

What can be noticed is that the algorithm, on this sample, achieves a clustering success that is greater than 95%. Also, what is common to all, if you look at the results, is that when we divide the image into smaller blocks, the performance increases.



Fig. 2. The first column represents the original images, and the second the modified ones.

Table 1. Results obtained by applying the proposed algorithm.

The first column represents the name of the image, the second column represents the success results (in %) through the values of success rate when the blocks are divided into 8x8, next to 16x16, and last 32x32.

<i>Row picture from Fig. 2.</i>	<i>Success rate (%) 8x8</i>	<i>Success rate (%) 16x16</i>	<i>Success rate (%) 32x32</i>
1	98.63	97.65	96.87
2	97.65	97.26	95.31
3	99.60	99.21	98.43

5. CONCLUSION

This algorithm, although it showed a success rate of more than 95% in this example, should be tested on a larger sample. What they would conclude from this research is that this problem should also be viewed from the point of view of what transformation was done on the image during the change.

What we will consider in some future research is some new similarity measures as well as other clustering algorithms.

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DETERMINATION OF EMULSIFYING PROPERTIES OF BIOPOLYMER PRODUCED ON GLYCEROL-BASED MEDIUM BY LOCAL *XANTHOMONAS* ISOLATE

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ABSTRACT:

Xanthan is natural polysaccharide which is produced by metabolic activity of Gram-negative bacteria from the genus Xanthomonas. Due to its non-toxicity and biocompatibility, xanthan has been approved by the United States Food and Drug Administration (FDA) as a food additive number E 415. Besides the food industry, this biopolymer is widely used as a thickener, adhesive, emulsifying and stabilizing agent in the chemical, pharmaceutical and oil-recovery industry. In this study, the emulsifying properties of xanthan produced by Xanthomonas PL 3 strain, isolated from pepper leave, on medium containing crude glycerol from biodiesel production were examined. Emulsifying activity of 0.1% (w/v) xanthan solution was examined in the presence of n-hexane, toluene, chloroform, liquid paraffin, sunflower oil, olive oil and soybean oil. The results of the emulsification test show that formation of emulsion of xanthan with chloroform, sunflower and soybean oil is reflected by the highest emulsification index with values higher than 60%. The highest emulsification index of $73.84 \pm 0.74\%$ was achieved when the emulsification properties were examined using sunflower oil after 24 h of rest. On the other side, the lowest value of emulsification index of $7.06 \pm 0.14\%$ was obtained when using n-hexane after 240 h of rest. The obtained results indicate that xanthan produced on the medium containing crude glycerol from biodiesel production can be used as an emulsion forming and stabilizing agent between aqueous solutions and hydrocarbons or oils. Findings from this study can contribute to future investigations related to the potential of specific xanthan applications.

Keywords: *Xanthomonas* isolates, xanthan, biopolymer, crude glycerol, emulsifying properties

1. INTRODUCTION

Xanthan is a natural polysaccharide of great biotechnological interest which is produced by metabolic activity of Gram-negative bacteria from the genus *Xanthomonas* [1]. Due to its high molecular weight and unique chemical structure, biodegradability, non-toxic nature and biocompatibility, this biopolymer shows excellent pseudoplasticity, thickening, and rheological properties and is widely used as a thickener, rheological modifier, stabilizer, and emulsifier in the food, biomedical, pharmaceutical, petrochemical,

chemical and textile industries [2-4]. Xanthan occurs as a white or cream-colored free-flowing powder of neutral smell and taste [5] and has been classified as a food additive number E 415 by the European List of Permitted Food Additives, and the United States Food and Drug Administration has given the GRAS status (Generally Recognized as Safe) to an ethanol precipitate of xanthan [6]. Most common application of xanthan worldwide is as stabilizer and thickening agent in creams, fruit juices, salad dressings, meat, chicken or fish as well as syrups, ice cream and dessert coverings [2]. High viscosity of its solutions and good solubility of xanthan in water are the main reasons why xanthan is suitable for application in the petroleum industry where it is commonly used in drilling fluids and in enhanced oil recovery processes [4, 6].

The primary structure of xanthan consists of a long chain of repeated pentasaccharide units of glucose, mannose and glucuronic acid in the molar ratio of 2:2:1. The main chain include β -D-glucose units linked at the 1 and 4 positions, while the trisaccharide side chain contains a D-glucuronic acid unit between two D-mannose units which are linked to alternate glucose unit within the main chain [7]. A pyruvic acid residue is linked to the terminal D-mannose unit and an acetyl group is linked to the D-mannose unit attached to the main chain [8]. Because of the presence of this pyruvic and acetic groups xanthan shows anionic nature and indicate a potential utility in cations removal, as well as drug carrier due to its ability to conjugate with other polymers, proteins, peptides and non-peptides where these conjugates exhibit stability toward degrading enzymes, inertness, biocompatibility, and efficient solubility [9]. The molecular weight distribution of this biopolymer depends on the association between structural chains. Therefore, the molecular weight of xanthan usually varies from around $2 \cdot 10^5$ g/mol to $2 \cdot 10^7$ g/mol [10, 11].

Different *Xanthomonas* species, such as *X. malvacearum*, *X. phaseoli*, *X. axonopodis* and *X. euvesicatoria*, have the ability to biosynthesize xanthan, but *X. campestris* is the species most commonly used for the industrial production of xanthan [12, 13]. All organisms from genus *Xanthomonas* are plant pathogens and they infect a large selection of plants including the ones of agricultural interest, e.g., cabbage, tomato, pepper, alfalfa, and beans [10, 13]. Their colonies are mostly yellow and smooth, and this bacterium is chemoorganotrophic and an obligate aerobe with a strictly respiratory type of metabolism. Bacteria of the genus *Xanthomonas* are able to oxidize glucose and the most glucose (about 90%) is primarily catabolized via the Entner-Doudoroff pathway in *Xanthomonas* species [10].

Commercial production of xanthan is mainly performed as aerobic submerged batch cultivation of the reference strain *X. campestris* ATCC 13951 on a medium of appropriate composition and under optimal conditions. The success of xanthan production is largely influenced by the cultivation medium composition, producing strains and bioprocess parameters [14]. Glucose and sucrose are frequently used carbon sources in cultivation media for xanthan production but rise in prices and the growing demand for mentioned

sugars indicate a need for more economical carbon sources in order to reduce the overall production costs [15]. Use of several alternative carbon sources such as waste streams and by-products from different industries can reduce the total costs of xanthan production, as well as reduce the environmental pollution caused by of waste generated from industrial processes [16]. Hence, crude glycerol from the biodiesel industry proved to be one of the promising alternative substrates of lower market value which may be used as a carbon source in the cultivation medium for xanthan production [17, 18]. Research related to the xanthan biosynthesis on glycerol-based media is still in initial stages, and there is a need for a more detailed examination regarding the optimization of the production process and properties of produced biopolymer. The viscosity of xanthan solution is stable over a wide range of temperatures and pH values and that is why it is widely used to control the rheological properties of the emulsions by contributing to the stability of the emulsion. However, its ability to increase both the viscosity and the stability of the emulsion depends on the concentration and structure of the biopolymer [16]. Emulsification properties of xanthan produced on medium containing waste streams and by-products from different industries are poorly explored and there are just a few reported studies related to the examination of emulsification properties of this biopolymer which indicate that emulsification properties of xanthan mainly depend of producing strain, cultivation medium composition and process conditions [16, 19].

The aim of this study was to examine emulsifying properties of xanthan produced by *Xanthomonas* PL 3 strain, isolated from pepper leave, on medium containing crude glycerol from biodiesel production. Emulsifying activity of 0.1% (w/v) xanthan solution was examined in the presence of n-hexane, toluene, chloroform, liquid paraffin, sunflower oil, soybean oil and olive oil.

2. MATERIALS AND METHODS

2.1. Xanthan sample

Xanthan used in this study was produced by the strain *Xanthomonas* PL 3, isolated from pepper leave in Serbia. Producing strain was subcultured on agar slant and incubated at 25°C for 48 h. Inoculum was prepared by the incubation of refreshed producing microorganism in liquid media in two steps: preparation of inoculum I and preparation of inoculum II. Inoculum I preparation considered the suspending of producing microorganism cells in YMB® and incubation for 48 h, while inoculum II preparation considered addition of 10% (v/v) of inoculum I to in YMB® and incubation for 48 h. Both suspensions were incubated in aerobic conditions at 25°C and 150 rpm (laboratory shaker KS 4000i control, Ika® Werke, Germany). Xanthan production was performed on a medium containing crude glycerol from biodiesel production in a factory located in the Republic of Serbia. Glycerol content in crude glycerol was around 50% (w/v) and its content in the cultivation medium was adjusted to 20.00 g/L. The cultivation medium also contained a yeast extract (3.0 g/L), (NH₄)₂SO₄

(1.5 g/L), K₂HPO₄ (3.0 g/L) and MgSO₄·7H₂O (0.3 g/L). The xanthan production was carried out in a 3 L laboratory bioreactor (Biostat® A plus, Sartorius AG, Germany) with 2 L of cultivation medium under aerobic conditions for 168 h. In the first 48 h, the biosynthesis was performed at a temperature of 25°C, air flow rate of 1 vvm and agitation rate of 200 rpm. Afterwards, temperature and air flow rate were increased to 30°C and 2 vvm, respectively, while agitation rate was corrected as needed and according to the dissolved oxygen concentration which was maintained at values higher than 30% during the biosynthesis. At the end of biosynthesis, xanthan was separated from the supernatant of the cultivation medium by precipitation with cold 96% (v/v) ethanol in the presence of potassium chloride as described in previous research [20].

2.2. Determination of emulsification index (IE₂₄)

The emulsification properties of xanthan produced on glycerol-based medium by the *Xanthomonas* PL 3 strain were tested by measuring the emulsification index. Hydrocarbon (n-hexane, toluene, liquid paraffin and chloroform) or oil (sunflower, soybean and olive oil) was added to aqueous phase containing the xanthan in a ratio of 3:2, v/v and agitated vigorously for 2 min on a vortex mixer. After 24 h and 240 h of rest, the height of the emulsified layer and the total height of the liquid layer were measured. Emulsification index was calculating according to the equation below:

$$1. \quad IE (\%) = \frac{\text{Height of emulsified layer}}{\text{Total height of liquid}} \times 100 \quad (1)$$

2.3. Data analysis

All experiments were carried out in triplicate and the results were averaged. The obtained data were processed using analysis of variance (Two-Way ANOVA). Significant differences between the means were determined by Duncan's multiple range test at the significance level of $\alpha=0.05$ using Statistica 13.2 software (Dell Inc., USA).

3. RESULTS AND DISCUSSION

In accordance with the defined aim of this research, emulsifying properties of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production were studied. Emulsifying activity of 0.1% (w/v) xanthan solution was examined in the presence of n-hexane, toluene, chloroform, liquid paraffin, sunflower oil, olive oil and soybean oil after 24 h and 240 h of rest. In order to examine the effect of different hydrocarbons/oils and resting time on emulsifying index of xanthan sample, statistical analysis of experimental data was carried out. The results summary of Two-Way ANOVA analysis for the effect of different hydrocarbons/oils and resting time on

emulsifying index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production are given in Table 1.

Table 1. Two-Way ANOVA results for the effect of different hydrocarbons/oils and time of rest on emulsifying index of xanthan

Variability	SS	DF	MS	F-value	p-value
Hydrocarbon/oil	17383.13	6	2897.19	1984.46	< 0.000001
Resting time	1634.94	1	1634.94	1119.87	< 0.000001
Hydrocarbon/oil and resting time	447.94	6	74.66	51.14	< 0.000001
Error	40.88	28	1.46	-	-

SS – sum of squares; DF – degrees of freedom; MS – mean square

According to the data presented in Table 1, it can be noticed that selection of hydrocarbon/oil, resting time and combination of selection of hydrocarbon/oil and resting time have a statistically significant effect on emulsification index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production ($p < 0.05$). The mean square values presented in Table 1 suggest that the selection of hydrocarbon/oil has the highest effect on emulsification index of xanthan, while the effect of combination of selection of hydrocarbon/oil and resting time has the lowest effect on the emulsification index of xanthan. The obtained results suggest that selection of hydrocarbon/oil and resting time are of great importance for emulsifying properties of xanthan, if the emulsification index of biopolymer is considered as an indicator of emulsifying activity. This is in accordance with findings from research where emulsification capability of xanthan produced by *Xanthomonas campestris* on YDCC (Yeast Dextrose Calcium Carbonat) broth was examined in various hydrocarbons/oils and different emulsification activity for each hydrocarbon/oil used was reported [21].

The results of the statistical analysis for the effect of different hydrocarbons/oils and time of rest on emulsifying index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production are also presented graphically in Figure 1 and Figure 2.

Figure 1a shows the results of statistical analysis of the effect of different hydrocarbons/oils on emulsifying index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production. From graphically represented results in Figure 1a it can be observed that the highest emulsification index of xanthan regardless of the resting time was achieved when using sunflower oil. Somewhat lower values of emulsification index were achieved when using soybean and olive oil. This result is in agreement with results obtained in research where emulsification

properties of xanthan produced by *X. campestris* pv. *mangiferaeindicae* IBSBF 1230 on crude glycerol containing medium were examined [19]. In this research, emulsification index of xanthan was also higher when using sunflower oil comparing to when using soybean and olive oil. According to the graphically presented results from Figure 1a, the lowest value of emulsification index of xanthan was achieved when using n-hexane. The lowest emulsification index of xanthan obtained when using n-hexane is probably the result of the high volatility of n-hexane [22]. Observing the results represented in Figure 1a it can be noticed that xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production show better emulsification activity in oils compared to hydrocarbons used in applied experimental conditions. These results imply that the emulsion forming and stabilizing capacity of xanthan is specific for certain hydrophobic compounds.

The results of statistical analysis of the effect of different resting time on emulsifying index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production regardless of the hydrocarbons/oils used are presented in Figure 1b.

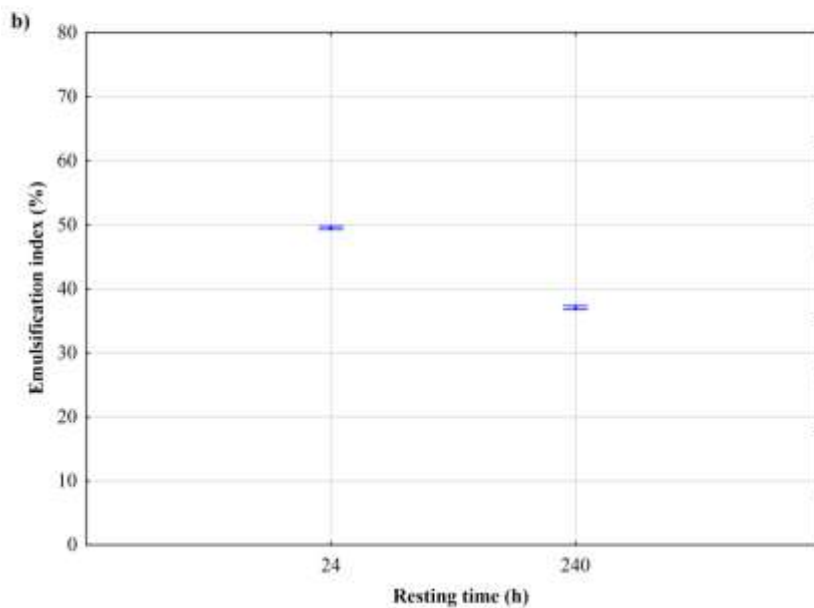
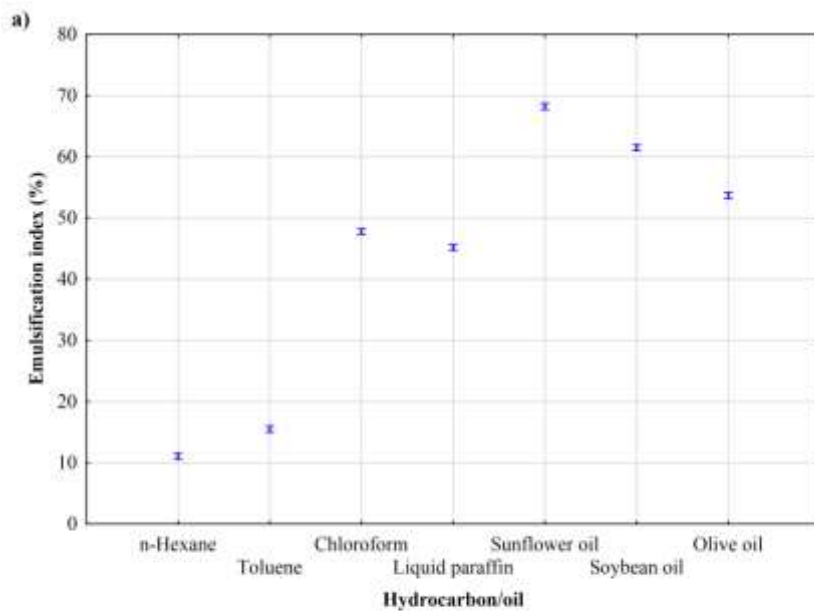


Figure 1. Effect of different hydrocarbons/oils (a) and resting time (b) on emulsification index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production

The presented results indicate that there is a statistically significant difference in emulsification index of xanthan when resting of emulsion is conducted for 24 h and 240 h. Graphically represented results (Figure 1b) indicate that the higher emulsification index of xanthan was achieved after 24 h of rest and that rise in resting time has negative effect on the value of emulsification index of xanthan. This is probably due the fact that the emulsions are thermodynamically unstable systems that tend to revert back during the time to the separate oil and water phases from which they were made [23].

The summary results of the statistical analysis for the effect of different hydrocarbons/oils and time of rest on emulsifying index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production are also presented graphically in Figure 2. From graphically represented results in Figure 2 it can be observed that the value of emulsification index of xanthan was higher after 24 h of rest for all tested hydrocarbons/oils and that rise in resting time has negative effect on the value of this parameter. When observing results for mean values of hydrocarbon/oil it can be noticed that the highest emulsifying index of xanthan was obtained when using sunflower oil and that xanthan show good emulsifying activity when using soybean oil, chloroform and olive oil too. However, xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production show the lowest emulsification activity when using

n-hexane and toluene. Observing the results presented in Figure 2 it can be noticed that values of emulsification index of applied biopolymer when using natural oils and hydrocarbons show different trend of change. Values of emulsification index of xanthan when using natural oils differ with tested oil and they are all above 50%. When observing values obtained with hydrocarbons it can be noticed that there are two groups, i.e. that xanthan showed similar emulsifying properties when using n-hexane and toluene on the one side, and chloroform and liquid paraffin on the another side. The main reason for this behaviour may be due to the similarity of their dielectric constants which is around 1.9 for n-hexane, 2.3 for toluene and on another side, the value for the same parameter for chloroform and liquid paraffin is around 4.6 and 4.8, respectively [24, 25].

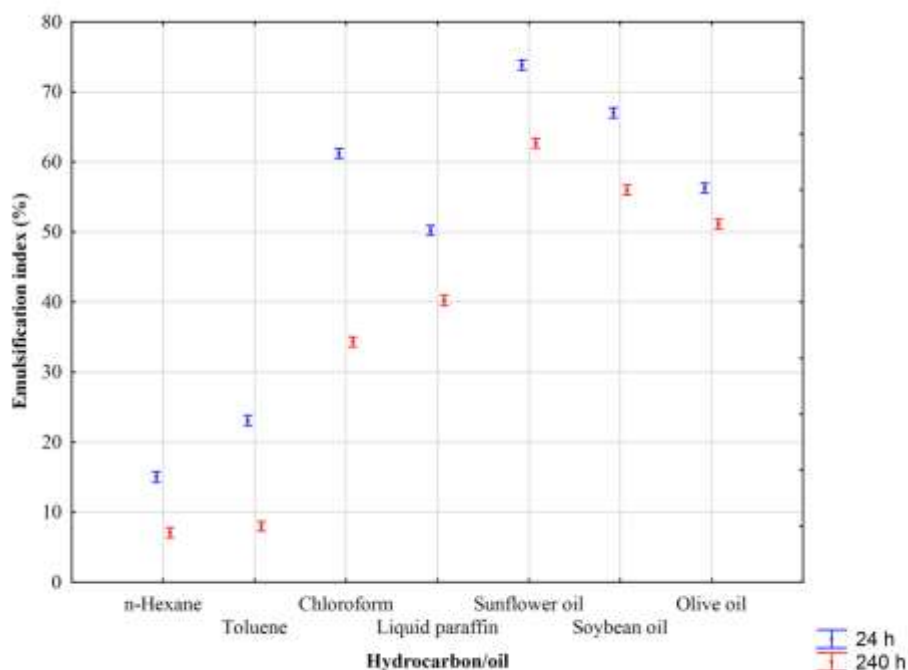


Figure 2. Emulsification index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production in different hydrocarbons/oils after 24 h and 240 h of rest

In order to define the best combination of hydrocarbon/oil and resting time, the values for emulsification index of xanthan were analysed using Duncan's multiple range tests. Obtained data are presented in Table 2.

Table 2. Duncan's multiple range test: mean \pm standard deviation for emulsification index of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production in different hydrocarbons/oils and after different resting time

Hydrocarbon/oil	Resting time (h)	Emulsification index (%)
n-Hexane	240	7.06 \pm 0.14 ^a
Toluene	240	7.97 \pm 1.33 ^a
n-Hexane	24	15.05 \pm 0.22 ^b
Toluene	24	23.06 \pm 0.98 ^c
Chloroform	240	34.32 \pm 1.24 ^d
Liquid paraffin	240	40.24 \pm 2.03 ^e

Liquid paraffin	24	50.24±0.94 ^f
Olive oil	240	51.13±0.98 ^f
Soybean oil	240	55.97±1.64 ^g
Olive oil	24	56.28±0.80 ^g
Chloroform	24	61.22±1.84 ^h
Sunflower oil	240	62.67±1.28 ^h
Soybean oil	24	67.02±1.10 ⁱ
Sunflower oil	24	73.84±0.74 ^j

^{a,b,...}Values in the same column marked with the same letter are not significantly different at $\alpha=0.05$

From the graphically presented results in Figure 2 and results of Duncan's multiple range test presented in Table 2, it can be seen that the highest emulsification index of 73.84±0.74% was achieved when the emulsification properties were examined using sunflower oil after 24 h of rest. This value is much higher comparing to the results reported in research where emulsification index of xanthan produced by *X. campestris* pv. *mangiferaeindicae* IBSBF 1230 strain on medium containing crude glycerol from biodiesel production when using sunflower oil and after 24 h of rest was 46.50 ± 0.30% [19]. Based on the results presented in Table 3, significantly lower value of emulsification index (67.02±1.10%) was obtained when examination was performed using soybean oil after 24 h of rest. As it can be noted, values of emulsification index of xanthan obtained when using sunflower oil (62.67±1.28%) and chloroform (61.22±1.84%) after 240 h and 24 h of rest, respectively, are at the same level of significance ($p=0.151230711$). Trindade et al. have reported in their study (2018) that the emulsification index of xanthan produced by *X. campestris* pv. *mangiferaeindicae* IBSBF 1230 strain on medium containing crude glycerol from biodiesel production when using soybean and olive oil after 24 h of rest was 8.30 ± 0.20% and 8.50 ± 0.20%, respectively. The values obtained in aforementioned study are much lower comparing to the results obtained in this research where emulsification index of xanthan after 24 h of rest of 67.02±1.10% and 56.28±0.80% were obtained when using soybean and olive oil, respectively. On the other side, results obtained in this research are in accordance with findings from literature data where the emulsification index of xanthan produced by *X. campestris* pv. *campestris* 1866 and 1867 strains on medium containing coconut shell, cocoa husks and sucrose was in range from 58-75% when using olive oil after 24 h of rest [16]. The main reason for this variation in emulsifying properties of xanthan may be due to the fact that different *Xanthomonas* strains on different substrates may produce biopolymers with different composition and properties [26, 27]. Observing the obtained results it can be noticed that the lowest value of emulsification index of 7.06±0.14% was obtained when using n-hexane after 240 h of rest. It can also be noticed that there was no statistically significant difference in the values of the analysed parameter when toluene and n-hexane were used after 240 h of rest ($p=0.364402354$).

If a criterion for determining the emulsion-stabilizing capacity of an emulsifier consists on evaluating its ability to maintain at least 50% of the original emulsion volume, it can be noticed that xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol has proven to possess the best emulsion-stabilizing capacity for olive, soybean and sunflower oil, since the value of emulsification index when using these oils was in the range from around 50% to around 75%. As it can be seen from the previously discussed results, values of emulsification index of applied biopolymer was in the range from around 25% to around 50% when using liquid paraffin and chloroform and less than 25% when using toluene and hexane. Despite the fact that emulsifying activity of applied biopolymer differ with used hydrocarbons/oils and resting time and showed better results when using oils, there is still a need to investigate how some thermodynamic and rheological properties of the system, such aqueous phase composition (salinity and pH) and temperature affect this parameter.

4. CONCLUSION

In this research, emulsifying properties of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production were examined. The experimental data show that this biopolymer has the ability to form and stabilize emulsions with all hydrocarbons/oils tested and that emulsifying activity of applied biopolymer differ with used hydrocarbons/oils and resting time. According to the obtained results, the highest emulsification index of $73.84 \pm 0.74\%$ was achieved when the emulsification properties were examined using sunflower oil after 24 h of rest. Summary results of the emulsification test show that formation of emulsion of xanthan with sunflower, soybean olive and liquid paraffin, as well as chloroform, is reflected by the emulsification index with values higher than 50%. Results obtained in this research are very important from an ecological aspect as they suggest prospects for application of xanthan produced by *Xanthomonas* PL 3 strain on medium containing crude glycerol from biodiesel production in bioremediation of environmental contaminants and oil recovery processes.

Since this research represent the initial and first ever screening of emulsifying properties of biopolymer produced by local-wild type *Xanthomonas* isolate on medium containing crude glycerol from biodiesel production in Serbia, the results obtained in this study represent valuable information that can be used in future research related to the examination and optimisation of emulsification activity of xanthan, as well as its potential application.

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RAZVOJ PROGRAMA ZA ADMINISTRIRANJE RADNIH NALOGA U PROIZVODNJI ŽICE

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SAŽETAK:

U radu je opisan razvoj programske podrške za administriranje radnih naloga u proizvodnji žice što će doprineti poboljšanju poslovnih aktivnosti unutar kompanije. Cilj rada jeste da se zaposlenima u kompaniji „Yazaki“ koji rade na izradi žica proces učini transparentnim i lakšim za praćenje. Razvojem ovog programa, zaposleni će moći da prate proces proizvodnje žice, da vrše administraciju mašina i radnih naloga za raspoložive radnike. Rad je grupisan u nekoliko celina. U prvom delu rada opisuje se kompanija za koju je programska podrška namenjena. Nakon toga, daje se pregled definisanih tabela i procedura. U radu je dat opis funkcionalnosti i karakteristika programa.

Ključne riječi: administracija naloga, praćenje izrade žice

1. UVOD

Kompanija Yazaki osnovana je u Japanu 1929. godine. Danas posluje u 46 zemalja i zapošljava oko 290.000 radnika. Kompanija se bavi proizvodnjom i distribucijom električnih sistema, elektronskih instrumenata za auto industriju. Ostvaruje saradnju sa najznačajnijim firmama iz oblasti proizvodnje motornih vozila, Japanska kompanija Yazaki je otvorila jedno fabričko postrojenje u okviru industrijske zone u Šapcu, Republika Srbija. Tu se odvija proizvodnja kablovskih setova za kamione OEM, i vrši se izvoz za evropsko tržište. Kompanija planira godišnji izvoz oko 120 mil EUR. Izgradnja pogona počela je 2016. godina i trajala je 258 dana, a u junu 2017. godine je započeto sa probnom proizvodnjom. Radnici su imali obuku u fabrikama Yazaki širom Evrope. Leta 2017. otvoren je centar za obuku kako bi se budući radnici obučavali u Šapcu. Postrojenje u Šapcu smešteno je se na oko 30.000 kvadratnih metara. Tu je za sada zaposleno oko 2500 radnika. Kompanija Yazaki se obavezala da će izvršiti ulaganje u Srbiji u vrednosti 25 miliona evra. Korporativna politika kompanije Yazaki podrazumeva posvećenost održivom rastu, koji je bezbedan i ekološki prihvatljiv. Firma je na usluzi svojim klijentima i društvenoj zajednici u celini.

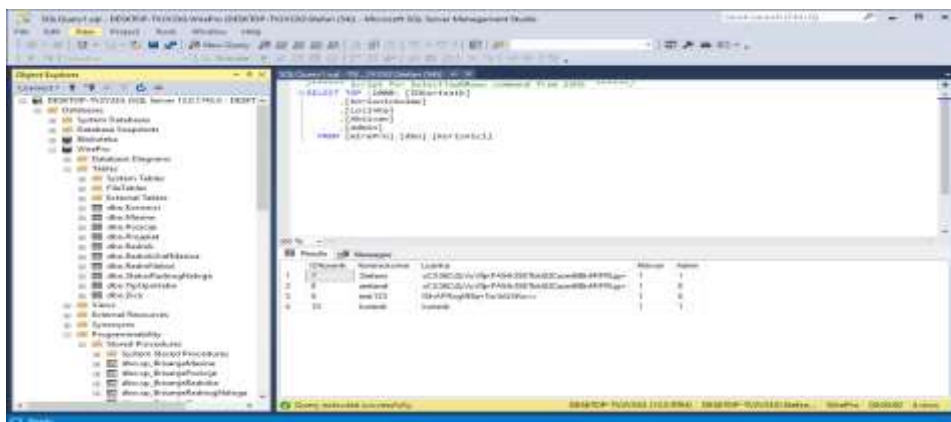
Proizvodnja se radi uglavnom za dva kupca, to su Daimler Trucks iz Nemačke i MAN trucks iz Austrije. Projekti se dobijaju iz centrale. Najozbiljniji konkurenti su Delphi, Lear, Yura, Leoni, Draxmeier

2. OPIS REŠENA

2.1. Definisanje baze podataka u SQL serveru

Podaci se čuvaju u bazi podataka MS SQL Server 2016 Enterprise, Projekat se sastoji od 10 tabela i 37 procedura.

Nazivi tabela – Korisnici, Masine, Pozicije, Projekat, Radnik, RadnikXrefMasina, RadniNalozi, StatusRadnogNaloga, TipUpotrebe, Zice.

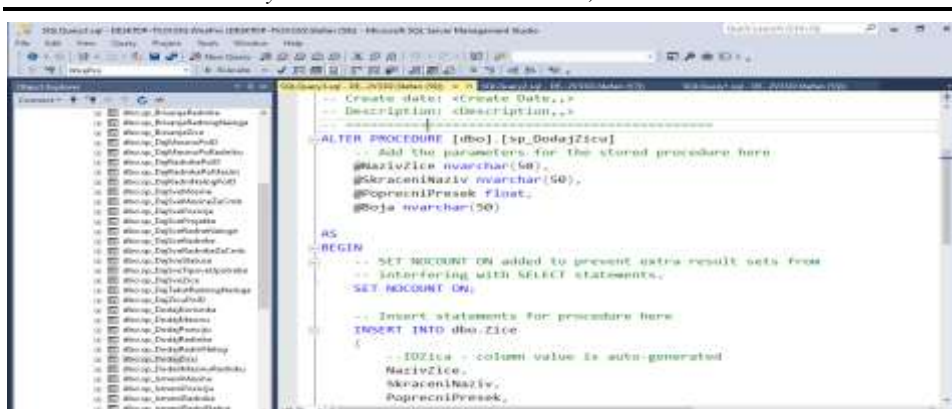


Slika 1. Prikaz kreiranih tabela

2.2. Pregled procedura

Nazivi procedura:

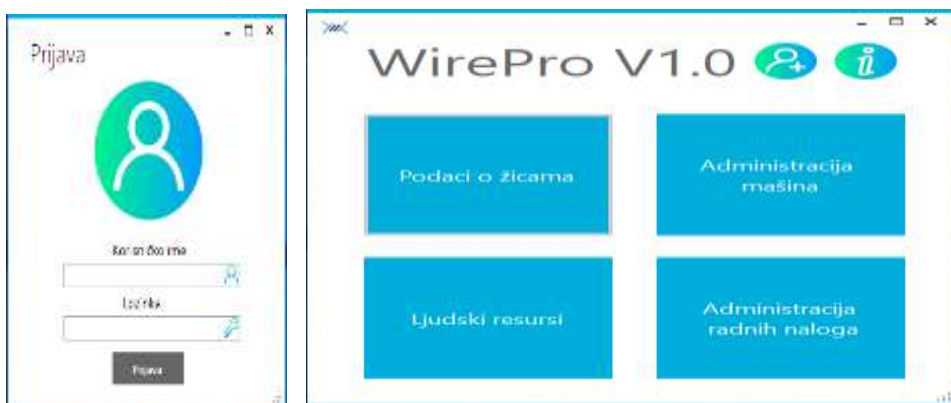
sp_BrisanjeMasine, sp_BrisanjePozicije, sp_BrisanjeRadnika,
sp_BrisanjeRadnogNaloga, sp_BrisanjeZice, sp_DajMasinuPoID,
sp_DajMasinuPoRadniku, sp_DajRadnikaPoID, sp_DajRadnikaPoMasini,
sp_DajRadniNalogPoID, sp_DajSveMasine, sp_DajSveMasineZaCmb,
sp_DajSvePozicije, sp_DajSveProjekte, sp_DajSveRadneNaloge, sp_DajSveRadnike,
sp_DajSveRadnikeZaCmb, sp_DajSveStatuse, sp_DajSveTipoveUpotrebe,
sp_DajSveZice, sp_DajTekstRadnogNaloga, sp_DajZicuPoID, sp_DodajKorisnika,
sp_DodajMasinu, sp_DodajPoziciju, sp_DodajRadnika, sp_DodajRadniNalog,
sp_DodajZicu, sp_DodeliMasinuRadniku, sp_IzmeniMasinu, sp_IzmeniPoziciju,
sp_IzmeniRadnika, sp_IzmeniRadniNalog, sp_IzmeniZicu, sp_PretraziRadneNaloge,
sp_Prijava, sp_ProveraKorisnickogImena.



Slika 2. Pregled kreiranih procedura

2.3. Opis i korišćenje programa

Program je izrađen u C# Windows Forms tehnologiji, direktno povezan sa SQL Serverom. U narednim poglavljima biće opisan princip rada i način upotrebe. Program zahteva potvrdu identiteta korisnika pre prikaza glavne forme. Nakon potvrde identiteta prikazuje se glavna forma.



Slika 3. Prijava korisnika i glavna forma

U modulu *Podaci o žicama* nalaze se podaci o svim žicama koje su u izradi i koje su izrađene. Podaci se sastoje od jedinstvenog ID broja žice, naziva, skraćenog naziva, poprečnog preseka i boje. Od ponuđenih opcija korisnik ima mogućnost dodavanja, izmene, brisanja žica ili izvoza u excel fajl.



ID žice	Naziv žice	Skrraćeni naziv	Poprečni presek	Boja
1	Single žica	SK03142751	0.5	Plava
7	Triple žica	SK03142752	1	Plava
10	TWIN-LEAD	TW039	1.5	Siva
11	TWIN-LEAD	TW040	1.5	Plava
24	Single žica	SK03142753	0.75	Crvena
25	Single žica	SK03142753	0.75	Crvena
26	Single žica	SK03142754	0.75	Bela
27	Single žica	SK03142755	1	Crna
29	Single žica	SK03142756	1	Žuta
29	Single žica	SK03142757	1	Plava
30	TWIN-LEAD	SK03143560	1.5	Plava
31	TWIN-LEAD	SK03143561	1.5	Crvena
32	TWIN-LEAD	SK03143561	1.5	Žuta
33	TWIN-LEAD	SK03143562	1.5	Zelena
34	TWIN-LEAD	SK03143563	1.5	Crvena

Slika 4. Pregled modula podaci o žicama

Forma za dodavanje žica sastoji se od četiri slobodna polja za unos, i to naziv, skraćeni naziv, poprečni presek i boja. Nakon odabira dugmeta „dodaj“, ukoliko su sva polja ispravno popunjena, dobijamo potvrdu putem forme.



Slika 5. Dodavanje nove žice

Postoji opcija izmena. Odabirom na postojeću žicu, otvara se forma sa već popunjenim podacima izabrane žice. Po potrebi se menjaju postojeći podaci u poljima. Klikom na dugme „izmeni“ se vrši izmena izabrane žice.



Slika 6. Izmjena podataka o žici

Izborom žice u meniju za prikazivanje i odabirom komande „obriši žicu“ pojavljuje se forma sa upitom „da li ste sigurni“. Prilikom odabira opcije „da“, dobija se potvrda i uspešnom brisanju.



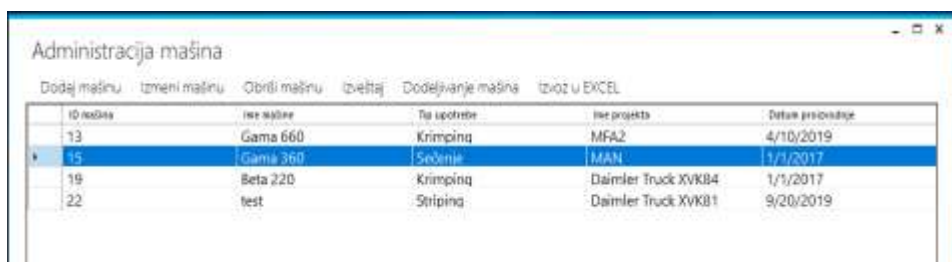
Slika 7. Brisanje podataka o žici

Program omogućava izvoz podataka u excel i tako daje mogućnost dalje manipulacije podacima poput filtriranja, sortiranja i mnogih drugih mogućnosti koje pruža excel.



Slika 8 Izvoz u excel, prikaz fajla

U modulu *Administracija mašina* nalaze se podaci o svim raspoloživim mašinama. Podaci se sastoje od jedinstvenog ID broja mašine, imena, tipa upotrebe, imena projekta na kojima se koriste kao i datuma proizvodnje mašine. Od ponuđenih opcija korisnik ima mogućnost dodavanja, izmene, brisanja mašina, pregleda izveštaja, dodeljivanja mašina pojedinačnom radniku kao i izvoza u excel fajl.



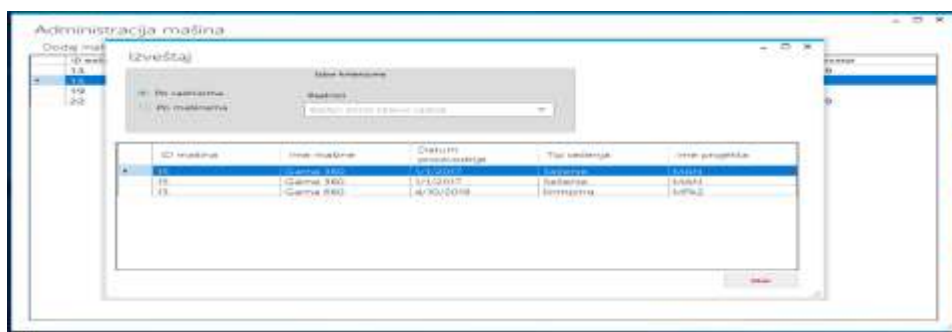
Administracija mašina

Dodaj mašinu Izmeni mašinu Obrisi mašinu Izveštaj Dodeljivanje mašina Izvoz u EXCEL

ID mašine	Izveštaj	Tip upotrebe	Izveštaj	Datum proizvodnje
13	Gama 660	Krmping	MFA2	4/10/2019
15	Gama 360	Sečenje	MAN	1/1/2017
19	Beta 220	Krmping	Daimler Truck XVKB4	1/1/2017
22	test	Striping	Daimler Truck XVKB1	9/20/2019

Slika 9 Pregled modula administracija mašina

U izveštaju postoje dve glavne opcije: po radnicima i po mašinama. Pri izboru, na primer, opcijepo radnicima, u padajućem meniju se nudi izbor radnika za kojeg ćemo raditi izveštaj.



Administracija mašina

Dodaj mašinu Izmeni mašinu Obrisi mašinu Izveštaj Dodeljivanje mašina Izvoz u EXCEL

Izveštaj

Izveštaj po:

☒ Po radnicima ☐ Po mašinama

Radnik:

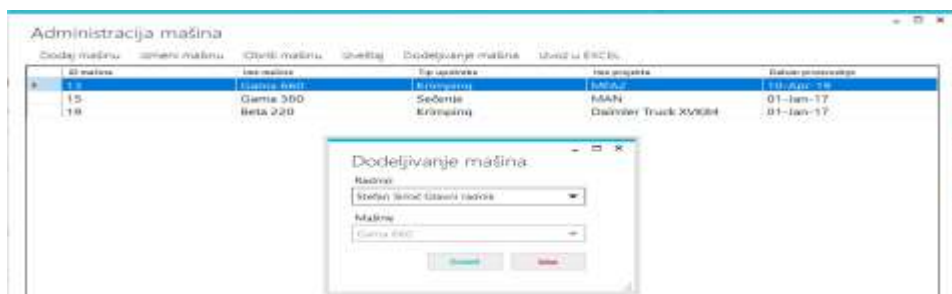
Radnik: [Padajući meni]

ID mašine	Izveštaj	Tip upotrebe	Izveštaj	Datum proizvodnje
13	Gama 660	Krmping	MFA2	4/10/2019
15	Gama 360	Sečenje	MAN	1/1/2017
19	Beta 220	Krmping	Daimler Truck XVKB4	1/1/2017
22	test	Striping	Daimler Truck XVKB1	9/20/2019

Slika 10 Izveštaj po radnicima

Pri izboru opcije po mašinama, u padajućem meniju se nudi izbor mašina za koje ćemo raditi izveštaj.

U opciji *Dodeljivanje mašina* radniku se dodeljuje mašina na kojoj će raditi.



Administracija mašina

Dodaj mašinu Izmeni mašinu Obrisi mašinu Izveštaj Dodeljivanje mašina Izvoz u EXCEL

ID mašine	Izveštaj	Tip upotrebe	Izveštaj	Datum proizvodnje
13	Gama 660	Krmping	MFA2	4/10/2019
15	Gama 360	Sečenje	MAN	1/1/2017
19	Beta 220	Krmping	Daimler Truck XVKB4	1/1/2017

Dodeljivanje mašina

Radnik:

Radnik: [Padajući meni]

Mašina:

Mašina: [Tekstualno polje]

Slika 11 Dodeljivanje mašina

U modulu *Ljudski resursi* nalaze se podaci o svim zaposlenima. Podaci se sastoje od jedinstvenog ID broja zaposlenog, imena, prezimena, naziva pozicije, adrese stanovanja, prebivališta i broja telefona. Od ponuđenih opcija korisnik ima mogućnost dodavanja, izmene, brisanja zaposlenog ili izvoza u excel fajl.

U modulu *Administracija radnih naloga* nalaze se podaci o svim radnim nalogima. Podaci se sastoje od jedinstvenog ID radnog naloga, imena radnika, prezimena radnika, imena mašine, naziva žice, skraćenog naziva, poprečnog preseka, datuma radnog naloga i naziva statusa. Od ponuđenih opcija korisnik ima mogućnost dodavanja, izmene, brisanja radnih naloga, izvoza u excel i pretrage prema imenu radnika ili nazivu žice.

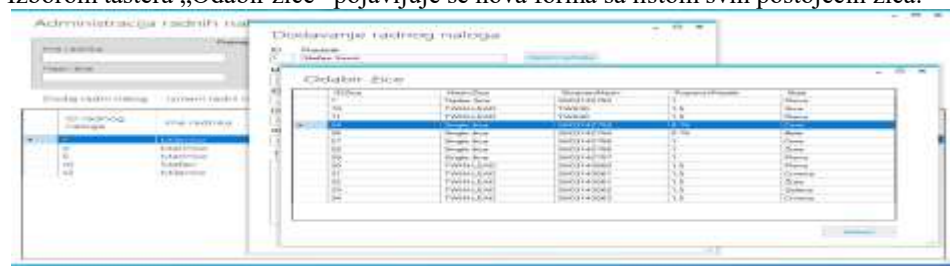


The screenshot shows a window titled "Administracija radnih naloga". It has a search bar at the top with fields for "Ime radnika" and "Naziv žice", and buttons for "Pretraga" and "Prikazivanje". Below the search bar are four buttons: "Dodaj radni nalog", "Izmeni radni nalog", "Obrisi radni nalog", and "Izvedi u EXCEL". The main part of the window is a table with the following columns: ID radnog naloga, Ime radnika, Prezime radnika, Ime mašine, Naziv žice, Skraćeni naziv, Poprečni presek, Datum radnog naloga, and Naziv statusa. The table contains five rows of data.

ID radnog naloga	Ime radnika	Prezime radnika	Ime mašine	Naziv žice	Skraćeni naziv	Poprečni presek	Datum radnog naloga	Naziv statusa
1	Milenko	Petrović	Gema 660	Tuflex 640	SK01141140	1.5	5/9/2019 5:28	Završen
4	Milenko	Milinković	Gema 660	Single 304	SK01142732	0.75	5/9/2019 5:28	Završen
5	Milenko	Milinković	Gema 660	Single 304	SK01142732	0.75	5/9/2019 5:28	Završen
10	Stefan	Simić	Gema 660	Triple 304	SK01142732	1	4/29/2019 2:0	Novi
12	Milenko	Petrović	Seta 220	TWIN-LEAD	TVH640	1.5	10/12/2019 9	Završen

Slika 12 Pregled modula administracija radnih naloga

Izborom tastera „Odabir žice“ pojavljuje se nova forma sa listom svih postojećih žica.



Slika 13 Odabir žice prilikom dodavanja/izmene radnog naloga

3. ZAKLJUČAK

U radu je opisan razvoj programa za praćenje procesa izrade žica u kompaniji Yazaki. Reč je o programu, rađenom u C# *WindowsForms* tehnologiji povezanog sa SQL Serverom. Ideja o pravljenju programa potekla je iz potrebe da se proces izrade žice, ljudski resursi, administriranje mašina i administriranje radnih naloga programski prati i podrži.

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DEVELOPMENT OF PROGRAMS FOR ADMINISTRATION OF WORK ORDERS IN WIRE PRODUCTION

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ABSTRACT:

The paper describes the development of software support for the administration of work orders in wire production, which will contribute to the improvement of business activities within the company. The goal of the work is to make the process transparent and easier to follow for the employees of the company "Yazaki" who work on the production of wires. By developing this program, employees will be able to monitor the wire production process, administer machines and work orders for available workers. The work is grouped into several parts. The first part of the work describes the company for which the program support is intended. After that, an overview of defined tables and procedures is given. The paper describes the functionality and features of the program.

Keywords: account administration, wire production tracking

OSMOTSKI TRETMAN LISTA KOPRIVE (*URTICA DIOICA*) U RASTVORU SAZHAROZE I NATRIJUM-HLORIDA

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SAŽETAK:

Kopriva (*Urtica dioica*) je kao biljka veoma često predstavljena jednom od najvrednijih biljaka na svetu. Pored njene karakteristične osobine da žari i nadražuje kožu, njeni svi delovi biljke su lekoviti. Sve češće se koristi kako u kulinarstvu tako i u lečenju raznih bolesti. Bogata je mnogobrojnim mineralima (Fe, Mg, Zn, K itd.) i vitaminima (C, A, B₂, B₅ itd.). Da bi se održala fizička, hemijska, mikrobiološka i antioksidativna stabilnost lista koprive, potrebno je primeniti neki vid konzervisanja. Jedan od procesa sušenja koji pokazuje brojne prednosti u odnosu na tradicionalne metode sušenja je osmotska dehidratacija. Njene prednosti su brojne: niska radna temperatura, uklanjanje vode u tečnom obliku, poboljšanje i održavanje faktora kvaliteta proizvoda, mogućnost ponovne upotrebe rastvora, skraćeno vreme sušenja itd. Istraživanja u okviru ovog rada baziraju se na osmotskom tretmanu lista koprive u rastvoru saharoze i natrijum-hlorida. Paretovi dijagrami modela sadržaja minerala tokom osmotskog tretmana lista koprive u rastvoru saharoze i natrijum-hlorida prikazani su u zavisnosti od vremena trajanja procesa i temperature osmotskog rastvora. Prikazani Paretovi dijagrami razvijenog polinoma drugog stepena za odzive Ca, Mg, Na, K, Fe, Zn, Mn i Co tokom osmotskog tretmana lista koprive u osmotskom rastvoru pokazuju najveći uticaj linearnih članova t i T , statistički značajno po nivou $p < 0,01$ ili $p < 0,05$, respektivno. Niske vrednosti parametara χ^2 , RMSE, MBE i MPE, kao i visoka vrednost koeficijenta determinacije ukazuju na pouzdanu predikciju predstavljenih minerala za osmotski tretman lista koprive u rastvoru saharoze u natrijum-hlorida.

Ključne riječi: osmotski tretman, list koprive, Paretovi dijagrami, regresivni koeficijent polinom drugog reda

1. UVOD

Kopriva (*Urtica dioica* L.) pripada porodici Urticaceae. Ima više od 40 rodova i preko 500 biljnih vrsta. Kopriva se iz dana u dan koristi sve više, kao lek, hrana, boja, u kozmetici, kao i za zaštitu biljaka od bolesti [1], [2]. Broj medicinskih i farmakoloških istraživanja je svakim danom sve veći i doprinose primeni koprive u lekovite svrhe. Kopriva je jedna od najboljih lekovitih biljaka rasprostranjenih na našim prostorima [3], [4]. U sastavu koprive nalazimo znatne količine gvožđa, kalcijuma, magnezijuma, natrijuma, fosfora, magnana, bora, provitamina A, vitamina B2 i znatne količine vitamina C [5], [6]. Najvažnija hemijska jedinjenja, koje se nalaze u koprivi su flavonoidi, tanini, fitosteroli, silicijska i mravlja kiselina [7], [8].

Jedan od procesa sušenja koji pokazuje brojne prednosti u odnosu na tradicionalne metode sušenja je osmotska dehidratacija. Osmotska dehidratacija može se definisati kao proces delimičnog uklanjanja vode iz životinjskog ili biljnog tkiva. Do uklanjanja vode dolazi direktnim kontaktom materijala sa hipertoničnim rastvorom [9]. Primena osmotske dehidratacije u prehrambenoj industriji ima brojnih prednosti poput: poboljšanja i održanja faktora kvaliteta proizvoda (tekstura, boja, stabilnost), isključivanja hemijskog predtretmana, blagog temperaturnog režima, skraćanja vremena sušenja, energetske efikasnosti i ekološke prihvatljivosti [10], [11], [12].

Cilj ovog rada je formiranje matematičkog modela, u obliku polinoma drugog stepena za predikciju vrednosti odziva sadržaja Ca, Mg, Na, K, Fe, Cu, Zn, Mn i Co tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze u zavisnosti od t i T .

2. MATERIJAL I METODE

2.1. Materijal

Sirovina na kojoj su sprovedena istraživanja je kopriva (*Urtica dioica* L.), brana na obroncima Fruške Gore, neposredno pre eksperimentalnog rada. Prosečni sadržaj suve materije u uzorcima lista koprive iznosio je $26,163 \pm 0,481\%$.

Za pripremu osmotskog rastvora upotrebljene su sirovine: komercijalni natrijum hlorid (NaCl), komercijalna saharoza i destilovana voda.

2.2. Eksperimentalni postupak osmotske dehidratacije

Pribor i radna površina potrebna za pripremu svežih uzoraka lista koprive i osmotskih rastvora temeljno su očišćeni, oprani i dezinfikovani farmaceutskim etanolom koncentracije 70 % v/v.

Ručno izdvajan list koprive od njene stabljike prvo je detaljno opran, osušen upijajućim papirom, a zatim isečen makazama na komade približnih dimenzija 1×1 cm. Pripremljenim uzorcima odmerila se početna masa u zavisnosti od zahteva izvođenja određene analize, i nakon toga uzorci su potopljeni u laboratorijske čase prethodno napunjene osmotskim rastvorima.

Vodeni rastvor natrijum-hlorida i saharae pripremljen je električnom propelerskom mešalicom sa kojom je u potpunosti rastvoreno 350g komercijalnog, kristalnog NaCl i 1200g komercijalne, kristalne saharae u 1kg destilovane vode. Natrijum-hlorid i saharae su u dobijenom osmotskom rastvoru bili na granici rastvorljivosti (www.chem.wisc.edu; www.sugartech.co.za). Maksimalna koncentracija suve materije osmotskog rastvora bila je 60% [13], [14].

Maseni odnos biljnog materijala i osmotskog rastvora iznosio je 1:20, da bi se sprečilo nepoželjno razblaženje prilikom otpuštanja vode iz uzoraka lista koprive. Potpuno potapanje uzoraka u osmotski rastvor, bez plutanja, obezbeđeno je plastičnim mrežicama. Da bi se izbegle degradacije tkiva lista koprive, izabrane su blage temperature (20°C, 35°C i 50°C) koje su održavane konstantnim u inkubatoru (IN 160, Memmert, Schwabach, Nemačka) tokom čitavog procesa. Eksperimenti su sprovedeni na atmosferskom pritisku. Proces osmotske dehidracije trajao je 90 min. Zbog praćenja promena tokom procesa, vršilo se uzorkovanje u različitim vremenskim intervalima. Uzorci lista koprive tretirani u procesu osmotske dehidracije vađeni su iz osmotskog rastvora, nakon 30, 60 i 90 min trajanja procesa, a zatim ispirani mlazom vode. Nakon ispiranja, preostala voda na površini uzoraka upijana je filter hartijom. Osmotski dehidrirani uzorci, dalje su analizirani prema propisanim metodama za određivanje sadržaja mineralnih materija.

2.3. Metode analize sadržaja mineralnih materija

Osnovni hemijski sastav lista koprive pre i nakon procesa osmotske dehidracije određen je na osnovu sledećih metoda:

- Sadržaj gvožđa, bakra i cinka u svežim i osmotski tretiranim uzorcima lista koprive određen je na osnovu metode FINSLab-5.4-3M-004/13, Određivanje Pb, Cd, As, Zn, Cu, Fe, Sn i Cr u hrani metodom atomske apsorpcione spektrometrije (AAS);
- Sadržaj kalcijuma, kalijuma, magnezijuma, natrijuma, mangana i kobalta u svežim i osmotski tretiranim uzorcima lista koprive određivan je na osnovu standarda SRPS EN ISO 6869:2008, Hrana za životinje. Određivanje sadržaja Ca, Mg, Mn, K, Na i Co u hrani metodom atomske apsorpcione spektrometrije (AAS).

2.4. Statistička obrada

Na osnovu rezultata merenja, formirani su matematički modeli u obliku polinoma drugog stepena za predikciju vrednosti odziva Ca, Mg, Na, K, Fe, Cu, Zn, Mn i Co tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharae u zavisnosti od t i T .

3. REZULTATI I DISKUSIJA

U tabeli 1.1. i 1.2. prikazane su ANOVA kalkulacije razvijenog SOP modela za odzive Ca, Mg, Na, K, Fe, Cu, Zn, Mn i Co tokom osmotskog tretmana lista koprive u osmotskom rastvoru NaCl i saharae. Tabele pokazuju da u SOP modelu na odzive sadržaja Ca, Mg, K, Cu, Mn i Co najveći uticaj imaju linearni članovi t i T , statistički značajno po nivou $p < 0,01$ ili $p < 0,05$, respektivno. U slučaju Fe i Zn, pored linearnih članova, statističku značajnost ima i kvadratni član T ($p < 0,01$ i $p < 0,05$, respektivno), dok

na Na najveći uticaj u SOP modelu ima linearni član t , statistički značajno na nivou $p < 0,01$.

Tabela 1.1. ANOVA modela odziva Ca, Mg, Na i K tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze

Član	df	Ca	Mg	Na	K
t	1	3,36E-01 ⁺	1,57E-03 ⁺	1,32E+01 ⁺	7,54E-02 ⁺
t^2	1	3,27E-02	6,08E-06	1,14E+00	1,31E-04
T	1	8,70E-01 ⁺	3,99E-03 ⁺	6,70E-01	2,46E-01 ⁺
T^2	1	4,07E-03	4,84E-04	1,63E-01	2,72E-02
$t \times T$	1	6,97E-05	1,03E-04	2,87E-01	1,12E-03
Greška	3	1,66E-02	1,67E-04	6,22E-01	1,33E-02

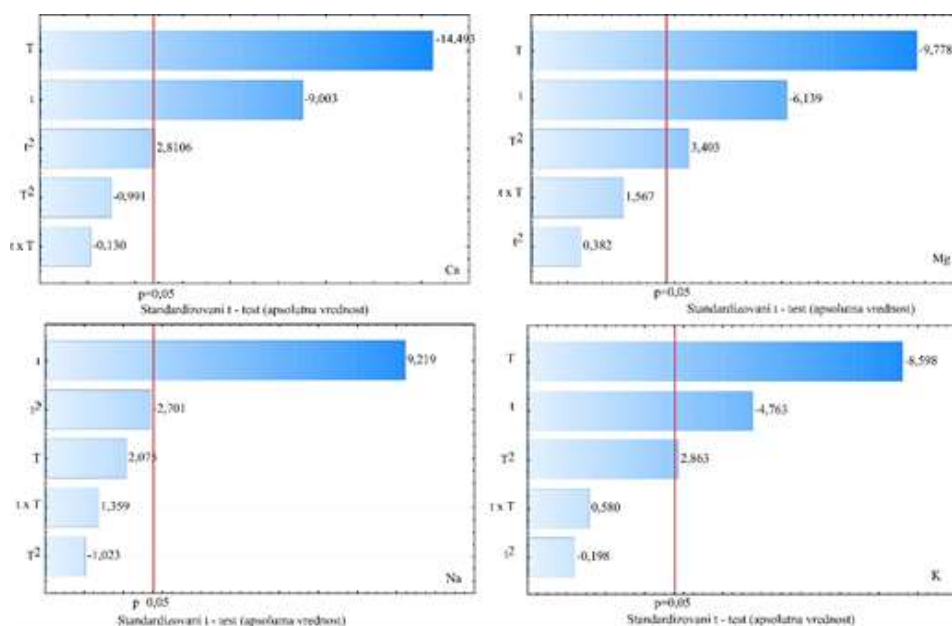
⁺Statistički značajan na nivou $p < 0,01$, ^{*}Statistički značajan na nivou $p < 0,05$,
^{**}Značajan na nivou $p < 0,10$, članovi koji nisu obeleženi nisu statistički značajni

Tabela 1.2. ANOVA modela odziva Fe, Cu, Zn, Mn i Co tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze

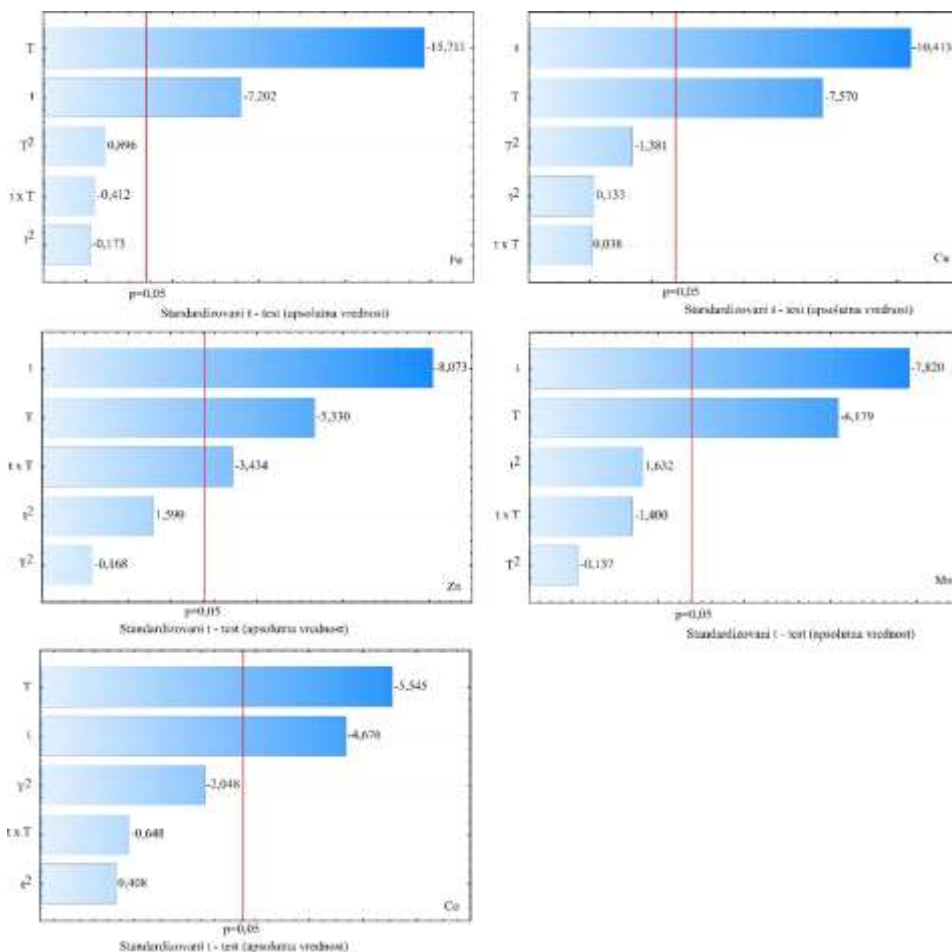
Član	df	Fe	Cu	Zn	Mn	Co
t	1	1,14E-01 ⁺	1,52E-01 ⁺	7,90E-02 ⁺	8,81E-02 ⁺	3,56E-02 ⁺
t^2	1	6,53E-05	2,48E-05	3,06E-03	3,84E-03	2,72E-04
T	1	5,41E-01	8,04E-02 [*]	3,44E-02 ⁺	5,50E-02 [*]	5,01E-02 [*]
T^2	1	1,76E-03 [*]	2,67E-03	3,44E-05 [*]	2,69E-05	6,83E-03
$t \times T$	1	3,72E-04	2,07E-06	1,43E-02	2,82E-03	6,83E-04
Greška	3	8,76E-03	5,61E-03	4,85E-03	5,76E-03	6,51E-03

⁺Statistički značajan na nivou $p < 0,01$, ^{*}Statistički značajan na nivou $p < 0,05$,
^{**}Značajan na nivou $p < 0,10$, članovi koji nisu obeleženi nisu statistički značajni

Na slici 2.1. i 2.2. prikazani su Paretovi dijagrami modela odziva Ca, Mg, Na i K, Fe, Cu, Zn, Mn i Co za osmotski tretman lista koprive u rastvoru NaCl i saharoze. Iz ove slike se vidi da u SOP modelu za izračunavanje Ca najveći uticaj imaju linearni članovi t i T , statistički značajno na nivou $p < 0,01$ i $p < 0,05$, respektivno. Najveći uticaj u SOP modelu za izračunavanje Mg imaju linearni članovi t i T , statistički značajno na nivou $p < 0,01$ i kvadratni član T . Za izračunavanje Na najveći uticaj imaju linearni članovi t i T . Najveći uticaj u SOP modelu za predikciju K imaju linearni članovi t i T ($p < 0,01$). Za sve ostale prikazane minerale (Fe, Cu, Zn, Mn i Co), najveći uticaj na rezultat imaju linearni članovi t i T , statistički značajno na nivou $p < 0,01$ i $p < 0,05$, respektivno.



Slika 2.1. Paretovi dijagrami modela odziva Ca, Mg, Na i K tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze



Slika 2.2. Paretovi dijagrami modela odziva Fe, Cu, Zn, Mn i Co tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze

Na osnovu rezultata merenja, formirani su matematički modeli u obliku polinoma drugog stepena za predikciju vrednosti odziva Ca, Mg, Na, K, Fe, Cu, Zn, Mn i Co tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze u zavisnosti od t i T.

U tabeli 1.3 i 1.4. regresioni koeficijenti su prikazani srednjom vrednošću i standardnom devijacijom, a statistička značajnost rezultata je izražena preko p vrednosti.

Tabela 1.3. Regresioni koeficijenti polinoma drugog stepena za odzive Ca, Mg, Na, K tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze

	Ca	Mg	Na	K
β_0	25,789±1,031 ⁺	6,546±0,337	5,120±1,457	48,029±3,094 ⁺
β_1	-0,012±0,013 ^{**}	-0,003±0,004 [*]	0,084±0,018	0,110±0,038
β_{11}	0,000±0,000	0,000±0,000	-0,001±0,000 [*]	-0,001±0,000 [*]
β_2	0,034±0,066	0,015±0,021	0,090±0,093	0,174±0,197
β_{22}	-0,001±0,001 [*]	0,000±0,000	-0,001±0,001 [*]	-0,003±0,003 [*]
β_{12}	0,000±0,000	0,000±0,000	0,001±0,000	0,001±0,001

⁺Statistički značajan na nivou p<0,01, ^{*}Statistički značajan na nivou p<0,05,

^{**} Značajan na nivou p<0,10

Tabela 1.4. Regresioni koeficijenti polinoma drugog stepena za odzive Fe, Cu, Zn, Mn i Co tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze

	Fe	Cu	Zn	Mn	Co
β_0	30,179±1,208 ⁺	11,422±0,587	26,990±1,275	37,526±2,634 ⁺	1,393±0,084 ⁺
β_1	0,030±0,015	0,016±0,007	0,051±0,016	0,051±0,032	0,002±0,001
β_{11}	0,000±0,000	0,000±0,000	0,000±0,000	0,000±0,000	0,000±0,000
β_2	0,025±0,077	0,050±0,037	0,026±0,081	0,151±0,168	0,002±0,005
β_{22}	0,000±0,001	0,000±0,001	0,000±0,001	-0,001±0,002 [*]	0,000±0,000
β_{12}	0,000±0,000	0,000±0,000	0,000±0,000	-0,001±0,001 [*]	0,000±0,000

⁺Statistički značajan na nivou p<0,01, ^{*}Statistički značajan na nivou p<0,05,

^{**} Značajan na nivou p<0,10

Standardne devijacije razlika, varijansa razlika, kao i srednje vrednosti razlika za odzive Ca, Mg, Na, K, Fe, Cu, Zn, Mn i Co bile su oko 0. Pošto su rezidualne vrednosti pokazale dobro poklapanje sa normalnom raspodelom, oko nulte srednje vrednosti, u okviru granice poverenja od 95%, rezultati pokazuju da model na odgovarajući način predviđa eksperimentalne podatke procesa osmotskog tretmana lista koprive u rastvoru NaCl i saharoze.

Parametrizacija Skew. (engl. *skewness* krivljenje), koja predstavlja odstupanje od normalne raspodele i Kurt. (kurtois), koji predstavlja odstupanje od "nazubljenosti" normalne r. Niske vrednosti parametara χ^2 , RMSE, MBE i MPE, kao i visoka vrednost koeficijenta

determinacije (r^2), prikazane u tabeli 1.5. ukazuju na pouzdanu predikciju Ca, Mg, Na, K, Fe, Cu, Zn, Mn i Co za osmotski tretman lista koprive u rastvoru NaCl i saharoze, na osnovu modela prikazanog u tabelama 1.3. i 1.4. i na dobro poklapanje vrednosti dobijenih ovim modelom sa eksperimentalnim rezultatima raspodele, prikazane su dobre osobine za generalizaciju modela.

Tabela 1.5. Rezidualna analiza matematičkih modela za odzive Ca, Mg, Na, K, Fe, Cu, Zn, Mn i Co tokom osmotskog tretmana lista koprive u rastvoru NaCl i saharoze

	χ^2	RMSE	MBE	MPE	r^2	Skew.	Kurt.	Sr.vred.	SD	Var.
Ca	0,002	0,041	0,000	0,137	0,993	-0,863	-0,548	0,000	0,043	0,002
Mg	0,000	0,004	0,000	0,049	0,986	0,465	0,490	0,000	0,004	0,000
Na	0,078	0,249	0,000	1,798	0,975	0,118	-0,320	0,000	0,263	0,069
K	0,002	0,036	0,000	0,063	0,980	0,260	-1,029	0,000	0,038	0,001
Fe	0,001	0,030	0,000	0,080	0,993	-0,573	0,001	0,000	0,031	0,001
Cu	0,001	0,024	0,000	0,162	0,988	0,357	-0,213	0,000	0,025	0,001
Zn	0,001	0,022	0,000	0,070	0,979	-0,355	-1,082	0,000	0,023	0,001
Mn	0,001	0,024	0,000	0,054	0,980	-0,007	-1,458	0,000	0,025	0,001
Co	0,001	0,026	0,000	1,954	0,962	-0,314	-0,824	0,000	0,027	0,001

4. ZAKLJUČAK

Na osnovu r^2 vrednosti za Ca, Mg, Na, K, Fe, Cu, Zn, Mn i Co (0,993;0,986;0,975;0,980;0,993;0,988;0,979;0,980 i 0,962 respektivno.), može se zaključiti da model na zadovoljavajući način predviđa sadržaje posmatranih minerala na osnovu eksperimentalnih rezultata.

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OSMOTIC TREATMENT OF NETTLE LEAVES (URTICA DIOICA) IN SUCROSE AND SODIUM CHLORIDE SOLUTION

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ABSTRACT:

Nettle (Urtica dioica) is often presented as one of the most valuable plants in the world. In addition to its characteristic property of burning and irritating the skin, all plant parts are medicinally beneficial. Furthermore, it contains numerous minerals (Fe, Mg, Zn, K, etc.) and vitamins (C, A, B2, B5, etc.). In order to maintain the physical, chemical, microbiological and antioxidant stability of nettle leaves, it is necessary to apply some form of preservation. The osmotic dehydration advantages are numerous: low operating temperature, removal of water in a technical form, improvement and maintenance of product quality factors, the possibility of reuse of the solution, shortened drying time, etc. This research is based on the osmotic treatment of nettle leaves in a solution of sucrose and sodium chloride. Pareto diagrams of the mineral content model during the osmotic treatment of nettle leaves in sucrose and sodium chloride solution are shown depending on the process's duration and the osmotic solution's temperature. The presented Pareto diagrams of the developed second-degree polynomial for the responses of Ca, Mg, Na, K, Fe, Zn, Mn and Co show the greatest influence of the linear terms t and T , statistically significant at the $p < 0.01$ level or $p < 0.05$, respectively. The low values of the parameters χ^2 , RMSE, MBE and MPE, as well as the high value of the coefficient of determination, indicate a reliable prediction of the presented minerals for the osmotic treatment of nettle leaves in a solution of sucrose in sodium chloride

Keywords: *osmotic treatment, nettle leaf, Pareto diagram, regression coefficient, polynomial of the second degree*

THE CONTEMPORARY FUNCTION OF THE BROWNFIELD- CASE ANALYSIS OF THE MUSIC SCHOOL IN NOVI PAZAR

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ABSTRACT:

Idealized architectural-urbanistic town politics implies the constant coherency of its urbanistic tissue and the activities undertaken within urbanistic tissue. Non-functionality of the area or building prevents urban tissue development, but, at the same time, urban tissue consists of the older buildings, which, even neglected, are present-time gatekeepers. Neglected and unutilized areas, within the international professional domain called brownfields, during past decades are successfully reanimated as they were reactivated - revived with new contents and repurposed for new functions and uses. The subject of this paper is the building of the Music School "Stevan Mokranjac" in Novi Pazar, i.e. the potential of the building's attic for reactivation and reshaping of the space for contemporary function. The aim of the study is to portray the importance of heritage, its authenticity, and its value so that future efforts for similar reactivations of particular objects in Novi Pazar could be promoted. Awakening consciousness and drawing the attention of the broad public to the existence of the objects as well as their valuing and protection presents one of the important turning points during the incitement of the town's cultural development. The concept of solution finds inspiration within the "free plan" concept of the pavilion by Mies van der Rohe

Keywords: brownfields, reactivations, cultural heritage

1.INTRODUCTION

Revitalization (regeneration) of brownfields could be defined, in the simplest sense, as the reuse of neglected sites. The terms brownfield renewal or recycling are often used for the reuse of neglected sites. Thus, Barch and Colleton in one of the first thematic works on this issue - "Brownfields: cleanup and reuse of contaminated property"¹ use the terms

¹ Bartsch, C., Collaton, E. (1997). Brownfields: Cleaning and reusing of contaminated properties, Northeast-Midwest Institute

renewal and reuse as synonyms of brownfield regeneration, and Hollander and others¹ act similarly later in "Principles of brownfield regeneration".

The international frame for the protection, preservation, management and use of industrial cultural heritage began to develop in the middle of the twentieth century in Great Britain where the appearance of the first texts and projects dealing with the problem of industrial heritage took place. After that, research of topic of the importance of industrial heritage and the need to preserve it was spread to other European countries. The International Charter of for the Conservation and Restoration of Monuments and Monumental Sites, known as the Venice Charter (ICOMOS, 1964), was adopted in 1964 in Venice by the International Council for Monuments (International Council of Monuments and Sites - ICOMOS). The Council was founded with the aim of theory, methodology and scientific techniques promotion that is applied in the conservation, protection and improvement of cultural heritage in the world. Since the adoption of the Charter, several international initiatives and activities of an interdisciplinary nature have been aimed at a better understanding of the industrial cultural heritage and the promotion of its use, protection and conservation.

In the last decades of the twentieth century, several international charters, recommendations and guides were adopted, where the most important one is the Convention on the Protection of World Cultural and Natural Heritage (UNESCO, 1972) adopted in Paris in 1972 by the Organization for Education, Science and the culture of the United Nations (United Nations Educational, Scientific and Cultural Organization - UNESCO).²

2. REGENERATION OF BROWNFIELDS

The primary goal of urban regeneration is to respond to the complex dynamics of contemporary urban life and the revitalization of economic, social, ecological and cultural functions. Social cohesion and diversity have a primary place in the process. The process begins with the analysis of urban problems. Drivers of urban regeneration are diverse:

- Social stimuli can be positive and negative in the context of changing needs and lifestyles or solving social problems (natural disasters, poverty, etc.)
- Environmental causes also provide an incentive for urban regeneration and are mostly negative in nature: environmental degradation, environmental risks, etc.
- Politically, they can initiate urban regeneration due to a change of government, changes in legal regimes, new planning instruments.

¹ Hollander, J., Kirkwood, N., Gold, J. (2009). Principles of brownfield regeneration, Washington: Island Press

² Ana B. Spiric, Beograd (2018). „The spatial patterns of brownfield locations in function of urban regeneration- case study Banjaluka “, Doctoral Dissertation.

The process of urban regeneration is represented in all national urban politics; the difference is only in the development of the country to invest in the process itself, which is reflected in the quality and speed of problem solving.

The need for urban regeneration can arise for several reasons, such as:

1. Economic: limited private investment, unemployment, decline in the urban economy, decline in the economy, etc.
2. Social: aging and shrinking population, poverty, deteriorating services and infrastructure
3. Spatial: high density of residential areas, illegal residential development
4. Environmental protection: loss of open spaces, air pollution, high noise levels, destruction of cultural buildings and monuments
5. Institutional: complex and outdated framework of urban management, poor implementation, overlapping of responsibilities.

The very law that deals with brownfields in the USA from 2002 explicitly mentions the concept of revitalization in its title - the Act on Exemption from Liability of Small Businesses and Revitalization of Brownfields.¹ The CLARINET definition refers to brownfield reuse in terms of future beneficial use. Brownfield redevelopment is defined as the reuse of land and the reintegration of assets into the economic cycle.²

Brownfield regeneration includes the definition of sustainability goals, sustainability indicators for contamination management and land reuse, management of existing projects and infrastructure, urban design, planning and citizen participation methods and management of brownfield projects (EUGRIS, 2005). The promotion of public-private partnership is important for strengthening urban projects and brownfield regeneration programs, and for encouraging communication and building trust and cooperation between actors. The effectiveness of the implementation of the regeneration of brownfield projects depends on numerous disciplines, on the promotion of public-private partnership and appropriate management mechanisms. A large number of successful examples of restoration of brownfield areas show numerous advantages³:

- health and environmental protection
- raising the value of space
- improved infrastructure
- economic development
- job openings
- prevention of uncontrolled expansion of industrial zones.

¹ <http://www.epa.gov/brownfields/laws/>

² Grimski, D., Lowe, J., Smith, S., Ferber, U. (Ed.) (2002). Brownfields and Redevelopment of Urban Areas - A report from the Contaminated Land Rehabilitation Network for Environmental Technologies (CLARINET), Umweltbundesamt Austria

³ Kurtovic Folic, N., Perovic, S.: Brownfield regeneration - imperative for sustainable urban development , GRABEVINAR, 64 (2012)

The revitalization of brownfield areas is a complex task, and existing brownfield initiatives are mainly focused on greenfield investments. New industrial and entrepreneurial zones in Serbia were created in accordance with the national policy aimed at attracting foreign investments and encouraging small and medium-sized companies¹. The problem of repurposing and regeneration of brownfield areas is caused by the inactivity of the local self-government in initiating the repurposing, and due to the low level of understanding and acceptance of the cooperation necessary for the implementation of complex projects.

3.CASE STUDY: "STEVAN MOKRANJAC" MUSIC SCHOOL BUILDING IN NOVI PAZAR



Fig. 1. Microlocation. Spatial building position

In degraded urban areas such as Novi Pazar, the goal is to develop an environment that will attract new residents and improve the quality of the environment, which is why it is

¹ Bokic, I., Sumpor, M. (2010). Brownfield Redevelopment Issues in Croatia.Privredna kretanja i ekonomska politika (Zagreb), Vol. 20, No 123, (August), 2010

especially important to establish a clear connection between economic development and physical regeneration "Sustainable brownfield regeneration is management, rehabilitation and return to purposeful use of the brownfield land base resources in a way as that the fulfillment and continuity human needs is ensured for current and future generations in an ecologically non-degrading, economically sustainable and socially acceptable way" Sustainable brownfield regeneration changes destroyed areas into new attractive, multifunctional environments, improving the character of places and respecting the peculiarities of the location. Those areas are recognized as having great potential for the development of new places for social and cultural events.

The Old Court building in Novi Pazar was built immediately after the First World War and represents an immovable cultural asset as a cultural monument.¹

The Old Court building in Novi Pazar is a massive, one-story building with a pronounced rectangular base. The facade is built in neoclassical style, horizontally divided by a cordon wreath into differently finished ground and first floor, and vertically into three rhizalite fields. In the central part of the main facade is the entrance, with a specially processed portal, while the lateral risalites are finished with tympanums and decorated with leaning shallow pilasters and capitals with floral ornamentation.

¹ Grujovic B., Katarina; Aleksic C., Marija (2016). "A look through heritage." Kraljevo: Institute for the Protection of Cultural Monuments.



Fig. 2. Facades of the building

The interior is arranged in the usual way, with a central staircase, spacious corridors and a series of rooms, with a courtroom on the first floor. The courtyard facade has a similar finish, while the side facades were changed by the later extension of the annex.

In 1986, with the adaptation of the old court building for the needs of SIZ culture, the "Sopocanska videnja" club, the school of old painting techniques and the native museum in Novi Pazar, the building, in addition to its new function, was also given the new name "Stevan Mokranjac". The main project of construction-craft works for the needs of SIZ culture was done by the design work organization "Sandzakprojekt".

In the municipal official gazette (number 40, Belgrade, December 31, 1986), the building of the constitutional court was declared a cultural heritage - a cultural monument.

The building is located in Oslobođenja Street in Novi Pazar, on cadastral plot number 2622 KO Novi Pazar. The border of the immediate surroundings of the subject cultural monument is formed by the inner edges of cadastral plot no. 2622 KO Novi Pazar in a total area of 25 ares. The function for the needs of the music school, native department and studio is adapted to the existing rooms that have not been changed.

The ground floor and first floor (right wing) are used as classrooms (music school), while the left part of the building is intended for the historical archive "Ras". The attic was turned into an "artistic" space where the studios are located, for the needs of the "Sopocani" painters' club.

The building is walled with bricks made in a lime mortar. The foundations are made of stone. The walls are plastered with lime mortar. The mezzanine constructions were previously wooden, but after the adaptation in 1986, they were replaced by reinforced concrete construction TM-3.



Fig. 3. Current state of the object.

The ceilings are slatted and then plastered with lime mortar. The floors on the first floor and the attic are wooden, and on the ground floor vinaz on a concrete base. The floors of the ground floor were thermally insulated and waterproofed back in 1986. The carpentry is completely worn out. Skylights are leaking, dried out and cracked. The roof leaks in some places, the sheet metal is worn out. The woodwork in the attic is in a bad condition, the ravages of time have affected it as well as various insects and careless users (floods, scraping for individual needs...)



Fig. 4. Current state of the object.

4. SUSTAINABLE REDEVELOPMENT OF A BROWNFIELD SITE

Urbanistic and ecological studies of brownfield sites have shown that the problem of stagnation of neglected buildings significantly affects human behavior and the environment in which it is located. With the passage of time, human civilization advances, develops and changes, so the needs for built space and new functions change accordingly. By reorganizing the building of the music school, the city of Novi Pazar gets a new useful space, and by revitalizing the building, its harmful effects in the domain of energy efficiency are reduced.

Under the UK's Town Planning Regulations 2017, local authorities are required to create a register of all brownfield sites in order to regularly consider the possibility of converting suitable buildings into residential space.¹ On the contrary, in Novi Pazar, as in most cities of Serbia, older buildings are not treated as purposeful space nor are the potentials of reuse considered. However, architectural space is a reflection of social needs. The current function of the attic is absolutely inadequate to the modern tendencies of Novi Pazar, which is a city of young people, a city of universities. Therefore, the compromise solution for conversion is to rearrange the space again so that it can be used by young people.²

The repurposing of old buildings represents a direct investment option from an economic point of view. A space that is exposed to deterioration can respond to the demands of different types of business, which in other cases is solved by a new building. The advantage of restoring old buildings is usually the location, which is exactly the case with the music school. Since it is the inner city center, it is not possible to build a new building in the vicinity due to the large number of built-up areas. In addition, the area of the building favors the restoration, because it is economically more profitable - lower costs.

There are also potential drawbacks. One of them is certainly the construction and finishing, but as it is the time of new technologies, it will certainly not be a factor in rejecting investments. Given the difficulties in predicting possible changes during the expected lifetime of the object, the following question arises: "What will happen if we design a space for one function, and it is not acceptable among users?". The general goal of every physical space is to increase its activity, that is, its exploitation. It is necessary to provide an open space, which will enable the organization of useful surfaces in a way that is most favorable at a certain moment. Open space gives flexibility to the object, which means the adaptability of the object's attributes to the needs of the user. Flexibility can also mean object neutrality.

3.CONCLUSION

Based on the above, it can be concluded that the brownfield location in Novi Pazar, specifically the music school "Stevan Mokranjac", has potential in the direction of

¹ <https://www.gov.uk/government/publications/brownfield-registers-and-permission-in-principle/brownfield-registers-and-permission-in-principle-frequently-asked-questions>

² Jevremovic Lj. (2022) "New use as a determinant in the treatment of industrial brownfields - revitalisation models and classifications." Doctoral dissertation, Nis.

transformation into spaces for new, future uses. The recommendation for further exploitation of the building, in terms of conversion, is multifunctional function and modernity for sure. In modern times - in which most work is done on the computer, co-working space offers an interesting alternative. Spaces in which it is possible to choose between private and open workplaces, with their Internet, printing, meeting room, restaurant, entertainment rooms and many other possible services, co-working spaces perfectly match the modern demand for business space.

It is also concluded that the advantages of restoration are certainly speed - a shorter time frame than new construction, cost savings and preservation of heritage. Also, with this kind of action, we raise the awareness of the city's residents about the principles of energy efficiency, and raise the level of interest and their involvement in the renovation of buildings that are witnesses of a bygone era. Taking into account all the processes that justify the restoration of old buildings, but also the fact that Serbia strives to become a full member of the European Union, there is a clear need for the introduction of clearly defined rules and decision-making processes when and how to act, to ensure the most economical and painless way of revitalizing the building but also proper treatment of cultural heritage.

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SAVREMENI RAZVOJ EKOLOŠKI PRIHVATLJIVOG PROIZVODA

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SAŽETAK:

Glavni izazov u razvoju savremenih proizvoda predstavljaju brojni zahtevi kupaca i tržišta, ali i izazovi uslovljeni energetsom krizom, ograničenom upotrebom resursa, kao i posledica drugih uticaja poput pandemije izazvane virusom Covid-19. Savremena proizvodnja odgovara na ove izazove upotrebom digitalnih alata i strategija u svim fazama životnog ciklusa proizvoda vodeći se pritom principima održivog razvoja. Ovaj rad prikazuje značaj upotrebe softverskih alata u procesu razvoja proizvoda kako bi se dobio konkurentan proizvod na tržištu pogodan ne samo sa aspekta tehnološko-ekonomskih zahteva, već i kao ekološki prihvatljiv proizvod. Na ovaj način rad će ukazati na značaj digitalne transformacije i razvoja digitalnih veština u ostvarivanju ciljeva zelene agende koji se ostvaruju primenom pametne proizvodnje u Industriji 4.0.

Ključne riječi: Razvoj proizvoda, Ekodizajn, Analiza životnog ciklusa proizvoda, Softverski alati.

1. UVOD

Savremen razvoj proizvoda [1] kao i mogućnosti projektovanja za proizvodnju (engl. Design for Manufacturing) [2] i inženjerstva znanja (engl. Knowledge Engineering) [3] predstavljaju svakodnevnu sliku na svetskom tržištu, gde kompanije nastoje da povećaju profit smanjenjem troškova tokom razvoja proizvoda i povećanjem kvaliteta. Integrisanim razvojem proizvoda i simultanim inženjerstvom [4] obezbeđuje se da multidisciplinarni timovi stručnjaka rade paralelno tokom razvoja proizvoda. U tom timu, posebno mesto poslednjih godina imaju i stručnjaci u oblasti zaštite životne sredine koji fokus stavljaju na značaj ekološki prihvatljivog proizvoda ne samo tokom njegove upotrebe nego tokom čitavog životnog ciklusa proizvoda (engl. Product Life Cycle) [5].

U takvom okruženju, pored brojnih pristupa dizajnu poput tzv. Dizajna za sve (engl. Design for X) [6], posebno mesto dobija i Ekodizajn [7] kao metodologija koja stavlja u fokus razmišljanje o životnom ciklusu kako bi preventivno delovali na sve faze u životnom

ciklusu proizvoda i tako obezbedili mogućnost primene strategija i pristupa poput smanjenja upotrebe resursa, traganja za alternativnim materijalima, revalorizacijom proizvoda i sl.

Danas proizvođači sve više stavljaju akcenat na ekološki prihvatljivom proizvodu koji minimalno utiče na životnu sredinu. U tom konceptu, savremeno tržište dobija novu dimenziju konkurentnosti. Cena, kvalitet, vek trajanja jesu važni zahtevi, ali oni moraju biti dostignuti racionalizacijom resursa, pre svega energenata i upotrebom obnovljivih ili reciklabilnih materijala. Na taj način se ostvaruje društveno odgovorno poslovanje a industrija dobija nove izazove u traženju adekvatnih (čistih) tehnologija koje imaju „prihvatljivu“ emisiju a proizvod „prihvatljiv“ ugljenični (ekološki) otisak. Ovi zahtevi dodatno su pojačani pojavom pandemije virusa Covid-19 kao i vojnim sukobima u Ukrajini.

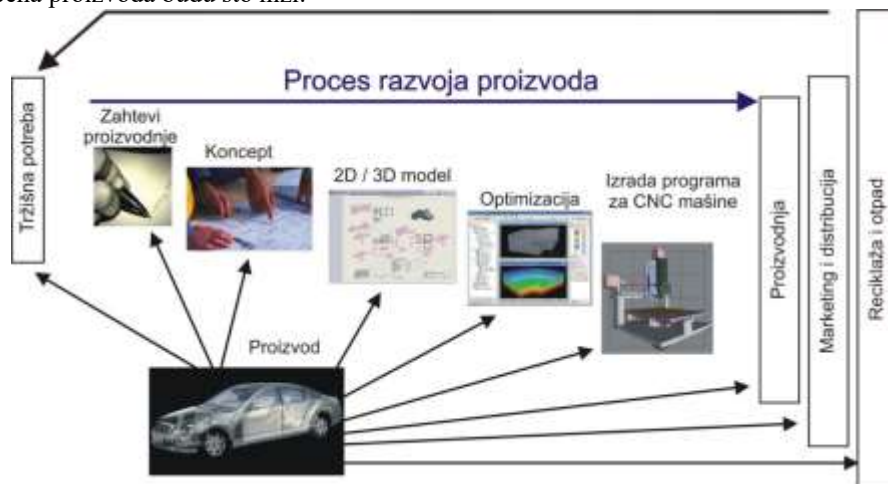
U ovom radu biće razmatrana upotreba savremenih softverskih alata u razvoju proizvoda. Zahvaljujući snažnom CAD alatu kakav je SolidWorks [8], biće prikazan primer modeliranja proizvoda nakon čega će se pristupiti analizi virtuelnog 3D modela proizvoda kroz SolidWorks-ov modul Sustainable Design. Na taj način biće prikazana analiza održivosti proizvoda i ekološki uticaj budućeg proizvoda u slučajevima kada na istom modelu koristimo različite materijale i tehnologije izrade. Upravo ove analize prave i najveću uštedu u procesu razvoja proizvoda, jer se u fazama projektovanja i konstruisanja ostvaruju najveće uštede, dok kasnije vremenom su izmene dizajna sve manje a troškovi izmena sve veći [9]. Zahvaljujući intuitivnom interfejsu, korisnik lako dobija jasnu analizu koja prikazuje podatke o proceni utrošene energije, procentu moguće reciklaže, uticaju transporta ali i celokupnom ekološkom otisku proizvoda na životnu sredinu.

2. OSNOVE DIZAJNA I RAZVOJA PROIZVODA

Projektovanje podrazumeva „nalaženje naučno opravdanog tehničkog rešenja sa funkcionalnog, sadržajnog i konstruktivnog aspekta koje se može praktično realizovati a da pri tom zadovolji ekonomske kriterijume”. Može se reći da je projektovanje proizvoda proces definisanja proizvoda kojim se obezbeđuju njegova neophodna svojstva kvaliteta, svojstva ekonomičnosti i definišu sve informacije neophodne za projektovanje tehnološkog postupka izrade tog proizvoda.

Savremeni razvoj proizvoda zahteva da tokom brojnih faza projektovanja, konstruisanja, oblikovanja, prilagođavanja, proizvodnje, testiranja, verifikovanja, itd. budu uključeni eksperti iz različitih oblasti. Zadatak multidisciplinarnog tima stručnjaka je da odgovore na brojne zahteve kupaca i tržišta kako bi zadovoljili brojne zahteve i kriterijume svih zainteresovanih strana. Ako posmatramo informacione tokove celog procesa proizvodnje (slika 1), sigurno je da je proces dizajna njegov najkompleksniji deo jer se tu obrađuje i stvara najveći deo informacija o proizvodu. Bitno je napomenuti da faza dizajna ima najveći uticaj na troškove proizvodnje i sam tehnološki proces izrade dela.

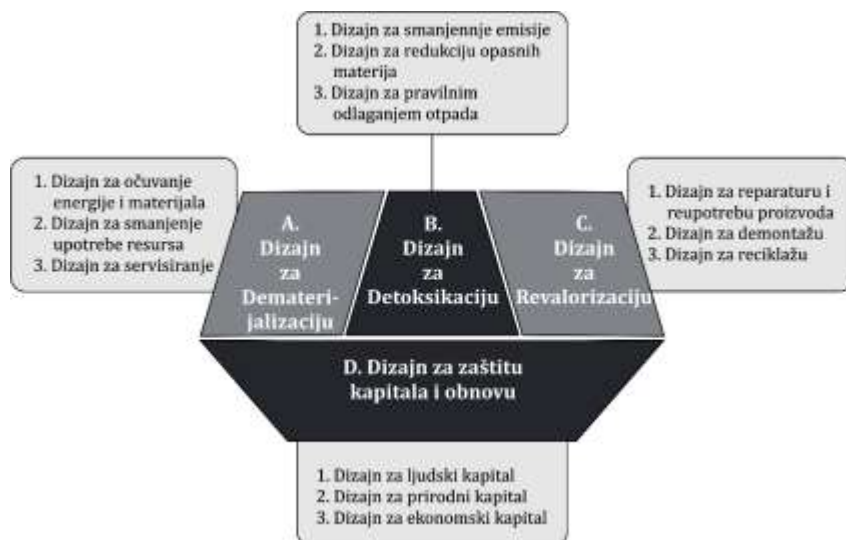
Dinamično tržišno okruženje zahteva od kompanija da se novi proizvodi razvijaju brzo, da zadovoljavaju propisane standarde i kvalitete, a da pri tom troškovi proizvodnje a time i cena proizvoda budu što niži.



Slika 1. Proces razvoja proizvoda [10]

Savremeno odgovorno poslovanje naglašava pristup održivog razvoja kao jedan od prioriteta u projektovanju ne samo kvalitetnog i cenom prihvatljivog proizvoda, već i ekološki prihvatljivog. To otvara još širi pristup projektovanju proizvoda i zahteva nova znanja i iskustva, odnosno nove eksperte u timu koji projektuje i razvija proizvod.

Ove strategije nisu jedinstvene i ne mogu se univerzalno primenjivati, već se shodno specifičnim osobinama proizvoda drugačije primenjuju, a mesto, uloga, funkcija i namena proizvoda snažno će ukazati koje koncepte strategije treba primeniti. Svaka od strategija nije nezavisna od drugih, već se prava mera pogodnog dizajna ostvaruje kombinovanjem ovih pristupa, (slika 2).



Slika 2. Četiri glavne strategije Ekodizajna [11]

Preporuke Ekodizajna dobijene iz proizvodnih pogona, sa praktičnih projekata, u različitim industrijama su objedinjene u 4 glavne strategije [11]:

1. Dizajn za Dematerijalizaciju teži da smanji upotrebu resursa;
2. Dizajn za Detoksikaciju smanjuje ili eliminiše toksične, opasne ili štetne karakteristike proizvoda i njegovih procesa;
3. Dizajn za Revalorizaciju pokušava da obnovi, reciklira ili na neki drugi način ponovo upotrebi ostatak materijala i energije, eliminišući pri tom otpad i smanjujući upotrebu sirovina;
4. Dizajn za Zaštitu Kapitala i Obnovu obezbeđuje dostupnost, integritet, vitalnost, produktivnost i kontinuitet ljudskih, prirodnih i ekonomskih resursa.

3. IZRADA 3D MODELA PROIZVODA

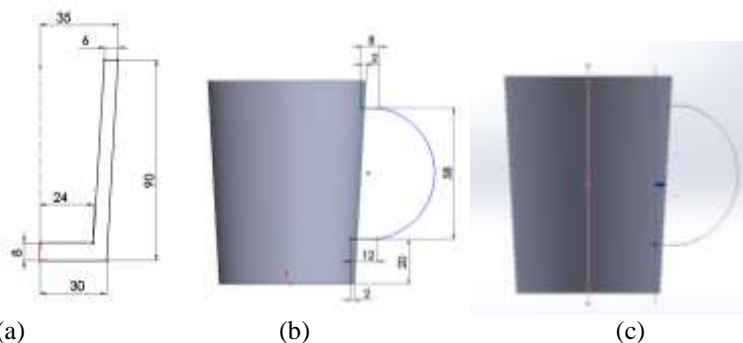
U postupku razvoja proizvoda, jedan od koraka je izrada modela proizvoda kako bi softverskim analizama verifikovali digitalni 3D model proizvoda i obezbedili da izrada fizičkog modela proizvoda bude sveobuhvatno sagledana u svim aspektima pre početka procesa proizvodnje.

Prvi korak u izradi 3D modela proizvoda je analiza samog proizvoda. Proizvod – šolja se sastoji od cilindričnog dela i drške (Slika 3). Prilikom kreiranja 3D modela proizvoda u softverskom paketu SolidWorks, cilindrični deo i drška se mogu smatrati tehnološkim celinama (engl. features) koje treba modelirati kroz različite operacije.



Slika 3. 3D model proizvoda - šolja

Cilindrični deo proizvoda je kreiran rotacijom prethodno dimenzionisane konture oko centralne ose simetrije (Slika 4 (a)). Sa druge strane, za kreiranje drške proizvoda, potreban je profil drške i putanja po kojoj će se profil kretati, kako bi formirao njen konačni izgled. Važno je napomenuti da se tokom kreiranja putanje po kojoj će se vršiti prebrisavanje prostora (engl. sweep), veoma važno postaviti da se referentna geometrija putanje i ivice šolje poklapaju (Slika 4 (b)), a tokom kreiranja profila putanje, važno je postaviti odgovarajuću referentnu ravan koja će obezbediti da se profil drške objedini sa postojećim cilindričnim delom (Slika 4 (c)). Naravno, bilo je potrebno dodati zaobljenja na određenim mestima, kako bi 3D model proizvoda bio kompletan.



Slika 4. Pojedine faze kreiranja 3D modela proizvoda – šolje: (a) kreiranje i dimenzionisanje konture; (b) kreiranje putanje za prebrisavanje, (c) postavljanje referentne ravni za profil drške

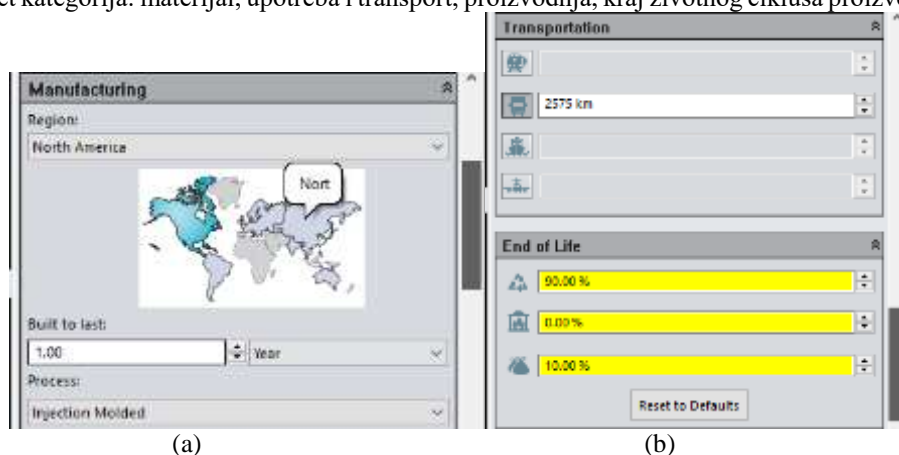
4. PRIMENA SOFTVERSKIH ALATA U RAZVOJU EKOLOŠKI PRIHVATLJIVOG PROIZVODA NA 3D MODELU PROIZVODA

U procesu razvoja ekološki prihvatljivog proizvoda, treba obratiti posebnu pažnju na uticaj tog proizvoda na životnu sredinu. Kroz analizu životnog ciklusa proizvoda može se videti

šta se dešava u procesu proizvodnje, upotrebe i na kraju životnog ciklusa proizvoda. Analiza održivosti u softverskom paketu SolidWorks je zasnovana na 3D modelu proizvoda. Pravilan izbor materijala ima značajan uticaj na njegov životni ciklus, te je to i prvi parametar koji se podešava. Materijali u softverskom paketu SolidWorks su podeljeni na odgovarajući način i to prema oznakama u odgovarajućim standardima, a zatim i prema grupama – čelici, različite legure, plastike, nemetali, itd. U okviru svake grupe, postoje određene vrste materijala, pa se prema potrebi mogu i odabrati. Odabirom određenog materijala, mogu se videti njegove karakteristike, npr. termička provodljivost, Poasonov koefijent, itd.

Tokom podešavanja materijala proizvoda, odabran je materijal plastika i to PET, pri čemu nema recikliranog udela (Slika 5). Zatim, izabran je region proizvodnje i upotrebe (Severna Amerika), transport gotovog dela drumskim saobraćajem, tehnologija proizvodnje (livenje plastike), potrošnja električne energije, prirodnog gasa i procenat škarta, i kako se tretira proizvod nakon završetka životnog ciklusa (90% se reciklira, 0% se spaljuje, 10% se deponuje). Pored toga, moguće je i izabrati postupak bojenja – na bazi vode, rastvarača ili praha, ali u ovom slučaju je izabran postupak bez bojenja.

S obzirom da svaki proizvod ima određeni uticaj na životnu sredinu, primenom ovog alata je moguće analizirati uticaj proizvoda na životnu sredinu po broju godina, meseci, dana ili sati upotrebe proizvoda i to kroz ugljenični otisak, potrošnju energije iz neobnovljivih izvora u megadžulima (MJ), uticaj na zagađenje vazduha (obično se meri u jedinicama kg ekvivalent sumpor-dioksida (SO_2) ili molova H^+), uticaj na zagađenje vode (obično se meri u jedinicama kg ekvivalent fosfatu (PO_4) ili kg ekvivalent azotu (N)), i to u okviru pet kategorija: materijal, upotreba i transport, proizvodnja, kraj životnog ciklusa proizvoda



Slika 5. Podešavanje parametara za analizu održivosti: (a) region proizvodnje i upotrebe i tehnologija izrade; (b) vrsta transporta i tretiranje nakon završetka životnog ciklusa proizvoda

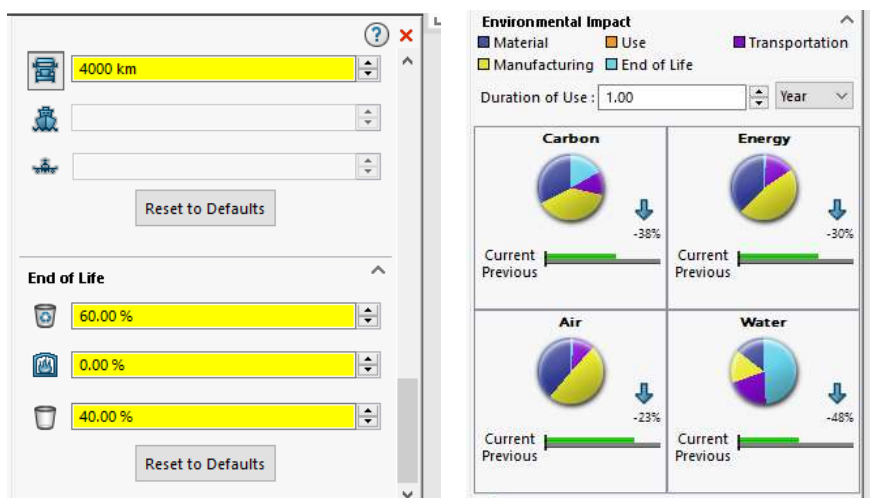
U slučaju ovog proizvoda – šolje od materijala PET, sa napred navedenim parametrima, raspodela uticaja na životnu sredinu, u okviru navedenih kategorija je prikazana na slici 6. Vrednost udela materijala u ugljeničnom otisku, procesa proizvodnje u potrošnji energije, transporta u zagađenju vazduha i kraja životnog ciklusa proizvoda u zagađenju vode su prikazane na slici 5. Sve ove kategorije imaju manje ili više udela u svim uticajima.

Kroz novu analizu održivosti, izabrana je vrsta materijala Other Non-Metals a zatim Glass, odnosno staklo. Može se primetiti da je sada sadržaj recikliranog materijala u sirovini 20%.



Slika 6. Uticaj na životnu sredinu, udeo materijala, procesa proizvodnje, transporta i kraja životnog ciklusa

Tokom dalje analize, izvršene su izmene odnosa tretiranja proizvoda nakon kraja njegovog životnog ciklusa, odnosno 60% procenata se reciklira a 40% se odlaže na deponiju, kao i povećanje distance za transport na 4000 km, što je rezultiralo promenom svih pokazatelja uticaja na životnu sredinu. Takođe, tokom promene materijala proizvoda, odnosno odabirom keramike, može se primetiti da nema recikliranog materijala u sirovini. Analizom rezultata, vidimo da je uticaj materijala relativno značajan na ugljenični otisak, potrošnju energije i zagađenje vazduha (Slika 7).



(a)

(b)

Slika 7. (a) Izmena parametara analize, (b) Uticaj na životnu sredinu sa udelima nakon izmene materijala

7. ZAKLJUČAK

Savremeni razvoj proizvoda zasniva se na snažnim softverskim alatima unutar informaciono komunikativnih platformi i informacionih sistema kompanija. Udaljeni pristup projektu i rad na različitim lokacijama dobio je još više na značaju tokom pandemije korona virusa. Proizvodnja u oblaku fizičkih proizvoda bila je do skoro nezamisliva a sada je važan segment u Industriji 4.0.

U ovom radu prikazan je primer savremenog razvoja proizvoda upotrebom digitalnih alata poput softverskog paketa SolidWorks u kome je osmišljen i dizajniran proizvod, a zatim kroz analizu održivosti i proverena njegova ekološka pogodnost. Upravo su strategije ekodizajna doprinele kreiranju modula održivog dizajna proizvoda.

Prikazane analize ukazuju da nam softverski alati obezbeđuju jasan okvir u procesu donošenja odluka dajući nam kriterijume poput procene potrebne energije u životnom ciklusu proizvoda ili energije u nekoj od faza životnog ciklusa proizvoda poput faze proizvodnje. Takođe, selekcijom različitih materijala i proizvodnih tehnologija projektantu se ukazuje na ugljenični (ekološki) otisak proizvoda kao važne karakteristike za postizanje konkurentnosti na tržištu u sve strožim ekološkim aspektima poslovnih procesa.

Sama upotreba digitalnih veština doprinosi kvalitetnijem ostvarivanju ciljeva Zelene Agende i naglašava upotrebu zelenih tehnologija u Industriji 4.0 sa ciljem da se teži kreiranju proizvodnje koja ne stvara otpad niti zagađuje okolinu.

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CONTEMPORARY DEVELOPMENT OF AN ECOFRIENDLY PRODUCT

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ABSTRACT:

The main challenge in the development of modern products is the numerous demands of customers and the market, but also challenges caused by the energy crisis, limited use of resources, as well as the consequences of other pandemics caused by the Covid-19 virus. Contemporary production responds to these challenges by using digital tools and strategies in all phases of the product life cycle, while being guided by the principles of sustainable development. This paper will show the importance of the use of engineering tools in the product development process in order to obtain a competitive product on the market suitable not only from the aspect of technological and economic requirements, but also as an environmentally friendly product. In this way, the paper will point out the importance of digital transformation and the development of digital skills in achieving the goals of the green agenda, which are realized by applying smart production in Industry 4.0.

Keywords: *Product development, Ecodesign, Product life cycle analysis, Software tools.*

USE OF OIL RESIDUES FROM OILSEEDS PROCESSING IN FUNGAL PROTEOLYTIC ENZYMES PRODUCTION

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ABSTRACT:

*Cold-pressed oils from various oilseeds have become very popular at global food market lately, due to its high quality and beneficial effects on human health. Oilseeds are widely grown in Vojvodina Province and further processed by regional enterprises causing significant amounts of effluents with no adequate method for its utilization. Production of industrial microbial enzymes might be a promising solution for sustainable valorisation of these effluents. Advanced developments in detergent industry require greener technology and cost-effective production and one of potential alternatives is the utilization of microbial enzymes. Proteolytic enzymes have found a very significant role in detergent industry for cleaning purposes. The aim of this study was to examine the possibility of proteolytic enzymes production by cultivation of reference strain *Trichoderma reesei* QM 9414 and wild-type isolate of *Trichoderma* sp. on medium containing oil residue from sunflower, pumpkin seed and soybean processing. The success of the bioprocess was estimated based on the proteolytic activity of enzymes in crude enzyme preparations in the temperature conditions of detergent application, i.e. at 30 °C and 60 °C. According to the obtained results maximal proteolytic activity of enzymes at 30 °C was achieved when wild-type isolate *Trichoderma* sp. was cultivated in medium with oil residues from soybean processing and at 60 °C when wild-type isolate *Trichoderma* sp. was cultivated in medium containing oil residues from pumpkin seed processing. The results obtained in this study represent valuable information for future investigations related to the utilization of oil residue through the production of value-added products.*

Keywords: *biotechnological production, cold-pressed oil residue, fungal enzymes, proteolytic activity, Trichoderma*

1. INTRODUCTION

Modern nutrition trends favor the use of food that is minimally chemically processed and that is less detrimental to the environment. As a result, the usage of cold-pressed oils in the diet as a "healthier" variant of oil has recently expanded dramatically [1]. Oilseeds, such as soybean and sunflower, are grown in large quantities in the territory of Vojvodina Province [2] and mostly used for oil production. However, due to the previously

mentioned reasons, there is a strong tendency to develop processes for the production of cold-pressed oils from these oilseeds. New practice of certain number of small factories to produce such oils resulted in effluent generation. One of these effluents is oil residues which contain oil and solid compounds originating from plants. Considering the fact that oil residues from cold-pressed oils production are rich in organic matter, a promising solution for sustainable valorisation of these effluents might be a production of industrial microbial enzymes [3].

Although the exact composition of these effluents is unknown, it can be assumed that it primarily consists of lipid fractions and also contains all other substances found in oilseeds. Even though the amount of effluents generated by the production of cold-pressed oils from oilseeds in Vojvodina Province is small, the amount of raw materials in the media for the biotechnological production of enzymes is in a range of 5-10% [4].

Many molds have the ability to absorb large molecules because they can create enzymes that break down these molecules and are therefore widely used as productive microorganisms in the biotechnological production of enzymes. Most industrially important enzymes are produced by molds of the genera *Aspergillus*, *Penicillium*, *Rhizopus*, *Mucor* and *Trichoderma*, bacteria of the genus *Bacillus*, actinomycetes of the genus *Streptomyces* and yeasts of the genus *Saccharomyces* [5, 6]. The ability of *Trichoderma* strains to produce extracellular proteases has been known for a long time [7], therefore in this paper the possibility of protease production by cultivating *Trichoderma* strains on a medium containing residues from oilseed processing was investigated. Different strains of *Trichoderma* mold can produce different amounts of proteases with different proteolytic activities, therefore, for the purpose of comparison, 2 strains were used, one of which is a reference strain (*Trichoderma reesei* QM 9414), and the other is a wild-type isolate (*Trichoderma* sp.).

Certain enzymes are of great commercial importance and are used as biocatalysts in numerous processes at the industrial level. They have found applications in the food and beverage industry, textile industry, detergent industry, paper industry, waste management, leather processing, biofuel industry, biotechnology industry and pharmaceuticals, as well as in agriculture and medicine [8]. Major classes of enzymes in detergents include proteases, lipases, amylases, and cellulases. Proteases were the first to be used in this branch of industry and are the most common group of enzymes in detergents, which is why today they have the largest number of commercial forms on the market. Alkaline proteases in detergents break peptide bonds in stains of protein origin and hydrolyze proteins into soluble polypeptides and amino acids [8].

By using detergents in water at a high temperature with vigorous mixing, it is possible to remove most of the stains, the origin of which can be different (proteins, fats, starch). However, these conditions damage the laundry and shorten its lifespan, and the economic costs arising from heating the water and washing the laundry for a long time cannot be

ignored. The addition of enzymes to detergents enables the use of lower temperatures and shorter washing times with better stain removal results [9].

The aim of this study was to examine the possibility of proteolytic enzymes production by cultivation of reference strain *T. reesei* QM 9414 and wild-type isolate of *Trichoderma* sp. on medium containing oil residue from sunflower, pumpkin seed and soybean processing. The success of the bioprocess was estimated based on the proteolytic activity of enzymes in crude enzyme preparations in the temperature conditions of detergent application, i.e. at 30 °C and 60 °C.

2. MATERIALS AND METHODS

2.1. Producing microorganisms

The reference strain *T. reesei* QM 9414 and one *Trichoderma* strain isolated from the natural environment were used as the producing microorganisms in these experiments. The strains were stored for a many years in the Microbial Culture Collection of the Faculty of Technology Novi Sad at 4 °C on agar slant (Sabouraud Maltose Agar ®, HiMedia, India) and subcultured every six months.

2.2. Cultivation media

The commercial semi-synthetic medium (Sabouraud Maltose Agar ®, HiMedia, India) was used in the initial stages of production. Enzyme production was performed on medium containing oil residue obtained from local oilseeds processing factories. Oil residue from sunflower, pumpkin seed and soybean processing were investigated as sources of this nutrient and used in a quantity of 15 g/L. The cultivation media also contained (NH₄)₂SO₄ and K₂HPO₄ in quantity of 5 g/L and 2 g/L, respectively. The pH value of used media was adjusted to 4.5±0.2 and then sterilized by autoclaving (121 °C, 2.1 bar, 20 min).

2.3. Inoculum preparation

Producing microorganisms were subcultured on agar slant and incubated at 28-30 °C until intensive sporulation. Further, inoculum preparation procedure has included suspending of spores of producing microorganisms in sterile physiological saline in order to obtain suspension with concentration in a range of 10⁶ spores/mL. Inoculation was performed by adding 10% (v/v) of inoculum, prepared as previously described, in cultivation medium.

2.4. Enzyme production

The enzyme production was carried out in 100 mL Erlenmeyer flasks with 30 mL of the cultivation medium with the appropriate composition. The biosynthesis was performed by submerged cultivation technique under aerobic conditions at 28-30 °C and 150 rpm

(Laboratory shaker KS 4000i control, Ika® Werke, Germany) for 168 h. At the end of biosynthesis, the solid and liquid phases of cultivation medium were separated by filtration through qualitative filter paper. The obtained filtrates were used for further analysis as crude enzyme preparations.

2.6. Protease activity assay

Protease activity of crude enzyme preparations was determined according to modified Hagihara method [8] where 1% solution of casein in a 0.05 M phosphate buffer with pH value of 7.5 was used as a substrate. Casein solution and crude enzyme preparation (blank: distilled water) were mixed in a ratio of 5:1. After homogenization, hydrolysis was performed at temperatures of 30 °C and 60 °C for 10 min in thermostatic water bath. After hydrolysis, 0.1 M CCl₃COOH was added and the mixture was homogenized and left for 30 min at 30 °C in thermostatic water bath, and then centrifuged for 20 min at 10,000 rpm at a temperature of 30°C. Proteolytic activity of crude enzyme preparations was evaluated based on the content of amino acids, expressed through the content of tyrosine, in supernatants obtained after centrifugation, which was determined by a spectrophotometric method at 275 nm, compared to a blank test. The L-tyrosine albumin standard was used for the construction of the calibration curve [10, 11].

3. RESULTS AND DISCUSSION

In accordance with the defined aim of this research, the possibility of proteolytic enzymes production by cultivation of reference strain *T. reesei* QM 9414 and wild-type isolate of *Trichoderma* sp. on media containing oil residue from sunflower, pumpkin seed and soybean processing was examined. Taking into account the origin of applied oil residues it is most likely that the synthesis of lipolytic enzymes will occur on such media, however, in this study, the possibility of *Trichoderma* strains to synthesize certain amounts of proteolytic enzymes with satisfactory activity was examined. Bioprocess success in the applied experimental conditions was evaluated based on the activity of crude enzyme preparations according to casein. Determination of the activity of produced fungal proteases was carried out in the temperature conditions of detergent application, i.e. at 30 °C and 60 °C.

The obtained results of determining the proteolytic activity of the crude enzyme preparations, obtained by cultivation of reference strain *T. reesei* QM 9414 and wild-type isolate of *Trichoderma* sp. on medium containing oil residue from sunflower, pumpkin seed and soybean processing, after hydrolysis at temperatures of 30 °C and 60 °C are presented in Table 1. Their activity is expressed through the content of amino acids, i.e. through the content of tyrosine in the hydrolyzed samples.

Table 1. Proteolytic activity of crude enzyme preparations at 30°C and 60°C

Medium	Proteolytic activity of crude enzyme preparations after hydrolysis at 30 °C [mg/mL]	
	<i>Trichoderma reesei</i> QM 9414	<i>Trichoderma</i> sp.
Soybean	0.301	0.380
Sunflower	0.027	0.067
Pumpkin seed	0.029	0.032
Medium	Proteolytic activity of crude enzyme preparations after hydrolysis at 60 °C [mg/mL]	
	<i>Trichoderma reesei</i> QM 9414	<i>Trichoderma</i> sp.
Soybean	0.021	0.028
Sunflower	0.027	0.085
Pumpkin seed	0.029	0.105

The obtained results shown in Table 1 suggest that measurable values of enzymes activity indicate that the tested microorganisms have the ability to biosynthesize proteolytic enzymes. This is in agreement with findings from previous research where it is confirmed that *T. reesei* have the ability to produce proteolytic enzymes on various carbon sources [12]. According to the results presented in Table 1, the proteolytic activity of crude enzyme preparations obtained by cultivation of both producing strains on a medium containing oil residues from the soybean processing is higher when hydrolysis is performed at 30°C, and the proteolytic activity of crude enzyme preparations obtained by cultivation of *Trichoderma* sp. on the other two media is higher when hydrolysis is performed at 60 °C. As it can be seen from the results presented in Table 1, cultivation of reference strain *T. reesei* QM 9414 on medium containing oil residue from pumpkin seed and soybean processing results in production of enzymes with similar proteolytic activity at both temperatures. The main difference in the ability of applied producing strains to produce enzymes with different activity on the same medium may be due to metabolic diversity of applied *Trichoderma* strains [13]. Results from previous studies indicate that reference strain *T. reesei* QM 9414 has the ability to produce proteolytic enzymes on synthetic or semi-synthetic media of optimal composition [14-16], however, in this research, the possibility of production of proteolytic enzymes on natural media based on oil residues from the processing of oilseeds has been proven.

In order to conduct mutual comparison of the obtained results and to easier interpret results, experimental data were relativized. The obtained results were relativized by assigning the largest obtained value to be maximally successful (100%) while the other values were expressed in a proportion of the maximum. Graphic representation of the

relativized values of the proteolytic activity of crude enzyme preparations after hydrolysis at 30 °C and at 60 °C is given in Figure 1 and Figure 2, respectively. The same enzymes can exhibit different activities at different temperatures [17], and taking this into account, the activities of proteolytic enzymes of crude enzyme preparations are shown through two graphs, one for each hydrolysis temperature.

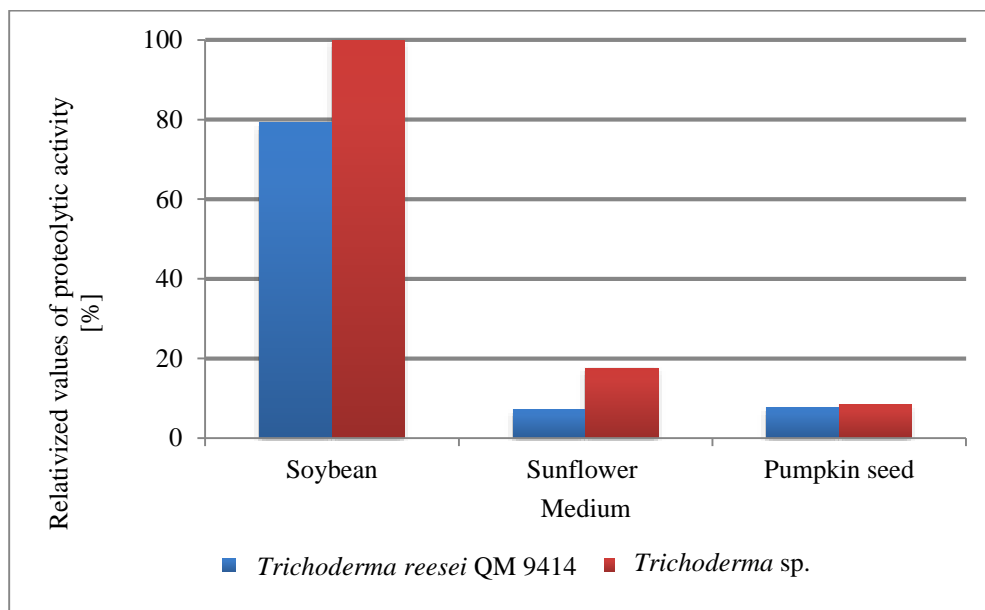


Figure 1. Relativized values of the proteolytic activity of crude enzyme preparations at 30 °C

As it can be seen in Figure 1, the crude enzyme preparation obtained by cultivation of the *Trichoderma* sp. strain on medium containing oil residues from soybean processing exhibited the highest proteolytic activity after hydrolysis at 30 °C. The main reason for this may be due to the fact that soybeans have the highest protein content of all oilseeds [18, 19] and due to the fact that the temperature optimum for the growth and development of the largest number of species from the genus *Trichoderma* is in the range of 27-30 °C [20]. In relation to this value, the other values were relativized and it can be noticed that after the hydrolysis at 30 °C, proteolytic activity of crude enzyme preparations obtained by cultivation of both strains on a medium containing oil residues from soybean processing is significantly higher comparing to the proteolytic activity of crude enzyme preparations obtained by cultivation of both of the strains on other two media. However, the obtained

results indicate that *Trichoderma* sp. strain proved to be more suitable for production of enzymes with higher proteolytic activity for all the used media in the applied experimental conditions and after hydrolysis at 30 °C.

Relativized values of the proteolytic activity of crude enzyme preparations obtained by cultivation of reference strain *T. reesei* QM 9414 and wild-type isolate of *Trichoderma* sp. on medium containing oil residue from sunflower, pumpkin seed and soybean processing, producing strains after hydrolysis at 60 °C are presented in Figure 2.

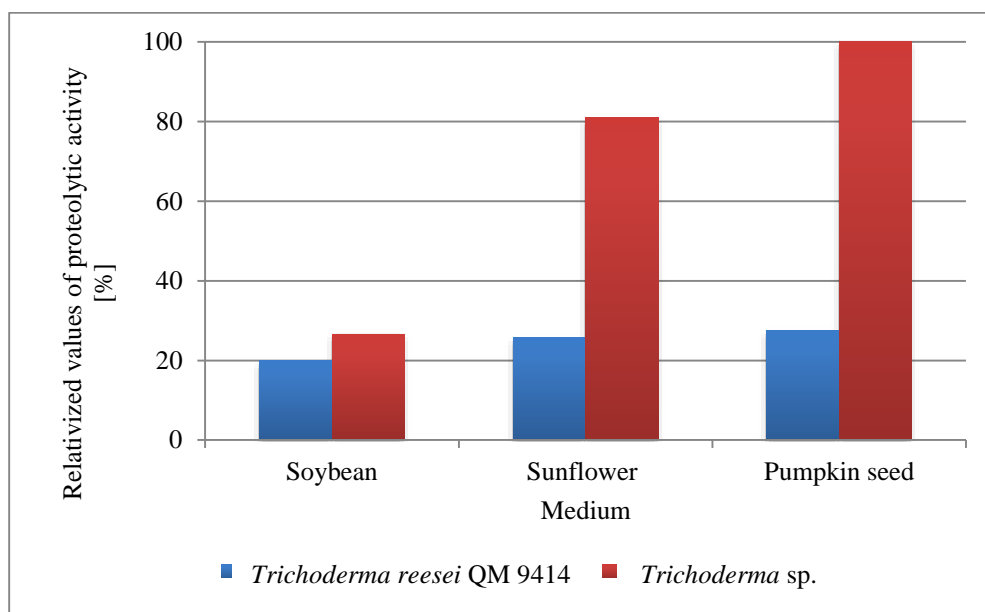


Figure 2. Relativized values of the proteolytic activity of crude enzyme preparations at 60 °C

Observing the results presented in Figure 2 it can be noticed that under the hydrolysis conditions of 60 °C, higher proteolytic activity was exhibited within the crude enzyme preparation obtained by cultivation of the strain *Trichoderma* sp. comparing to the reference strain *T. reesei* QM 9414 for all three medium used. Also, it can be noted that during hydrolysis at 60 °C the proteolytic enzymes of the reference strain *T. reesei* QM 9414 reach maximum relativized values of activity of around 20%, regardless of medium which was used for cultivation. This is probably due the fact that the species from the genus *Trichoderma* isolated from natural environment usually compete with pathogens for

nutrients, ecological niches or infection sites on plant roots, easier adapt to the non-standard content of the media, so they have the ability to grow and metabolize different carbon sources in extreme conditions [21].

The highest proteolytic activity was exhibited within the crude enzyme preparation obtained by cultivation of the strain *Trichoderma* sp. on the medium containing oil residues from the processing of pumpkin seeds and in relation to this value, the other values of the proteolytic activity of crude enzyme preparations were relativized. It can be noticed that the lowest proteolytic activity was exhibited within the crude enzyme preparation obtained by cultivation of the both producing strains on the medium containing oil residues from the processing of soybean. Despite the fact that the highest proteolytic activity at 30 °C was exhibited within the crude enzyme preparation obtained by cultivation of the producing strain on the medium containing oil residues from the processing of soybean, at 60 °C this activity was the lowest. This indicates that temperature of 60 °C have negative effect not only the producing strain but substrate e. i. oil residue from soybean processing too.

By analyzing all the results given above it can be concluded that strain *Trichoderma* sp. isolated from natural environment have a great potential for production of enzymes with proteolytic activity in the temperature conditions of detergent application, i.e. at 30 °C and 60 °C. On the other side, in this study it is confirmed for the first time ever that *Trichoderma* species possess ability to produce enzymes with proteolytic activity on medium containing oil residue from sunflower, pumpkin seed and soybean processing. Despite the fact that some of experiments in this research resulted in production of enzymes with poor proteolytic activity, the obtained results are important for purpose of minimizing the negative impact of effluents from oilseeds processing on the environment. Future research related to fungal enzymes production on oil residues from oilseed processing should encompass optimization of bioprocess conditions, as well as screening of different producing strains and residues from processing of other substrates.

4. CONCLUSIONS

In accordance with the defined aim, in this study the possibility of proteolytic enzymes production by cultivation of reference strain *T. reesei* QM 9414 and wild-type isolate of *Trichoderma* sp. on medium containing oil residue from sunflower, pumpkin seed and soybean processing was examined. The results of this study have confirmed that the production of fungal proteolytic enzymes may be suitable solution for the usage of oil residues generated in the production of cold-pressed oils.

The results of this study have a great importance from an ecological point of view, considering the fact that the biotechnological production of enzymes with proteolytic

activity on cultivation medium containing oil residue from sunflower, pumpkin seed and soybean processing represents a promising solution for sustainable valorization of this effluent. Moreover, the results obtained in this study represent valuable information that can be used in future investigation research related to the optimization of bioprocess in the term of increasing the bioprocess success and estimation of possible application of obtained enzymes.

5. ACKNOWLEDGEMENT

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SAVREMENE ZAŠTITNE KOMPONENTE I METODE ISPITIVANJA NISKONAPONSKIH ELEKTRIČNIH INSTALACIJA KAO PREVENTIVNA ZAŠTITA OD POŽARA

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SAŽETAK:

U radu su objašnjeni kvarovi na niskonaponskim električnim instalacijama koji najčešće izazivaju požare u građevinskim objektima. U zavisnosti od stepena opasnosti da izazovu požar, odnosno tehničkih mogućnosti da se kvar detektuje pre nego što izazove požar, električni kvarovi su razvrstani u kategorije. Za najopasnije kvarove, loš električni kontakt i redni električni luk, dat je pregled savremenih metoda i zaštitnih komponenti koje se danas mogu naći na tržištu. Ukratko je objašnjen i princip njihovog rada. Kritički su analizirani važeći evropski standardi o verifikaciji kvaliteta niskonaponskih električnih instalacija u pogledu njihove primene sa aspekta zaštite od požara. Predstavljene su dve savremene metode za preventivno otkrivanje loših električnih kontakata – termovizijsko snimanje razvodnih ormara i nedavno razvijena nova metoda zasnovana na električnim merenjima uz pomoću standardnog testera instalacija.

Ključne reči: niskonaponske električne instalacije, detektor električnog luka, termovizija, loš električni kontakt, tester instalacija

1. UVOD

Usled lošeg izbora, nepropisne ugradnje, bahatog korišćenja ili neadekvatnog održavanja niskonaponskih električnih instalacija javiće se kvarovi koji lako mogu da budu uzročnici požara u građevinskim objektima. Koliko je važno da se redukuju takvi požari pokazuju statistički podaci da npr. u Sjedinjenim Američkim Državama (SAD), gde se zaštititi od požara posvećuje velika pažnja, električni kvarovi na instalacijama i prijemnicima električne energije izazovu prosečno godišnje 46700 registrovanih požara u domaćinstvima, prosečno pogine 390 građana i da prosečna materijalna šteta nastala u tim požarima prevazilazi milijardu i po dolara [1]. U period 2010–2020. godine statistički podaci za Evropsku uniju pokazuju da su kvarovi na električnim instalacijama uzrokovali 25–30% ukupnog broja požara, i da se u tom periodu broj požara uzrokovanih kvarovima na električnim instalacijama povećao za 5–10% [2]. U Velikoj Britaniji statistički podaci za 2020. i 2021. godinu pokazuju da je ukupno 14% svih požara u porodičnim kućama i stanovima nastalo na električnoj instalaciji, prijemnicima električne energije i sistemima za osvetljenje [3]. Uprava za analitiku Ministarstva unutrašnjih poslova Republike Srbije, Sektora za vanredne situacije, saopštila je da požari na električnim instalacijama učestvuju

prosečno sa oko 25% u ukupnom broju požara u Republici Srbiji. Zanimljiv je podatak da je 2004. godine u Srbiji bilo 1,37 požara na 1000 stanovnika, a da je taj broj neprekidno rastao do 4,4 požara na 1000 stanovnika 2011. godine [4]. U radu su prvo predstavljeni najčešći kvarovi na električnim instalacijama koje prema opasnosti da uzrokuju požar mogu da se razvrstaju u kategorije. Za najopasnije kvarove predstaviće se odgovarajuće savremene zaštitne komponente koje mogu preventivno da štite od požara, kao i tehničke metode čijom primenom tokom periodične verifikacije električnih instalacija mogu da se otkriju potencijalno opasne situacije. Na kraju rada rezimirano je koje sve nedostatke u pravnoj tehničkoj regulativi treba otkloniti da bi se nivo zaštite od požara podigao na viši nivo.

2. PREGLED I KLASIFIKACIJA ELEKTRIČNIH KVAROVA

Tokom korišćenja niskonaponskih električnih instalacija javljaju se kvarovi i neregularne situacije u kojima bi zaštitne električne komponente instalirane u razvodnim ormanima i tablama trebalo na vreme da reaguju i spreče dalje trajanje kvarova koji neretko vode ka požaru. U tabeli 1 dat je pregled vrsta kvarova na niskonaponskim električnim instalacijama i zaštitnih komponenti koje mogu da ih detektuju.

Tabela 1. Pregled vrsta kvarova i zaštitnih komponenti koje mogu da ih detektuju

Redni broj	Vrsta kvara u niskonaponskim električnim instalacijama	Mogućnost detekcije kvara	Kategorija kvara
1	Kratak spoj – metalni (faza-faza, faza-neutralni provodnik)	Automatski prekidač, topljivi umetak, AFDD* (AFCI**)	I
2	Kratak spoj – metalni ili preko stabilnog paralelnog električnog luka (faza-izloženi elektroprovodni deo kućišta prijemnika)	Automatski prekidač, topljivi umetak, AFDD (AFCI), RCD*** (GFCI****)	
3	Preopterećenje strujnog kola	Automatski prekidač, topljivi umetak, AFDD	
4	Kratak spoj – preko paralelnog intermitentnog električnog luka (faza-faza, faza-neutralni provodnik)	Automatski prekidač, topljivi umetak, AFDD (AFCI)	II
5	Kratak spoj – preko paralelnog intermitentnog električnog luka (faza-elektroprovodni deo kućišta prijemnika)	Automatski prekidač, topljivi umetak, AFDD (AFCI), RCD (GFCI)	

6	Zemljospoj preko struje curenja (faza-strani elektroprovodni delovi)	AFDD (AFCI), RCD(GFCI)	
7	Redni električni luk – stabilan (fazni i/ili neutralni provodnik)	AFDD (AFCI)	III
8	Redni električni luk – intermitentan (fazni i/ili neutralni provodnik)	AFDD (AFCI)	
9	Loš električni kontakt	NEMA DETEKCIJE	

* Arc Fault Detection Device, ** Arc Fault Circuit Interruption, *** Residual current device, **** Ground fault circuit interrupter

Kao što se vidi u tabeli 1 kvarovi su razvrstani u tri kategorije sa aspekta opasnosti da izazovu požar: u I kategoriji su kvarovi kao što su preopterećenje i kratak spoj (metalni) kada klasične zaštitne električne komponente (automatski prekidači i topljivi umeci) na vreme reaguju i prekidaju napajanje strujnog kola, u II kategoriji su kvarovi kao što su kratki spojevi preko prekidnog (intermitentnog) paralelnog električnog luka i struje zemljospoja kada se ne može sa sigurnošću tvrditi da li će zaštitna komponenta na vreme odreagovati (automatski prekidač, topljivi umetak ili zaštitni uređaj diferencijalne struje – RCD) jer će to pre svega zavisiti od osetljivosti zaštitne komponente, i III kategorija su najopasniji kvarovi – loš električni kontakt i posledično izazvan redni električni luk (stabilan i prekidni – intermitentan). Trenutno u svetu postoje savremene zaštitne komponente AFCI prekidač (za američko tržište) i AFDD prekidač (za evropsko tržište) koje pružaju pouzdanu zaštitu od rednog električnog luka. Treba istaći da ne postoji zaštitna elektroinstalaciona komponenta koja može da pruži zaštitu od lošeg električnog kontakta.

3. SAVREMENE ZAŠTITNE KOMPONENTE (AFDD I AFCI)

Jasno je da kvarovi iz treće kategorije predstavljaju najveću opasnost od izbijanja požara na niskonaponskim električnim instalacijama, jer klasične zaštitne komponente nisu osetljive na te kvarove. Upravo zbog toga poslednje dve decenije radilo se na razvoju specijalizovanih zaštitnih komponenti koje uz pomoć takozvane „pametne“ elektronike mogu da detektuju kvar kao što je redni električni luk. Ukoliko na bilo kojoj elektroinstalacionoj komponenti (prekidač, šuko utičnica, automatski prekidač, redne kleme, sabirnice itd.) dođe do pojave labave veze između stezaljke komponente i bakarnog provodnika prvo će se uspostaviti loš električni kontakt čija temperatura može da pređe vrednost od 1000 °C. Posle određenog vremena labav električni kontakt preraste u progresivni kvar koji je još opasniji – redni električni luk, kada temperatura na mestu lošeg električnog kontakta prelazi 5000 °C [5]. Princip rada savremenih zaštitnih komponenti za detektovanje rednog električnog luka zasniva se na spektralnoj analizi talasnog oblika struje u strujnom kolu u kome se pojavio redni električni luk [6,7]. Izgled savremene

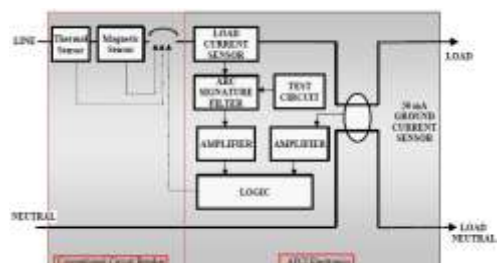
zaštitne komponente namenjene za otkrivanje rednog električnog luka za američko i evropsko tržište je prikazan na slici 1.



Slika 1. AFI prekidač (američko tržište) i AFDD prekidač (evropsko tržište)

3.1. AFI prekidač

Razvoj AFI prekidača je počeo posle velikog broja katastrofalnih požara na avionima kada je veštačenjem dokazano da su se avioni srušili usled požara na električnim instalacijama koje je izazvao redni električni luk. Na slici 2 je prikazana principijelna šema delovanja savremenog AFI prekidača.



Slika 2. AFI prekidač – princip rada [8]

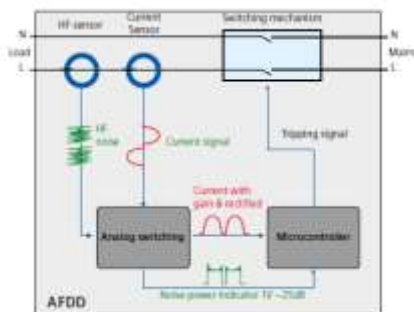
U jednom AFI prekidaču su u principu instalirana dva funkcionalna dela, jedan je standardni automatski prekidač sa funkcijom zaštite od preopterećenja (bimetal) i kratkog spoja (prekostrujno rele), a drugi je tzv. sklop pametne elektronike koji služi da prepozna manifestacije neželjenog rednog električnog luka u talasnom obliku struje. AFI prekidač prepoznaje opasan redni električni luk posledično nastao na lošem električnom kontaktu, u slučaju njegove pojave, isključuje napojni napon strujnog kola. Kako bi se sprečilo lažno reagovanje, AFI prekidač može da prepozna električni luk nastao u normalnom režimu rada električnih komponenti i uređaja (prekidača, lučnih upaljača, komutatorskih motora,

itd.), kao i struju pojedinih uređaja koja je po svom talasnom obliku slična struji rednog električnog luka (npr. struja mikrotalasne peći, računara, kompakt fluo izvora ili LED panela). Od 1. januara 2008. godine novi tip AFCI prekidača (Combination Type AFCI koji omogućava i zaštitu strujnog kola od zemljospoja) mora da se ugradi u sva strujna kola novosagrađenih stambenih objekata u SAD-u kod kojih nominalna struja zaštitne komponente iznosi 15 A ili 20 A [9]. Poslednjih godina na američkom tržištu rasprostranjene su i elektroinstalacione komponente koje imaju ugrađenu AFCI komponentu kao što su produžni kablovi, utičnice, klima uređaji itd. [8]. Cena jedne ove zaštitne komponente na američkom tržištu kreće se u rasponu 30–50 \$ u zavisnosti od tipa, nazivne struje i marke proizvođača (najpoznatiji proizvođači za američko tržište su firme Cutler Hammer, Square D, Siemens...) [10].

3.2. AFDD prekidač

Par godina posle uvođenja zakonske obaveze da se u SAD-u obavezno upotrebljavaju AFCI prekidači, prve verzije automatskog prekidača (AFDD) sa mogućnošću da mogu da detektuju redni električni luk pojavljuju se i na evropskom tržištu (prve komponente ovog tipa na tržištu nudi Siemens krajem 2010 godine). Na slici 3 je prikazana principijelna šema delovanja savremenog AFDD prekidača.

AFDD jedinica je mehanički povezana sa prekidačkim mehanizmom jednopolnog ili dvopolnog automatskog prekidača, čijim se reagovanjem strujno kolo u kome se pojavio redni električni luk ostavlja bez napajanja. Posle reagovanja automatskog prekidača, na prednjoj strani kućišta AFDD jedinice treperi žuta LED diodica. Pomoću odgovarajućih senzora dobija se informacija o strujnom signalu i visokofrekventnom šumu koji analogna elektronika priprema za obradu u mikrokontroleru, a koji pomoću odgovarajućih algoritama (spektralna analiza harmonika signala na niskim i visokim frekvencijama) prepoznaje karakteristike koje su svojstvene pojavljivanju rednog električnog luka. AFDD jedinica skeniranjem šuma u opsegu 22–24 MHz vrši proveru kao potvrdu za pojavu rednog električnog luka (karakteristika struje rednog električnog luka je da ima visokofrekventni šum u opsegu 22–24 MHz) [11]. Poslednjih godina se na tržištu pojavila tehnički savremenija komponenta koja u jednom telu prekidača sadrži i AFDD jedinicu i izvršni deo - automatski prekidač. Na ovo rešenje se prelazi zbog uštede prostora u razvodnim ormanima i tablama. Cena ove zaštitne savremene komponente na evropskom tržištu se kreće u opsegu 100–150 € [12] u zavisnosti od tipa, nazivne struje i marke proizvođača (najpoznatiji proizvođači za evropsko tržište su firme Siemens, Shrack, Eaton-Moeller...).



Slika 3. AFDD prekidač – princip rada [11]

4. VERIFIKACIJA KVALITETA NISKONAPONSKIH ELEKTRIČNIH INSTALACIJA

Početne i periodične verifikacije kvaliteta niskonaponskih električnih instalacija u Republici Srbiji predviđene su standardom Električne instalacije niskog napona, Deo 6: Verifikacija (SRPS HD 60364-6, 2012) i Pravilnikom o tehničkim normativima za električne instalacije niskog napona (Službeni list SFRJ, br. 53/88, 54/88, 28/95). Početna verifikacija kvaliteta niskonaponskih električnih instalacija je obavezna radnja koja mora da se obavi kako bi građevinski objekat posle tehničke kontrole dobio upotrebnu dozvolu. Ona obuhvata sledeće aktivnosti: vizuelni pregled izvedenih električnih instalacija, proveru funkcionalnosti iste, kao i električna merenja kojima treba da se potvrdi efikasnost sistema isključenja napajanja u slučaju kvara (provera neprekidnosti zaštitnog provodnika i provodnika za izjednačenje potencijala, kao i merenje impedanse – otpornosti petlje kvara), merenje otpornosti električne izolacije provodnika kao i provera ispravnosti zaštitnog uređaja diferencijalne struje (provera funkcionalnosti RCD-a). Tokom vremena korišćenja niskonaponskih električnih instalacija neophodno je izvršiti periodičnu verifikaciju njihovog kvaliteta kako bi se proverilo da li postoje kvarovi i/ili neusklađenosti sa tehničkim propisima koji mogu da izazovu požar ili električni udar korisnika objekta. Ove provere se praktično ne razlikuju od onih koje se vrše prilikom početne verifikacije kvaliteta niskonaponskih električnih instalacija. Najveći problem predstavlja određivanje periodike kojom se vrši periodična verifikacija kvaliteta niskonaponskih električnih instalacija u zavisnosti od tipa i namene objekta. To nije definisano standardom Električne instalacije niskog napona, Deo 6: Verifikacija (SRPS HD 60364-6, 2012) koji se istovetan primenjuje i u velikoj većini evropskih zemalja. Ova periodika i uslovi koje moraju da ispunjavaju firme koje vrše verifikaciju kvaliteta niskonaponskih električnih instalacija trebalo bi da budu definisane Pravilnikom o tehničkim normativima za električne instalacije niskog napona što u Republici Srbiji nije urađeno jer je taj pravilnik prilično zastareo. Da bi se ostvarila zaštita od oštećenja objekta vatrom ili toplotom koja nastaje na mestima na kojima se pojavio kvar ili oštećenja na

električnim instalacijama moraju se definisati nove metode za otkrivanje loših električnih kontakata.

4.1. Termovizijska kontrola loših električnih kontakata

Vremenom na elektroinstalacionim komponentama dolazi do mikrovibracija, i/ili krunjenja sloja oksida, kao i do zaprljanja kontaktnih površina koji dovode do slabljenja kontakta između provodnika i priključnog elementa (papučiće, stezaljke ili kleme). Na oslabljenim kontaktima dolazi do pregrevanja, čime se formiraju tzv. vrela tačke. Ukoliko temperatura vrela tačke premaši vrednost trajno dozvoljene temperature električne izolacije provodnika, koja zavisi od tipa izolacije, počinje degradacije njenih izolacionih svojstava.

Termovizijska kontrola loših električnih kontakata je široko rasprostranjena metoda za otkrivanje vrela tačaka na lošim električnim kontaktima. Termovizija je neinvazivna i beskontaktna metoda za proveru da li postoje loši električni kontakti. Pre termoviziskog snimanja neophodno je da se električna instalacija maksimalno optereći (najbolje bi bilo nazivnom snagom opterećenja) najmanje pola sata pre ispitivanja kako bi se sve potencijalne vrela tačke aktivirale [13]. Nedostatak termoviziskog snimanja je što se mogu samo proveriti električni kontakti dostupni IC senzoru termovizijske kamere (ne mogu se detektovati loši električni kontakti u razvodnim kutijama, šuko utičnicama, prekidačima i drugi „sakriveni“ kontakti u strujnom kolu). Ukoliko se snimanje vrši sa većih udaljenosti i pod određenim uglom treba izvršiti korekciju dobijenih rezultata prema preporučenoj proceduri opisanoj u [14].

Za procenu stanja elektroinstalacionih komponenti na osnovu njihove radne temperature koriste se dva kriterijuma u svetu: ΔT kriterijum i kriterijum apsolutne temperature [15]. Prema prvom kriterijumu termografista donosi odluku o prioritetu otklanjanja nedostataka ako je porast temperature značajan u odnosu na temperaturu ambijenta ili je značajna razlika porasta temperature između dve iste električne komponente ako su pod sličnim električnim opterećenjem. U tabeli 3 je data tabela sa prioritetima za otklanjanje nedostataka detektovanih termovizijskim snimanjem.

Prema kriterijumu apsolutne temperature termografista proverava da li temperatura neke elektroinstalacione komponente ne prelazi maksimalno dozvoljenu temperaturu za tu vrstu električnih komponenti. Prema ANSI standardu [16] maksimalno dozvoljena temperatura se dobija kao zbir temperature ambijenta i dozvoljenog porasta temperature koji je u funkciji vrste elektroinstalacione komponente (Tabela 4).

Treba napomenuti da navedeni kriterijumi apsolutne temperature važe za električnu opremu (elektroinstalacione komponente) koja radi na unapred navedenoj temperaturi ambijenta i sa 100% nominalnog opterećenja. Međutim, ako se temperatura ambijenta razlikuje od napred navedene temperature ambijenta navedene u tabeli 4, i ako

elektroinstalaciona komponenta nije nominalno opterećena postoji formula preko koje se dobija korigovana maksimalna dozvoljena temperatura ($T_{maks. kor.}$) koja treba da se koristi kao granično dozvoljenu temperaturu [16].

Tabela 3. ΔT Kriterijum za procenu stanja električnih komponenti sistema [16]

Prioriteti za otklanjanje nedostataka	ΔT između iste vrste i tipa električnih komponenti pod sličnim opterećenjem	ΔT u odnosu na temperaturu ambijenta	Preporučena akcija
4	1–3°C	1–10°C	Nastaviti sa redovnom periodičnom kontrolom
3	4–10°C	11–20°C	Ukazuje na mogući nedostatak, ukoliko je moguće treba uočiti i otkloniti nedostatak – defekt
2	11–15°C	21–40°C	Obavezno nadgledanje dok se ne otkloni detektovani defekt
1	>15°C	>40°C	Upozoravajuće odstupanje, odmah otkloniti nedostatak (izvršiti popravku)

Tabela 4. Kriterijumi apsolutne temperature sa primerima električne opreme (i komponenti) [16]

Električna oprema (komponenta)	Ambijentalna temperatura ($T_{amb.}$)	Porast temperature ($T_{porast temp.}$)	Maksimalno dozvoljena temperatura (T_{maks})
PVC izolacija	30	45	75
Silikonska guma	30	95	125
Električni kontakt (bakar, legura bakra)	40	50	90
Automatski prekidač	40	30	70
Osigurači sa topljivim umetkom	40	30	70

Primer detektovanja vrela tačke termovizijskim snimanjem je prikazan na slici 4.



Slika 4. Pregrevanje kontakata na grebenastom prekidaču [15]

Važno je napomenuti, da kada se uoče elektroinstalacione komponente sa pregrejanim električnim kontaktima neophodna je intervencija električara koji može da pritegne olabavljene električne kontakte, ili ako to ne može da uradi jer zavrtanj proklizava zbog dotrajalosti, neophodno je što pre zameniti celu elektroinstalacionu komponentu. Dok se to ne uradi elektroinstalacionu komponentu treba isključiti sa napajanja.

Veliki nedostatak predstavlja činjenica da u zemljama Evropske unije (za razliku od SAD-a) ne postoji ni standard ni pravilnik prema kojem bi termovizijsko snimanje bila, ako ne obavezna, bar preporučena metoda za otkrivanje loših električnih kontakata.

4.2. Specijalna metoda otkrivanja loših električnih kontakata pomoću standardnog testera instalacija

Međunarodni pravilnici i standardi kojima su propisane periodične verifikacije kvaliteta električnih instalacija ne sadrže procedure pomoću kojih bi se u ranoj fazi detektovao loš električni kontakt (najčešći uzrok požara na instalacijama). Na Elektrotehničkom fakultetu u Beogradu zajedničkom analizom podataka dobijenih eksperimentalnim putem u laboratoriji i rezultata električnih merenja dobijenih na terenu razvijena je metoda za otkrivanje loših električnih kontakata u niskonaponskim instalacijama [17-19]. Ona je zasnovana na uspostavljanju veze između izmerenih vrednosti električne otpornosti petlje kvara i kratkog spoja (R_{SL-PE} , R_{SL-N} respektivno) univerzalnim testerom instalacija i povećanja električne otpornosti lošeg kontakta u strujnom kolu. Zaključeno je da se otpornost za najmanje $0,5 \Omega$ veća od najveće izmerene otpornosti R_{SL-PE} (R_{SL-N}) na susednim šuko utičnicama može preporučiti kao granična otpornost (R_{lim}) koja pokazuje da li u nekom strujnom kolu postoji loš električni kontakt. Primenom ove korigovane metode u okviru važeće procedure za verifikaciju kvaliteta električnih instalacija mogu se preduprediti mnogi požari na električnim instalacijama. Detektovani kvarovi i neregularnosti najčešće se mogu otkloniti jednostavnim intervencijama električara ili tehničkih službi korisnika objekta.

5. ZAKLJUČAK

Stari pravilnici kojima su regulisani tehnički normativi za niskonaponske električne instalacije kriju brojne nedostatke, a najviše u oblasti verifikacije sa stanovišta zaštite građevinskih objekata od požara. Najvažniji nedostaci tih pravilnika u Republici Srbiji na čijem otklanjanju u budućnosti bi trebalo raditi kako bi se smanjio broj požara na električnim instalacijama su:

- Nepostojanje adekvatne metode (procedure) za detektovanje loših električnih kontakata električnim merenjima (broj jedan uzročnik požara jer ne postoje elektroinstalacione zaštitne komponente koje mogu da ga detektuju)
- Potpuno odsustvo zahteva za izvođenjem termovizijskih pregleda, bar kao preporučene, ako ne obavezne, metode za otkrivanje loših električnih kontakata
- Nepostojanje zahteva za instaliranje uređaja za otkrivanje rednog električnog luka koji nastaje kao posledica neotklonjenog lošeg električnog kontakta (AFDD prekidač)
- Nije definisan maksimalan vremenski period između dve uzastopne verifikacije niskonaponskih električnih instalacija (najbolji primer su stambene zgrade, koje se posle početne verifikacije i dobijanja upotrebne dozvole praktično više i ne kontrolišu!)
- Nisu definisani kriterijumi koja pravna lica mogu da vrše verifikaciju niskonaponskih električnih instalacija (ne postoji obaveza da stručne nalaze za niskonaponske električne instalacije može da potpisuje samo diplomirani elektroinženjer elektrotehnike – energetičar, nosilac odgovarajuće licence Inženjerske komore) itd.

Unapređenjem regulative otklanjanjem svih njenih napred navedenih nedostataka značajno može da se doprinese prevenciji požara nastalih usled kvara na električnim instalacijama. Veoma je važno da se firmama koje vrše verifikaciju kvaliteta niskonaponskih električnih instalacija, kroz kratko uputstvo i primere, predstavi praktična primena nove metode za detekciju loših električnih kontakata razvijena na Elektrotehničkom fakultetu u Beogradu. Pretpostavlja se da će zbog jednostavnosti primene nova metoda uskoro početi široko da se primenjuje čime može efikasno da se smanji broj požara nastalih usled lošeg električnog kontakta. Cena termovizijskih kamera koje mogu efikasno da se upotrebe za otkrivanje loših električnih kontakata, kao i cene elektroinstalacionih komponenti koje pružaju kompletnu zaštitu od preopterećenja, kratkog spoja, zemljospoja, paralelnog i rednog električnog luka poslednjih godina postaju sve prihvatljivije za široku masovnu upotrebu. Ako se zakonski uvede zahtev za redovnom periodičnom verifikacijom kvaliteta niskonaponskih električnih instalacija za sve građevinske objekte, i ako stručne nalaze budu izrađivale kvalifikovane stručne i odgovorne sobe, broj požara uzrokovanih kvarovima na električnim instalacijama može se značajno smanjiti.

6. ZAHVALNICA

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CONTEMPORARY PROTECTIVE COMPONENTS AND METHODS OF TESTING LOW VOLTAGE ELECTRICAL INSTALLATIONS AS PREVENTIVE FIRE PROTECTION

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ABSTRACT:

The paper explains the failures of low-voltage electrical installations, which most often cause fires in buildings. Depending on the degree of danger of causing a fire, that is, on the technical possibilities to detect the fault before it causes a fire, electrical faults are classified into categories. For the most dangerous faults, poor electrical contact and series electric arc, an overview of contemporary protective components that can be found on the market today is given. The principle of their work is also briefly explained. The valid European standards on the verification of the quality of low-voltage electrical installations are critically analyzed in terms of their application from the aspect of fire protection. Two contemporary methods for preventive detection of poor electrical contacts will be presented – thermal imaging of distribution cabinets and a recently developed new method based on electrical measurements with the use of a standard installation tester.

Keywords: low-voltage electrical installations, electric arc detector, thermal imaging, poor electrical contact, installation tester

POSSIBILITIES OF CONSTRUCTION IMPROVEMENT OF THE COMBINED VALVE FOR DISTRICT HEATING SYSTEMS

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ABSTRACT:

The paper presents the construction and characteristics of the combined valve used in district heating systems, as well as a proposal of its construction improvement. In construction improvement of a combined valve, the task is to improve all the shortcomings and regulatory characteristics of that valve while maintaining the maximum declared flow for that valve. Special attention was paid to new parts and materials, sealing elements, regulatory features and valve housing during construction. Constructive improvements in the sealing of the combined valve enable the prevention of leakage on the seals, which will lead to an increase in operational safety and an extension of the service life of the valve. Monitoring the operation of the combined valve during exploitation should confirm the steps taken to design improvement.

Keywords: *construction improvement, combined valve, district heating systems*

1. INTRODUCTION

In district heating systems, the control valve has the role of releasing a certain amount of heat that is extracted from the district heating system by controlling the fluid flow through the heating substation, depending on the building's heat needs. Regulation of heat energy delivery is performed by sliding the temperature of water in the supply hot water network when the temperature of the outside air changes and the flow changes [1]. The sliding of the water temperature in the supply water of the hot water network is carried out in the heating plant. The flow is changed in the heat transfer station, and for this a combination valve is used as an executive element. Limiting the maximum flow is also done by a combined valve.

The advantage of using a combined valve in comparison to through-valves with an electric drive for temperature regulation and flow limitation are: reliable flow limitation provided by the differential pressure regulator and thus greater hydraulic stability of the hot water network; easier selection of valves. It is not necessary to know the exact pressure

difference for damping in the transmission station or for damping at the control valve; successful damping, without the appearance of cavitation in the valve, large pressure differences in the transmission station, 6 to 10 bar; for the same actual valve regulation ratio, the combined valve enables achieving significantly lower minimum flows and successful regulation of very low heat powers; the possibility of using the valve only for limiting the flow, until conditions are created for temperature regulation; and lower electrical power of electric motor drives of combined valves.

Disadvantages of using combined valves compared to valves with electric drive for temperature regulation and flow limitation are: more complex construction of combined valves and therefore greater possibility of malfunctions; and more expensive maintenance [2].

2. CONSTRUCTION OF THE COMBINED VALVE

The combined valve is used as an executive element in regulation circuits for temperature regulation in installations for district heating systems, cooling, air conditioning, preparation of domestic hot water, etc [3]. The combined valve presents the executive element in two regulatory circuits:

1. The regulation circuit for water temperature regulation in the supply line of the installation for district heating and flow limitation and
2. The regulating circuit for temperature regulation and flow limitation.

The combined valve consists of two control valves: a control valve with electric drive for temperature regulation and a differential pressure regulator for flow limitation, which are connected in series. Both control valves are placed in one housing and represent a whole combined valve presented on Figure 1 [4].

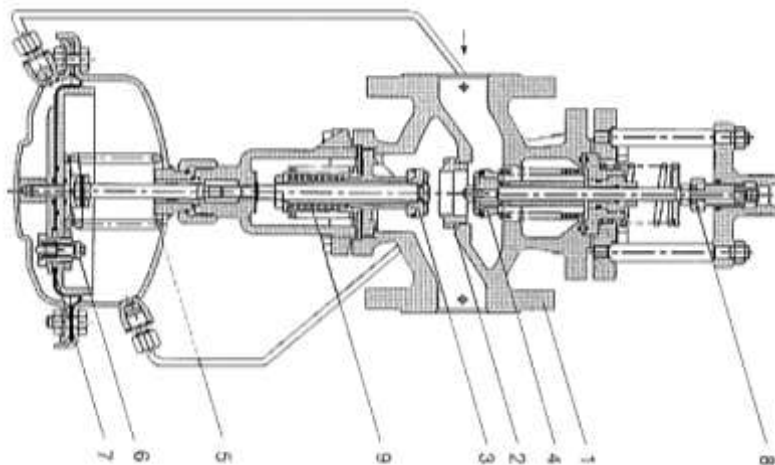


Fig. 1. Cross section of a combined valve: 1. Valve housing, 2. Valve seat, 3,4. Valve mushroom, 5. Actuator housing, 6. Overpressure protection, 7. Moving diaphragm, 8. Adjusting nut, 9. Balance spring

The combined valve consists of the basic elements shown in Figure 1. Their role is as follows: the valve body protects the internal components of the valve and has connection points at the inlet and outlet of the valve. Variants with flanged or threaded connections are available. The valve body extends equally on both sides of the valve centerline to form a cavity long enough to contain the valve seat with an opening equal to or approximately the inside diameter of the pipe to which the valve is connected. It can be made, depending on the purpose of the valve, from cast brass or cast iron. With the combined valve, depending on the nominal pressure, gray cast iron and nodular cast iron are used as casting material.

The valve pin allows axial movement of the valve mushroom. An electric valve drive is mounted on the shaft from the upper side, on a specially adapted holder, which transmits force to the shaft and ensures that axial movement. Depending on the direction of movement of the pin, the valve is brought to the open or closed position.

The valve plug is directly connected to the valve stem. It is also a moving part of the valve, designed to change the flow according to a certain law. With the valve seat, depending on the change in relative travel, it forms a certain surface through which the fluid flows. When changing the relative stroke, a certain regularity of the change in the surface of the fluid flow causes the same regularity of the change in the relative flow coefficient to occur. The most commonly used mathematical functions that change the relative flow coefficient are:

linear, quadratic and exponential. Certain regularities in the change of the surface for fluid flow are achieved by profiling the valve mushroom.

The valve seat is a cylindrical component, with a diameter equal to or close to the nominal diameter of the pipe on which the valve is mounted. The seat is mounted in the middle of the housing, and the valve mushroom approaches it. When the profile of the mushroom is completely in the seat, and the sealing ring of the mushroom rests on the surface, we consider that the valve is completely closed. The seat must support and seal the valve mushroom when the valve closes. Bad manufacturing or bad mounting of the seat can lead to incomplete seating when closing the valve or deviation of the surfaces from concentricity, and thus bad valve operation.

Sealing elements are elements that prevent leaking of fluids, creating a fluid-tight connection. In order to achieve zero leakage, the sealant must be elastic enough to change its shape to fill any unevenness on the contact surface, while remaining at the same time strong enough and resistant to possible extrusion in the tolerated gap between the surfaces under the total pressure of the sealing system. The quality of the processing of two adjoining surfaces, which are in relative motion with each other, significantly affects the friction, wear and life of the mechanical seal. It is necessary to know the characteristics of the materials used to make sealing parts, because the material affects how the seal will behave when working with certain fluids and at certain temperatures. Most of the sealants used are made of synthetic rubber. The main reason for this is the elasticity in their molecular shapes in the structure. The rubber also offers an extremely wide selection of different characteristics, depending on the different composition of the mixture.

3. POSSIBLE CONSTRUCTION IMPROVEMENT OF THE COMBINED VALVE

The working fluid that flow through the combined valve in district heating system is water. Water quality is defined according to VDI 2035 [5]. The purpose of this guideline is to avoid damage due to scale formation when heating water in heating systems. Factors that influence the formation of deposits are water quality, supplementing the system with an additional amount of water, wall temperatures on the surfaces where heat transfer takes place, and working conditions. As the temperature rises, so does the risk of deposits form.

With the existing construction of the combined valve, there are some problems with the valve operation in some areas where the valve is used. The most significant problems that occurred when using these valves were leakage on the upper part of the valve, and that after a short time of operation of the valve. Visible corrosion was observed on the upper assemblies, even on the brass parts. Deposits were also observed.

The results of the water testing used in the district heating system in the territory where the problems appeared showed that the water was of very poor quality: the water had

higher hardness, higher conductivity, and a significantly higher amount of chlorine and iron in the water, much higher than the set reference values. Good quality water should not contain such high levels of iron in the sample. The limit value is <0.1 mg/l. Such high concentrations of iron can lead to the deposition of deposits in the area between the gasket and the sealing surface, eventually leading to the deterioration of the gasket and leakage. In addition to the high iron values, the high hardness of the water also contributes to this.

Considering the appearance of corrosion and deposits on the parts that make up the upper valve assembly, an analysis was made of the materials that were used when making the parts that enter the combined valve assembly.

An analysis of the brass quality from which the parts of the assembly were made concluded that the used brass was of poor quality, which led to the occurrence of dezincification of brass, which is the selective removal of zinc from brass alloys, leaving a porous residue rich in metallic copper with poor mechanical strength. Dezincification can be prevented by appropriate material selection. It is recommended to use brass with at least 85% copper [6]. It is important to ensure a clean surface, by maintaining adequate flow and periodic cleaning of the surface. In addition, appropriate water treatment is required to prevent deposition of corrosion products, biological contamination or sludge that leads to surface damage. In order to solve this problem, brass CW602N, which is a standard alloy resistant to dezincification, was adopted as the material for making parts of the combined valve [6].

In construction improvement of a combined valve, the task is to eliminate defects with the regulatory characteristics of the valve and to maintain the maximum declared flow for that valve. Special attention in design improvement was paid to the sealing elements and the valve housing material and design.

Analysis of the cross-section of the upper assembly concluded that the brass part can only come into contact with water if its sealing elements are not functioning. For this reason, the arrangement of seals in the upper valve assembly has been improved. It is especially necessary to adopt seals that are declared for high temperatures, and at the same time for circulating hot water. The recommended material for making these seals is ethylene propylene monomer (EPDM) material intended for high temperatures. Additional sealing rings are made of Teflon (PTFE), which is a non-elastomeric material that has the function of a static and dynamic secondary seal (Figure 2). It is usually produced in such a way that it is allowed to stretch no more than 10% of the initial size of the outer diameter of the ring, which conditions the use of split rings for smaller diameters.

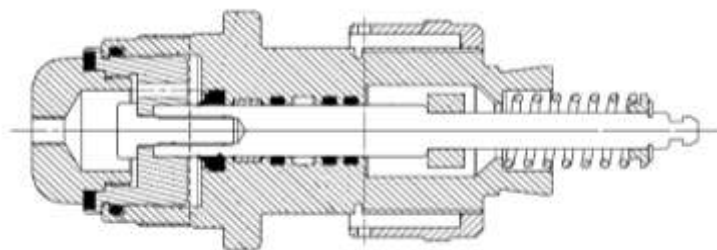


Fig. 2. Construction improvement of the upper combination valve assembly

The lower assembly of the combination valve is sensitive to the accumulation of impurities, which is why the valve can remain stuck in one position and lead to flow disturbances. For this reason, during the improvement, another wiper made of EPDM was added, as presented in Figure 3, so that there are two wipers in the differential pressure regulator, which, in addition to having the role of a seal, also clean the shaft in both directions while it moves axially [7].

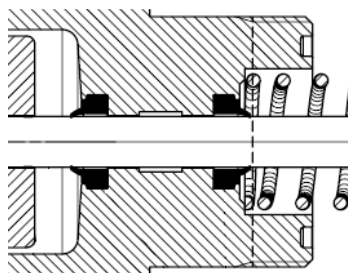


Fig. 3. Construction improvement of the lower assembly of the combined valve

3. CONCLUSION

Rapid, sudden and large changes in the regulating circuit for temperature regulation and flow limitation demand that temperature regulation equipment meet high technical requirements. That is why it is extremely important that designers of installations for the preparation of the regulating circuit for temperature regulation and flow limitation, when choosing regulation equipment, adhere to the requirements and recommendations of the manufacturers.

Constructional improvements in the sealing of the combination valve enable the prevention of leakage on the seals, which leads to an increase in operational safety and an increase in service life. Monitoring the operation of the combined valve during exploitation should confirm the steps taken to improve sealing.

Based on the obtained results, it can be concluded that the construction improvement of the combined valve has regulatory characteristics equal to and better than those declared and that its overall quality corresponds to valves of the same type from other world manufacturers.

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VINSKI TURIZAM NA PODRUČJU SJEVERNE HRVATSKE

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SAŽETAK:

U ovome radu istražuje se ponuda vinskog turizma na području sjeverne Hrvatske te zadovoljstvo potrošača ponudom. Vinsko tržište u svijetu je dobro razvijeno, a države koje se nalaze na samom vrhu proizvodnje ulažu velike napore kako bi održale svoje vodeće mjesto. Tradicionalno vinogradarstvo i autohtone sorte posebno su cijenjene, a tu posebnost i kvalitetu su mnogi turisti spremni dobro platiti, zbog čega se u posljednjih 20 godina sve više razvija vinski turizam. Tako se konzumacija vina spaja s gastronomijom, ugostiteljstvom, kulturom i prirodom nekog prostora te se na taj način stvara cjelovita turistička ponuda. Za potrebe rada provedeno je anketno istraživanje. Prikupljeni podaci obrađeni su metodama grafičke analize i deskriptivne statistike. U radu je postavljeno sljedeće istraživačko pitanje: Jesu li potrošači zadovoljni trenutnom ponudom vinskog turizma na području sjeverne Hrvatske?

Ključne riječi: vinski turizam, istraživanje, sjeverna Hrvatska

1. UVOD

Proizvodnja i konzumacija vina ima dugu povijest gotovo u svim dijelovima Svijeta, pa tako i na području Hrvatske. Iako ima brojnih autohtonih i zaštićenih vrsta, velik broj proizvođača te samodostatne zalihe vina, vinogradarstvo i vinarstvo u Hrvatskoj još uvijek teži razvoju i boljoj prepoznatljivosti na svjetskom tržištu. Vinogradarstvo i vinarstvo posebice je popularno i prisutno u Europi, no činjenica je da se broj vinogradarskih površina u Europi proteklih nekoliko godina postupno smanjuje. Veliku ulogu u tome igraju nepovoljni vremenski i ekonomski uvjeti te omjer cijene i kvalitete na tržištu koji nije uvijek vjerodostojan. Vinogradarstvo u Hrvatskoj prati nekoliko državnih institucija, a proces proizvodnje popraćen je zakonom i popratnim zakonskim aktima. Važnu ulogu ima i Vinogradarski registar u kojeg se moraju upisati svi proizvođači koji proizvode određene količine vina. Distribucija vina odvija se putem nekoliko kanala poput maloprodajnih dućana, restorana i hotela, prodaje na kućnom pragu, no najveći doživljaj i užitak pružaju brojne vinarije na području Hrvatske. U ovom radu vinarije i vinski turizam koji svoje temelje ima u ponudi vinarija glavni je predmet ovog rada. Vinski

turizam kao dio cjelovite ponude u turizmu posebno je važan u sjevernom dijelu Hrvatske u kojoj su smješteni neki od najpoznatijih vinogradara Hrvatske. Cilj ovog rada je istražiti ponudu vinskog turizma sjeverne Hrvatske te posebno zadovoljstvo potrošača ponudom. Provedeno je online anketno istraživanje koje je obuhvatilo 338 ispitanika. Formirane je sljedeće istraživačko pitanje:

- Jesu li potrošači zadovoljni trenutnom ponudom vinskog turizma na području sjeverne Hrvatske?

Prikupljeni podaci obraditi će se metodama deskriptivne statistike. Rad se sastoji od četiri poglavlja. Nakon uvoda slijedi teorijski okvir u kojem će se detaljnije prikazati značaj vinskog turizma u ukupnoj turističkoj ponudi. Rezultati istraživanja koje je provedeno za potrebe ovog rada prikazati će se u trećem poglavlju. Glavni zaključci rada biti će izloženi u četvrtom, zaključnom poglavlju.

2. VINSKI TURIZAM

Vinski turizam je oblik turizma koji primarno obuhvaća aktivnosti i atrakcije vezane uz vino. Većinom se ostvaruje u obliku posjeta vinogradima, vinarijama, festivalima i izložbama vina pri čemu se kao glavni motivi ističu kušanja vina i doživljavanja atributa regija vinove loze. Vinski turizam prvotno je nastao razvojem vinarske industrije kao reakcija na smanjenje konzumacije vina u svijetu. U sklopu turističkog aranžmana, vino i hrana mogu se iskoristiti kao predstavnici pojedine destinacije te diverzifikacije njezine ponude, što može imati efekt produljivanja turističke sezone, poticanje razvoja lokalne ekonomije te stvaranje posebnog doživljaja za turiste. [1]

Proizvodi vinskog turizma ne obuhvaćaju samo proizvode proizašle uzgojem vina, već i proizvode održivog vinogradarstva i eno gastronomskih usluga. Uspješnost pojedine vinske regije očituje se kroz oblik ponašanja kupca kojeg turističke destinacije koriste za razvoj lokalne zajednice te plasiranje lokalnih vina na tržište ili pojačani marketing za vinarije koje svoje proizvode prodaju neposredno kupcima. [1]

Spas brojnih vinogradarskih i vinskih gospodarstva može biti u poboljšavanju turističkih usluga kreiranjem vinskih cesta i ostalih sadržaja koji promoviraju vino. Kontinuitet proizvodnje i vjerodostojnost kakvoće vina proizlazi iz promoviranja određenog proizvođača, načina proizvodnje grožđa i vina te običaja i događaja vezanih uz proizvodnju vina. [2]

Aktivnosti vinskih turista mogu biti različite, od posjeta vinarijama i kušanja vina do edukacije o vinogradarstvu i vinarstvu. S obzirom da se posebni vinski doživljaj često postiže u kombinaciji s gastronomskim aktivnostima, vinski turizam oslanja na sva osjetila. Prije svega bitan je prizor ugodan oku, poput idiličnog ambijenta u vinogradu, tradicijske arhitekture, uređenih podruma, životopisnog pogleda, specifične boje vina i ostalih karakteristika koje opisuju prostor na kojem vino nastaje. Zatim dolazi zvuk kroz točenje vina, stvaranje ambijenta uz prikladnu glazbu i razgovor ili druženje. Prisutan je i dodir kroz razne aktivnosti poput diranja čaše, boce, bačve ili pak branja grožđa. Ono što

upotpunjuje doživljaj i kreira razliku između više destinacija su specifični okusi i mirisi vina, hrane i prostora općenito. [2]

Glavni motivi proizvođača u stvaranju vinskog turizma su: veći dohodak, veće prodajne cijene, veća zarada po satu rada, izravni susret s kupcima, manje kolebanje prodajnih cijena te veća uposlenost članova gospodarstva. Ono što kupci traže je svježina proizvoda, veća kakvoća proizvoda, posebnost seljačkih specijaliteta, obavijesti o proizvodnji i preradi, osobni kontakt s proizvođačem te međusobno povjerenje, preglednost proizvodnog postupka i kupovno ozračje. Vinski turizam najveću korist daje proizvođačima, zatim turističkom odredu i na poslijetku lokalnoj zajednici. [2]

U Hrvatskoj postoji više vinskih manifestacija koje se održavaju dugi niz godina. Gotovo svako naselje ima zasebne manje manifestacije poput brojnih blagdana koji su povezani s vinom poput Martinja i Vincekova, a tu su i sajmovi, izložbe vina i dani otvorenih podruma. Vinski festivali većinom se održavaju u sklopu neke vinarije ili kušaonice gdje se okuplja više vinarija iz tog područja kako bi približili svoje proizvode brojnim posjetiteljima. U organizaciji se često ističu razne udruge vinogradara i vinara, jedinice lokalne samouprave te turističke zajednice nekog područja. Iako postoji više vinskih manifestacija u Hrvatskoj koje su već postale dio tradicije određenog prostora, u nastavku su opisane samo neke od njih.

Jedan od najprestižnijih vinskih sajmova u Hrvatskoj je "Vinart Grand Tasting", održavan u Zagrebu, na kojem se mogu kušati hrvatska vina pomno odabranih vinarija. Ovaj sajam izvanredna je prilika za proizvođače jer se potiče razvoj kulture vina te prodaja vina koja su prepoznata kao vrhunska na tržištu. S druge strane, posjetitelji i ljubitelji vina mogu kušati najbolja hrvatska vina, educirati se o vinu te upotpuniti svoju vinsku arhivu teško dostupnim vinima [3]. "Vinistra" je također jedan od najznačajnijih i utjecajnijih sajmova vina u Hrvatskoj koji se već 28 puta održavao u Poreču. Poseban naglasak stavljen je na sortu Malvaziju za koju je organizirano međunarodno natjecanje. Manifestacija je pogodna za sve ljubitelje vina koji žele saznati nešto više ili žele kušati vina istarskih vinara [4].

Na području Međimurske županije ističe se "Urbanovo- Manifestacija putevima vina u Međimurju". Manifestaciju organizira udruga vinara Mediterra te okupljaju 35 najboljih proizvođača vina. Uz ocjenjivanje vina među najvažnijim događajima je proglašenje najboljeg pušpela u regiji, autohtone međimurske sorte [5]. U sklopu navedenog festivala kreiraju se i drugi novi festivali poput događaja "Pjenušavi međimurski doručak" na atraktivnoj lokaciji Mađerkin Breg, na kojem se u 2022. godini predstavilo više lokalnih vinarija te je odrađena premijera novih vina tzv. „En Primeur Međimurje“ [6]. Vinarija Kota iz Zlatara, Krapinsko- zagorska županija, ugostila je "3. Pjenušavi doručak u vinogradu" gdje su se predstavile neke od najpoznatijih vinarija na području Zagorja. Festivalu pjenušavih vina pridružuje se i "Festival pjenušaca i jagoda" koji se održava na području Samoborskog gorja te prikazuje kako se vino odlično sljubljuje s hranom [7].

Među zanimljivijim festivalima je i "Pink Day" tj. međunarodni festival ružičastih vina koji se održava u Zagrebu. Festival okuplja velik broj ženske populacije, a u 2022. godini izloženo je 120 etiketa rose vina iz Hrvatske, Francuske, Italije, Slovenije, Austrije i

Srbije. Cilj festivala je prije svega stvaranje pozitivne atmosfere i optimističnijeg pogleda na svijet uz bogatu ponudu hrane i vina te brojnih nagrada. [8]

Sve veću popularnost ima festival "Vinski grad" koji se organizira u više gradova u Hrvatskoj. To je ljetni festival koji je prilagođen posjetiteljima koji se ne bave vinom profesionalno već uživaju konzumirajući ga u opuštenoj atmosferi. Prema riječima organizacijskog tima vinskog grada, festival se fokusira na edukaciju o vinu na jedan suptilan i ležeran način kroz široku ponudu domaćih vina. U Vinskom gradu se nerijetko nađu i vina stranih proizvođača, što posjetiteljima daje i neku širu perspektivu. Pokretač Vinskog grada je Vinart, poduzeće koje se općenito bavi promocijom i marketingom vina, kao i organizacijom vinskih festivala i radionica. Manifestacija Vinski grad u 2022. godini održavala se u Zagrebu, Varaždinu i Rijeci. [9]

Restorani ili općenito ugostiteljski objekti imaju značajnu ulogu u priči o vinu [10], no za istinske ljubitelje vina puno je prikladnije posjetiti vinariju ili vinske ceste koje pružaju potpuni doživljaj degustiranja i uživanja u vinu te obuhvaćaju više vinarija. Osim turističke i ugostiteljske ponude, sastavni dio vinske ceste čini atraktivnost okoliša te povijesne i kulturne znamenitosti. Izgradnja vinske ceste podrazumijeva određivanje i označavanje njezine trase, uređivanje prostora za doček gostiju, definiranje ugostiteljske ponude i osmišljavanje turističke ponude kod svakog pojedinog vinara-domaćina. Vinske ceste nude široki izbor vina i imaju funkciju vodiča prilikom posjete pojedinih vinogradarsko-vinarskih krajeva. Vinske ceste zamišljene su na način da za posjetitelja to ne bude slučajno putovanje već sistematično otkrivanje vinogradarsko-vinarskih krajeva, prirodnih vrijednosti i kulturnog nasljeđa nekog kraja [11]. Hrvatska ima velik potencijal za stvaranje vinskih cesta, no trenutno je taj oblik promocije slabo iskorišten, jer vinske ceste nisu izgrađene ili nemaju dovoljno sadržaja koji bi bili privlačni za goste [2].

Slijedom gore navedenog može se zaključiti da je Sjeverna Hrvatska poznata kao razvijena vinska regija i prepoznatljiva po bogatoj ponudi vinskog turizma. Broj vinarija u pojedinoj županiji prikazan je u tablici 1.

Tablica 1. Broj vinarija na području sjeverne Hrvatske

<i>Županija/ područje</i>	<i>Broj vinarija</i>
<i>Koprivničko- križevačka</i>	<i>29</i>
<i>Krapinsko- zagorska</i>	<i>45</i>
<i>Međimurska</i>	<i>48</i>
<i>Varaždinska</i>	<i>42</i>
<i>Zagrebačka</i>	<i>117</i>
<i>UKUPNO</i>	<i>281</i>

Izvor: izrada autora, prema Vinarnice.hr (bez datuma)

Na području Sjeverne Hrvatske se ukupno nalazi oko 280 vinarija. Najviše vinarija nalazi se u Zagrebačkoj županiji (117), zatim dolaze Međimurska, Krapinsko- zagorska, Varaždinska i Koprivničko- križevačka županija [10].

3. REZULTATI ISTRAŽIVANJA

Cilj ovog rada je istražiti značaj i ponudu vinskog turizma te zadovoljstvo ponudom vinskog turizma u sjevernoj Hrvatskoj. Prikaz ponude vinskog turizma sadržan je u prethodnom poglavlju analizom sekundarnih izvora dok je u svrhu istraživanja zadovoljstva ponudom vinskog turizma provedeno primarno istraživanje. Kao temelj provedenog anketnog istraživanja postavljeno je sljedeće istraživačko pitanje:

- Jesu li potrošači zadovoljni trenutnom ponudom vinskog turizma na području sjeverne Hrvatske?

Prikupljeni podaci obrađeni su grafičkim metodama i metodama deskriptivne statistike. Ciljani uzorak demografski je ograničen na punoljetne osobe koje žive na području sjeverne Hrvatske, što prema novoj statističkoj podjeli Hrvatske [12] obuhvaća sljedećih 5 županija: Međimurska, Varaždinska, Krapinsko- zagorska, Koprivničko- križevačka, Zagrebačka. Uzorak je prigodan, s obzirom da se anketni upitnik izrađen putem Google Forms-a provodio putem Facebook stranice autorice te je objavljen u nekoliko Facebook grupa (Volim gemišt, Anketalica, Studentski dom "Stjepan Radić"- "Sava"). Istraživanje se provodilo u razdoblju od 31. svibnja 2022. do 13. lipnja 2022. U istraživanju je sudjelovalo ukupno 338 ispitanika. Svi ispitanici su stariji 18 godina, dolaze iz područja sjeverne Hrvatske te su barem jednom u životu kušali vino. Ispitanici su anketom grupirani na osobe koje konzumiraju vino i osobe koje ne konzumiraju vino.

Najveći broj ispitanika (65,4 %) ima između 18 i 30 godina, zatim 31 do 44 godine (25,4), 45 do 60 godina (8,3 %) i najmanje ispitanika (0,9 %) ima 61 ili više godina. Većina

ispitanika (68,6 %) je muškog roda. Najviše ispitanika dolazi iz Varaždinske županije (45,9 %), najmanje iz Međimurske (7 %), a u 69 % slučajeva žive na ruralnim područjima tj. na selu. Najviše ispitanika ima srednju stručnu spremu (59,2 %), zatim visoku stručnu spremu (39,6 %) te osnovnu stručnu spremu (1,2 %). Većina ispitanika (70,1 %) je zaposleno ili samozaposleno, 27,2 % ispitanika čine učenici ili studenti, a u manjem postotku prisutni su nezaposleni (1,2 %) i umirovljenici (1,2 %). Navedeni podaci prikazani su u tablici 2.

Tablica 2. Demografska obilježja ispitanika

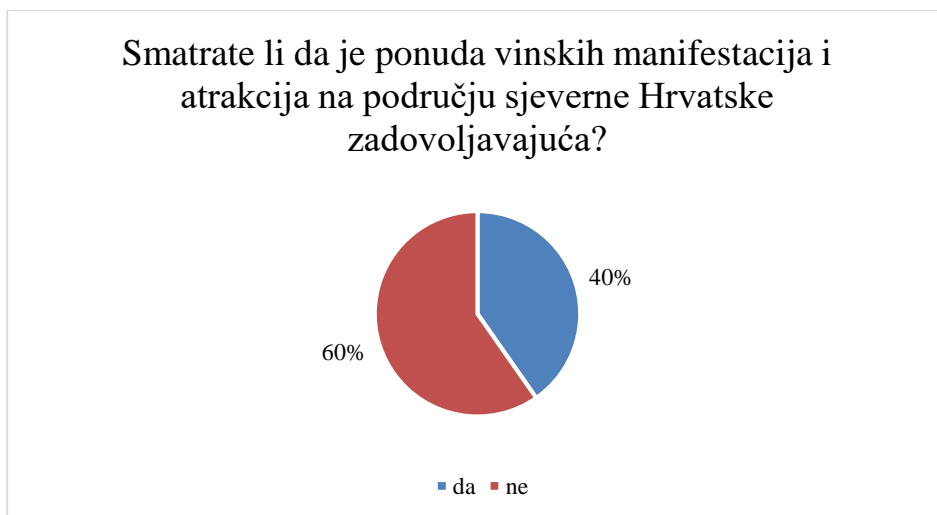
Varijabla	Odgovori	Broj ispitanika	%
Starosna dob	<i>18- 30</i>	<i>221</i>	<i>65,4</i>
	<i>31-44</i>	<i>86</i>	<i>25,4</i>
	<i>45-60</i>	<i>28</i>	<i>8,3</i>
	<i>61 i više</i>	<i>3</i>	<i>0,9</i>
Spol	<i>Muški</i>	<i>232</i>	<i>68,6</i>
	<i>Ženski</i>	<i>106</i>	<i>31,4</i>
Mjesto	<i>Selo</i>	<i>234</i>	<i>69,2</i>
	<i>Grad</i>	<i>104</i>	<i>30,8</i>
Županija	<i>Medimurska</i>	<i>24</i>	<i>7,1</i>
	<i>Varaždinska</i>	<i>155</i>	<i>45,9</i>
	<i>Krapinsko-zagorska</i>	<i>38</i>	<i>11,2</i>
	<i>Koprivničko-križevačka</i>	<i>46</i>	<i>13,6</i>
	<i>Zagrebačka</i>	<i>75</i>	<i>22,2</i>
Obrazovanje	<i>Osnovno</i>	<i>4</i>	<i>1,2</i>
	<i>Srednje</i>	<i>200</i>	<i>59,2</i>
	<i>Visoko</i>	<i>134</i>	<i>39,6</i>
Radni status*	<i>Zaposlen/a ili samozaposlen/a</i>	<i>237</i>	<i>70,1</i>
	<i>Nezaposlen/a</i>	<i>4</i>	<i>1,2</i>
	<i>Učenik, student</i>	<i>92</i>	<i>27,2</i>
	<i>Umirovljenik</i>	<i>4</i>	<i>1,2</i>
N= 338			

Izvor: vlastito istraživanje

Sljedeći graf prikazuje zadovoljstvo ponudom vinskog turizma na području sjeverne Hrvatske. Rezultati istraživanja ukazuju da su potrošači nezadovoljni trenutnom ponudom

vinskih manifestacija i atrakcija. Takav stav potrošača zapravo otkriva neiskorišteni potencijal takve vrste turizma na ovom području te implicira razvojni pravac kontinentalnog turizma u budućem razdoblju. (graf 1.).

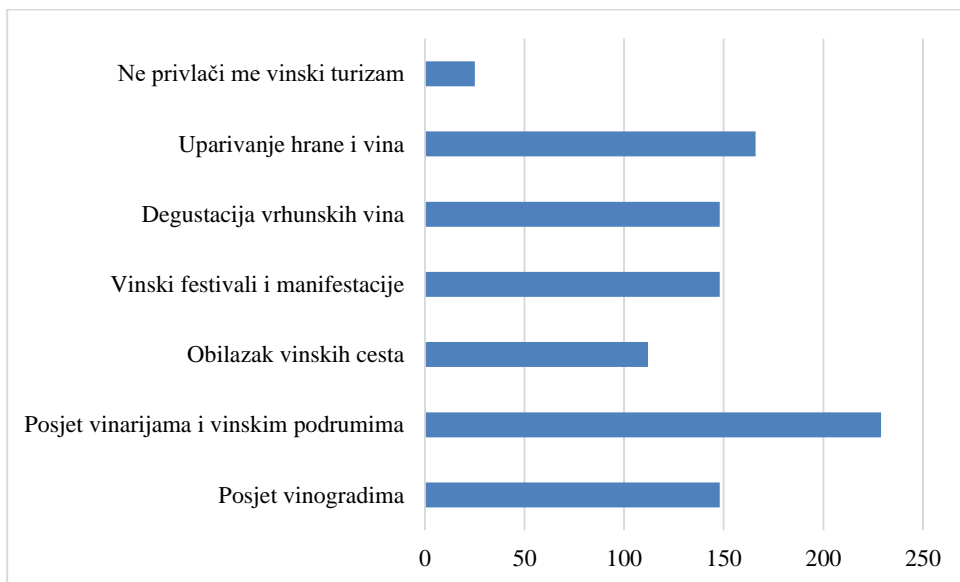
Graf 1. Ponuda vinskih manifestacija i atrakcija na području sjeverne Hrvatske



Izvor: vlastito istraživanje

Među vinskim manifestacijama i atrakcijama koje su potrošači najčešće posjetili su Urbanovo, Vinski grad te lokalni dani vina. Vinarije koje se najviše spominju su Vinarija Štampar, Vinarija Cmrečnjak i Vinarija Bolfan. Među ponudom vinskog turizma, najatraktivniji su posjeti vinarijama i vinskim podrumima, nakon čega dolazi uparivanje hrane i vina. U podjednakom omjeru su privlačne degustacije vrhunskih vina, vinski festivali i manifestacije te posjet vinogradima, dok se najmanje potrošača odlučilo za obilazak vinskih cesta. Ono što bi trebalo istaknuti jest podatak da samo 7,5 % potrošača vina ne privlači niti jedan oblik vinskog turizma. Privlačnost pojedinih sadržaja vinskog turizma prikazana je na grafu 2.

Graf 2. Posjećenost sadržaja vinskog turizma



Izvor: vlastito istraživanje

Neka od ograničenja ovog istraživanja su korištenje prigodnog uzorka koji potencijalno nije reprezentativan za ovo područje i nedostupnost podataka. Ograničenja vezana uz uzorak prvenstveno se odnose na dobnu skupinu i županiju ispitanika tj. najveći broj ispitanika pripada dobnoj skupini od 18 do 30 godina te najviše ispitanika dolazi iz Varaždinske županije. Uz to, prikupljanje sekundarnih podataka o pojedinim temama prisutnim u radu je otežano zbog nepostojanja podataka ili prisutnosti više verzija podataka. Pojedini dijelovi vinskog tržišta nisu istraženi na razini države, poput posjećenosti hrvatskih vinarija. Navedena ograničenja ujedno su i prijedlog za daljnja istraživanja koja bi pridonijela kreiranju kvalitetnije turističke ponude.

4. ZAKLJUČAK

Konzumiranje vina ne predstavlja samo zabavu i opuštanje, već čini bitan dio gospodarstva te je dio kulture stare tisućama godine. Vjeruje se da proizvodnja vina potječe iz područja Mezopotamije te da su kulturu sadnje vinove loze prema ostatku svijeta prenijeli trgovci. Čitav proces proizvodnje i potrošnje vina znatno se mijenjao kroz povijest u smislu razvoja novih tehnologija te poljoprivrednih postupaka što je samo pridonijelo širenju te kulture i razvoju novih sorti. Brojne vrste i sorte vina daju široku lepezu proizvoda koja može zadovoljiti potrebe od osnovnih do najzahtjevnijih potrošača. Poznato je kako se pojedina vina više cijene kroz proces starenja. Posebno se cijeni tradicionalno vinogradarstvo koje se na određenom prostoru razvija dugi niz godina, poput vinogradarstva mnogih europskih država među kojima se ističu Italija, Španjolska i Francuska kao vodeći svjetski proizvođači vina. Vinogradarstvo kao poljoprivredna djelatnost znatno ovisi o vremenskim uvjetima kao i o gospodarskim krizama, zbog čega u posljednjih nekoliko godina dolazi do smanjivanja količine proizvodnje vina. Tu je i zakonski okvir koji kroz ministarstva, agencije i institucije pruža određenu kontrolu kvalitete, evidenciju o stanju uvoza i izvoza te vinskih zaliha, određivanje prosječnih cijena i mnoge druge kontrolne funkcije. Posebice se ističe vinogradarski registar koji objedinjuje informacije o proizvodnji vina u Hrvatskoj.

Vinski turizam značajan je dio ukupne turističke potrebe posebno u kontinentalnom dijelu Hrvatske, a okosnicu mu čine razne vinske manifestacije, sajmovi i izložbe na kojima proizvođači dobivaju priliku za direktnu promociju. Takve manifestacije većinom se odvijaju na lokalnoj razini na kojoj se mogu uključiti i manji proizvođači koji imaju ambicije za širenje tržišta. Istraživanje prikazano u ovom radu pokazuje da više od polovice anketiranih potrošača nije zadovoljna ponudom vinskog turizma što ukazuje da postoji prostor za rast tog segmenta turističke ponude.

Interes i potreba za vinskim turizmom svakako postoji. Posjeti vinarijama i vinskim manifestacijama trebaju se prilagoditi užurbanom životu današnjice. Ponekad potrošači nemaju mogućnost izdvojiti cijeli dan za obilazak vinskih cesta, no rado će stvoriti vrijeme za večernji odlazak do obližnje vinarije ili na neku manifestaciju koja im pruža savršen spoj gastronomije i enologije. Hrvatska je raznolika država te svako područje može dati nešto jedinstveno i autohtono. Stoga je potrebno kreirati sadržaj koji vjerno i sažeto prikazuje tradiciju i kulturu vinarstva i vinogradarstva nekog prostora, uz spajanje s gastronomijom i ugostiteljstvom, što će dodatno privući turiste. Važno je stvoriti pozitivno ozračje i dati do znanja da uživanje u vinu ne mora biti skupo i nepristupačno te da degustiranje vina nije namijenjeno samo vrhunskim znalcima, iako komunikacija s njima itekako može upotpuniti doživljaj i proširiti znanje o vinu.

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VIRTUAL POWER PLANT: CHALLENGES AND OPPORTUNITIES

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ABSTRACT:

In recent years, the European electricity markets have reached a high level of liberalization, with one most important goal, to provide the end users of electricity with the lowest possible price. At the same time, the integration of renewable energy sources into distributed energy systems is increasing in accordance with the achievement of the goals of the green agenda and obtaining a greater share of "green energy" in the total production of electricity. The number of installations of small solar capacities at the point of consumption has increased in particular, leading to the fact that the current customers are becoming active customers, i.e. prosumers. Such customers generally do not meet the conditions for independent participation in the electricity market and thereby lose the opportunity to earn additional profit, and therefore their joint appearance on the market is necessary. In accordance of liberalized markets conditions, one of the ways of joint action is possible through the concept of "virtual power plant". This paper provides a general overview of the concept of a virtual power plant through the possibility of participating in different electricity markets, as well as an overview of the models developed so far for the energy management of virtual power plants. Also, challenges in implementation and opportunities for further development are described.

Keywords: *virtual power plant, electricity market, renewable energy sources*

1. INTRODUCTION

With the aim of ensuring energy independence and achieving the goals of the green agenda, many countries around the world are relaxing legal provisions to allow for greater representation of renewable energy sources (RES). According to the International Renewable Energy Agency (IRENA) report, the year 2022 was a record year for the number of installed RES capacities with about 295 GW, which led to RES accounting for 40% of the total installed electricity capacities worldwide [1]. On the one hand, the increase in the amount of installed RES capacity contributes to the achievement of the set goals of the green agenda because it does not directly generate additional amounts of carbon dioxide, but on the other hand, it can cause difficulties in the operation of the power system. The power system must have stable, secure, and balanced operation at all times, which is achieved by balancing the production and consumption of electricity. The

problem arises due to the nature of electricity production from RES, which is intermittent and dependent primarily on weather conditions, which can cause serious disturbances in the stability of the power system's operation. For a more comprehensive integration of RES into the power system and overcoming these problems, in addition to building backup capacities that would be used in conditions of reduced production from RES, it is necessary to adequately manage production and consumption [2]. To do this, it is necessary to interconnect and group renewable energy sources within one entity called a Virtual Power Plant.

2. CONCEPT OF VIRTUAL POWER PLANT

A Virtual Power Plant can be composed of various Distributed Energy Resources (DERs) such as Distributed Generators (DG), energy storage (ES), controlled loads (e.g. electric vehicles), as well as heat pumps or demand response that act on the power system as a single unit [3]. The main goal of the VPP is to participate in the organized electricity market and to generate additional profits for all owners of distributed sources included in the portfolio by selling electricity or participating in ancillary services. Additionally, VPP reduces deviations in electricity production and consumption forecasting, significantly reducing financial penalties charged in case of poor forecasting. This is achieved by engaging storage units to generate missing energy, on the demand-side and optimizing production from flexible, but stable sources such as biogas power plants, on the supply-side [4]. The VPP's operation optimization is based on historical data on consumption, electricity prices, and weather conditions, as well as the predictions created based on them. Figure 1 shows the VPP management scheme.

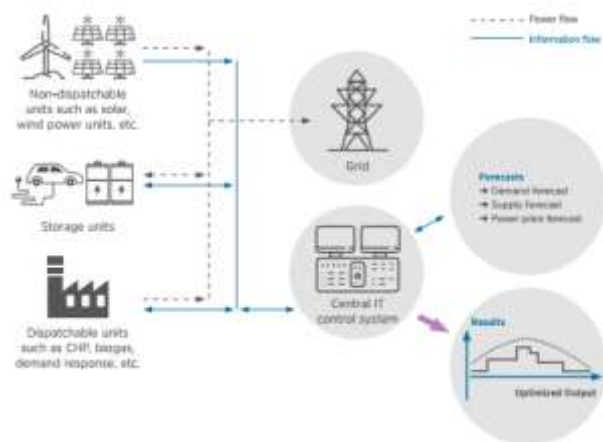


Fig. 1. Overview of VPP [4]

The benefits realized by the operation of VPP in the energy system are [4]

- Ancillary services to the energy system, including load shifting, balancing services, and local flexibility.
- Reduction of marginal power costs by reducing peak loads or engaging smaller capacity generators to cover smaller amounts of demand power instead of using expensive large (fossil fuel) generators.
- Optimization of investments in energy infrastructure by utilizing available distributed sources optimally and achieving real-time operating reserve capacity, which will defer investments in peak generating capacity.

3. ENERGY MANAGEMENT AND OPTIMIZATIONS MODELS

Due to its role in operation, the Energy Management System (EMS) is one of the key elements of every VPP. The EMS is responsible for collecting, storing, and analyzing data gathered from sources in the VPP portfolio, as well as for communicating, controlling, and coordinating the operation of all DERs. Based on the gathered information, a forecast of consumption and production is created, then an optimal schedule for the operation of all units is determined in order to meet the set goals [5]. In the literature, three types of optimization strategies, or goals, are dominantly mentioned, depending on the stakeholders and DER owners involved in the VPP. These include economic goals [6,7], technical goals, and environmental goals. The first goal is to reduce total costs with minimal impact on the grid, the second goal is to maintain grid conditions within acceptable limits (voltage fluctuation and frequency oscillation), while the third goal disregards economic and technical goals in favor of reducing greenhouse gas emissions.

To achieve all of the mentioned goals, it is necessary to formulate a mathematical problem expressed through an objective function. In practice, it is often necessary to achieve a balance between multiple objectives, so it is necessary to define a multiobjective function. For example, in the study [8], the optimization goal is to maximize profits and minimize costs, while in other studies [9, 10], the goal is to maximize profit while minimizing CO₂ emissions. On the other hand, there are studies in which the goal is to maximize profit, but minimize the economic risk of VPP participation in electricity markets [11, 12].

Optimization problems can be classified according to the category of variables (continuous, integer) and the type of constraints into [13]:

- linear programming (LP)
- mixed-integer linear programming (MILP)
- nonlinear programming (NLP)

- mixed-integer nonlinear programming (MINLP).

In literature, optimization problems are mostly formulated as mixed-integer mathematical problems which ensure simplicity and fast execution in finding the optimal solution. On the other hand, there are formulations with nonlinear constraints that need to be transformed into a mixed-integer linear programming model using the Karush-Kuhn-Tucker optimality conditions and duality theory before solving. Some authors also define models with integer variables and nonlinear constraints, making the problem a mixed-integer nonlinear model that is difficult to solve because there are multiple local optima, none of which may be global. In such cases, an appropriate way of solving the problem must be chosen, and the literature distinguishes between mathematical and heuristic methods of solving the problem.

Mathematical methods that guarantee convergence to the optimal solution include:

- simple methods [14],
- branch and bound technique [15]
- quadratic programming [16]
- interior-point method [17]
- dynamic programming [18]
- game theory [19]
- fuzzy simulation [20]

Although they are very flexible and offer a good solution, heuristic methods do not necessarily lead to an optimal solution. They are good in situations where it is difficult to reach an efficient optimal solution with the help of mathematical methods. The most frequently used heuristic methods in the literature are particle swarm optimization algorithm (PSO) and generic algorithm (GA) [21,22].

4. PARTICIPATION IN ELECTRICITY MARKETS

The process of liberalizing the electricity market and relaxing legal regulations has been completed or is nearing completion in many developed countries. This process has brought about a change in organizational structures from vertical to a structure in which production, transmission, distribution, and retail operate independently. The liberalization of the electricity market has enabled end-users to have the most favorable possible prices, and has contributed to the economic efficiency of energy companies and numerous new investments in the energy sector.

Figure 2 shows the order of organization of different electricity markets in relation to the time when they are held, while the following provides an overview of the participation of VPPs in each of them.

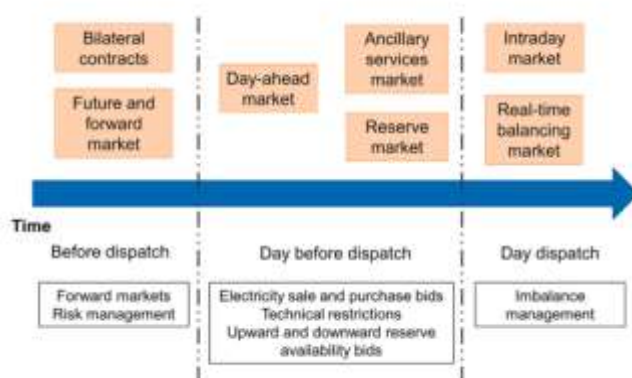


Fig. 2. Sequence of electricity market types [13]

Futures and forward market is a type of market where energy is bought and sold for a longer period of time (from a few weeks to several months) at fixed prices. For a VPP, it is beneficial to sell a portion of its energy on this market in order to ensure a certain profit and mitigate the risk of trading on other markets where prices are much more uncertain. In study [23], a model of VPP for participation in the futures market was proposed.

Bilateral contracts (Power Purchasing Agreements - PPAs) are a method of selling in which the seller directly negotiates the terms of sale of electricity with the buyer. The rapid increase in this type of energy sales occurred due to the growth in the number of DERs, which, by signing such contracts, reduce the impact of price instability on the market. The paper [24] presents a VPP model that generates secure revenues in the market based on bilateral contracts, despite the volatility of market prices.

Day-ahead market is a market where energy is bought and sold for every hour of the next day, i.e. for the day ahead. Given that the prediction of consumption and production is much more accurate within a 24-hour timeframe, this market also represents an opportunity to compensate for any inaccuracies in long-term prediction or energy shortages caused by faults through the purchase or sale of energy [25].

Ancillary services market. The most important task of this market is to ensure the reliability and security of the power grid by maintaining a balance between production and consumption at all times. The increasing use of renewable energy sources in production capacities causes large fluctuations in production, so it is necessary to provide certain capacities for ancillary services. The participation of VPPs in this market can be very significant because it typically has stored capacities that are essential for overcoming instability in the production of RES [26].

Reserve market exists to ensure the necessary amount of reserve capacity in case of a failure that could cause a generator outage. It is necessary to have a backup that would

compensate for the shortfall. Several studies in the literature have analyzed this business strategy for VPPs with the aim of maximizing profits [27,28].

Intraday market exists as a corrective factor for the day-ahead market. Energy that is contracted on the day-ahead market but for some reason is not delivered becomes the subject of trading on this market. This market is particularly important for all RES due to the unpredictability of energy production, but certainly all participants in this market can achieve high profits. Strategies for optimal VPP participation in this market have been discussed in the literature [29].

Real-time balancing market is the last place for energy trading, which usually closes 5 to 30 minutes before the moment of energy delivery. Despite the precise forecast and additional balancing adjustments between production and consumption on the intraday market, there may still be certain deviations, so additional energy can be secured on this market to avoid financial penalties [14].

In summary, considering the nature of VPPs and the goal to achieve business strategy objectives, the safest method for energy trading is to participate in multiple electricity markets. However, there are few developed models in the literature that ensure participation in multiple markets at the same time, which leaves room for progress.

5. CHALLENGES AND OPPORTUNITIS

Although much research in recent years has been devoted to the development of an optimal VPP model, the number of real cases VPPs is still extremely small due to the challenges that need to be overcome. Four types of challenges have been identified in the literature, namely technical, regulatory, commercial, and environmental challenges [30]. Figure 3 graphically shows the limitations in implementing VPPs [5].

Technical limitations primarily refer to the control system that should manage the operation of the VPP and communicate with all units in the portfolio. Certain levels of complexity of the control and communication systems already exist, but they are limited to a certain, smaller number of controllable units that do not meet the needs in real cases. Also, it is possible to make more efficient use of data collected through data acquisition systems and incorporate them for more accurate forecasting of consumption and production.

Commercial or economic limitations relate to business conditions in electricity markets and are closely related to incentive programs and market prices. In moments of market development, incentive programs are very important, e.g. if the development of VPP and the integration of DERs within the VPP were encouraged, it would be beneficial for both the energy system and the producers themselves. Also, commercial limitations are often influenced by regulatory rules that restrict the development of VPP business models.

Regulatory limitations can impact VPP if the market is not fully liberalized in a way that does not discriminate against any participant. Also, it is important that incentive programs motivate the development of VPP and its participation in the market. The greatest

limitations are present in the ancillary services market where conventional generators are usually dominant and participation requires a large reserve capacity. In addition, it is necessary to adjust the opening and closing times of gates on the market to the needs of volatility technologies to increase their participation in the market.

Environmental limitations primarily refer to balancing issues of sources considered "green," and their nature is intermittent. Due to this intermittency, VPP must have certain capacities on fossil fuels in its portfolio for easier management. If environmental limitations are strict, in terms of limited use of fossil production capacities, VPP may have problems with its operation.

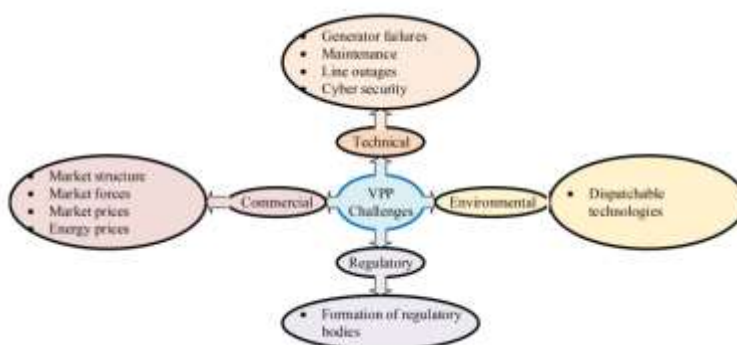


Fig. 3. Limitations in implementing VPP [5]

Currently, in Serbia, there is a dominant regulatory limitation for the development of the VPP concept, primarily due to the fact that the role of the aggregator, who is actually the entity that manages the Virtual Power Plant, is not precisely defined in the relevant laws. Although certain provisions of the Energy Law [31] and the Law on the Use of Renewable Energy Sources [32] recognize the aggregator as an entity, it is necessary for sub-legal acts to regulate in detail the rights and obligations of the aggregator in accordance with the guidelines from the EU Directive 2019/994 [33]. In this way, among other things, a very important feature of the aggregator would also be defined, which is direct and active management of consumption and production.

6. CONCLUSION

This paper provides a general overview of a new and very interesting concept for managing electricity production and consumption, called Virtual Power Plant (VPP). The paper also provides an overview of the most important components and management strategies of VPP, as well as the possibility of participating in various electricity markets. Although the concept of VPP is widely known and there have been many publications on the topic in recent years, breakthroughs are needed in the use of machine learning algorithms for optimal VPP operation planning, as well as in developing more robust

optimization models for creating more successful strategies based on stochastic programming. Currently, there are not many VPPs operating in real market conditions, which would significantly change if better management strategies were created that would generate higher profits for the owners of units participating in VPPs.

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APPLICATION OF ADDITIVE TECHNOLOGIES IN PRODUCT DEVELOPMENT PROCESS OF COOLER FOR RASPBERRY PI

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ABSTRACT:

This paper presents the process of developing a cooler for the Raspberry Pi 4 computer by application of additive technologies. First, based on real measurement 3D CAD models of the active cooling system parts and housing were designed using SolidWorks software. By using of 3D printing technology, prototype of cooler was produced and checked visually and functionally, while final product was produced by using CNC milling machine. Functional tests of final product showed that active cooling system was decreased operating temperature of the computer for about 35%, while noise level is lower than one generated by personal computers, so it can be used without possibility to make damage to human health.

Keywords: product development, 3D model, cooler, Raspberry Pi 4, additive technologies

1. INTRODUCTION

The strong development of the industry requires the application of computers in all segments, from product development to the application of information systems for monitoring the production of final products. With the emergence of rapid prototyping technologies i.e., rapid production technologies in the late eighties of the last century, the production of physical models of products and prototypes was significantly accelerated [1]. Given that this approach has been shown to offer significant capacity, the application of additive technologies as one of the rapid prototyping technologies has also found application in the production of final products. Additive technologies are among the key elements of Industry 4.0 and, while they were once possible in large companies, today small and medium-sized enterprises have machines that use these technologies. Their significant application in the product development process through the rapid development of prototypes and the use of different materials such as plastic, ceramic, metal, etc., can have a great impact on the competitiveness and success of the product in the market.

Thanks to additive technologies, manufacturers are able to test new products and processes before embarking on the full production of final products, but also to create and produce various accessories and tools that are not on the market or have high prices, but are necessary for smooth operation or they can even significantly improve the production process. On the other hand, the further development of these technologies is aimed at the development of new materials, as well as combining several materials in order to make both individual products and entire assemblies.

High temperature is one of the main problems that can affect the efficiency of computer processes, and prolonged exposure to high temperatures can damage certain components. That is why heat dissipation is a key to maintaining the optimal temperature inside the computer and preventing damage. There are different solutions for heat dissipation, such as air cooling and liquid cooling, and the choice depends on the type and purpose of the computer. Without a proper cooling system, the computer can cause overheating and reduced performance, and even permanent damage to components, which can cause the entire system to fail. Raspberry Pi 4 [2], like any other computer, generates high temperatures during the operation that can reach over 100°C. The high temperature of computer components can significantly affect the reduction of the processes efficiency performed by the computer. In addition, high temperatures can affect permanent damage to certain components. Raspberry Pi 4 does not have a factory heat dissipation system, and the NESPI 4 CASE housing has a factory active cooling system that is not efficient [3]. There are various heat dissipation solutions on the market that are specifically designed for Raspberry Pi 4 computers, but in combination with the NESPI 4 CASE they are not compatible.

This paper shows the application of additive technologies for development of a prototype of a cooler for the Raspberry Pi 4 computer. By using the SolidWorks software package, 3D models of the housing, fan and cooler were created, while the 3D model of computer was downloaded from a 3D model sharing website. Prototype was checked visually and with a functionality test in operating conditions. Final product was produced by using CNC milling machine. Functional test of device with mounted active cooling system was performed in the form of operating temperature and noise level generation in different operating modes of the cooling system.

2. DEVELOPMENT PROCESS OF COOLER PROTOTYPE

During the development process of cooling system, an analysis of possible solutions for passive and active cooling of the Raspberry Pi 4 computer was performed. Namely, the computer is mounted in a NESPI 4 CASE housing (Fig. 1 (a)) that has grid ventilation openings. These openings serve to ventilate the interior of the housing. The Raspberry Pi 4 computer is placed inside the housing, in a certain place where connections of the computer are exposed to the outside of the housing, in order to be functional for use. All other connections of the housing are connected to the computer via cables according to the instructions. The computer is attached with two screws from the inside of the housing, and the remaining two attachment points are secured after mounting the upper part of the

housing and securing it with six screws from the outside of the housing. The NESPI 4 CASE housing also has a 30x30x8 mm small fan, which serves to ventilate the housing (marked with blue in Fig. 1 (b)), with operating voltage of 5V. The efficiency of this cooling system is low and can be considered negligible. Precisely for this reason, during the computer operation, there is a risk of overheating and failure of individual computer components.

In order to improve cooling for the components of the Raspberry Pi 4 computer, the idea is based on the principle of active air cooling in personal computers. This method of cooling requires the integration of passive and active cooling components i.e., a cooler made of aluminum or copper and a fan. The contact between the motherboard and the cooler should be achieved using thermal paste or a thermal pad, whereby direct "metal to metal" contact should be avoided. The cooler should have ribs between which the air flows that would push the axial fan mounted on the cooler from the top (Fig. 1 (c)).

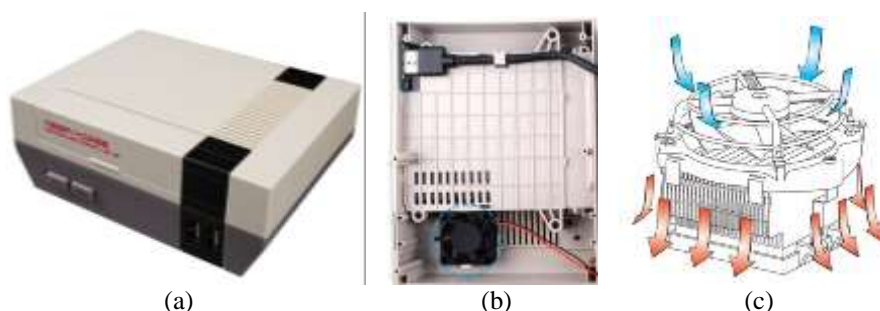


Fig 1. (a) NESPI 4 CASE, (b) Small fan in housing, (c) Principle of air cooling system [4]

Since the Raspberry Pi 4 is a small computer by dimension, it does not have a strong construction, therefore it is preferable to avoid putting pressure on the computer's motherboard and straining it to bend or twist in order to avoid physical damage of the computer. The practice of using thermal paste as a heat conductor between computer components and the cooler is not suitable in this case because it requires applying pressure between the components and the cooler. On the other hand, the thermal pad is made in standard thicknesses, it is stable, the texture is similar to a sponge or softer rubber, it is sticky, easy to shape with scissors, according to the required dimensions. Due to all the above, it was adopted as a solution to use a thermal pad with a thickness of 1.5 mm, whereby the gap between the computer components and the cooler will be 1 mm. These characteristics meet the requirements to achieve the largest possible contact surface between the thermal pad on one side and the motherboard board and cooler on the other side, with a minimum of pressure on the computer's motherboard.

The active component of the cooling system of the Raspberry Pi 4 computer will be the axial fan. By analyzing the dimensions of the computer and the fans available on the market, it was concluded that the largest possible size of the fan that can be used is 45x45x10 mm. Also, the fan must meet the characteristics of the electric power supply

i.e., the operating voltage of the motor should be 5V DC, so the fan produced by Sunon was chosen [5] (Fig. 2 (a)). The reason for choosing the mentioned fan is that the fan's propeller captures as much of the cooler surface as possible, which increases the number of ribs and channels between the ribs that serve to flow air through the cooler and remove as much heat as possible. For connecting all parts of the assembly, standard dimensions of screws are chosen as needed and a separable connection between the parts of the assembly will be achieved.

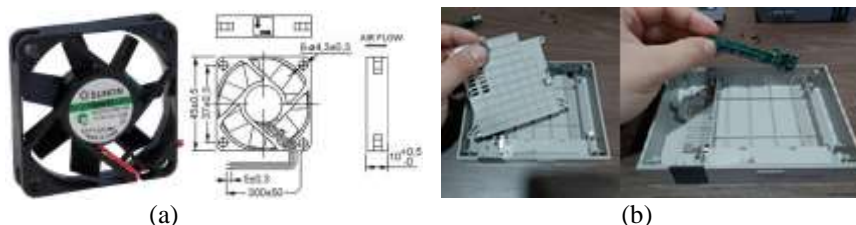


Fig 2. (a) Selected fan for active cooling, (b) Removing the drawer and the SSD memory carrier [4]

The analysis determined that it is not possible changing of the external appearance of the housing in order to install the cooler, so it was decided to modify the housing in the form of removing unnecessary parts of the housing, with the aim of freeing up space for the installation of the cooler. Considering the needs and ways of using the computer Raspberry PI 4, as well as that the microSD memory is used as the computer's memory, it is possible to remove the drawer and the carrier for the SSD memory (Fig 2 (b)). That will obtain the appropriate space for installation of the cooler.

2.1. 3D model of Cooler

3D modeling process allows engineers to create digital models of products and processes, which they can use for virtual simulation and testing. This significantly reduces the time and costs needed to develop new products and processes, and allows manufacturers to respond more quickly to changes in demand and adapt to new trends. Therefore, phase of creating a 3D model of the cooler is based on the dimensions, materials, connection method and other parameters that can significantly affect the accuracy of the product model. In this phase, it was necessary to have 3D models of all the components in order to be able to check their possible overlapping. Certainly, it is very important to do this in a virtual environment in order to reduce the overall time and cost of prototyping and the final product production. The 3D model of the Raspberry Pi 4 computer is available and has been downloaded from the CAD model sharing website. After comparing specific dimensions between the 3D model and the physical product, it was concluded that the model is accurate and suitable for use in the development process of the cooler. The models of the housing, printed circuit boards and fan are made based on the dimensions of real products, using the SolidWorks software package (Fig. 3).



Fig 3. (a) 3D model of housing, (b) 3D model of fan [4]

In further steps, an analysis and review of the housing assembly was performed, as well as the dimensions and position of the fan, the contact surfaces between the parts, which elements of the parts should be separated in order to function safely, at which points they are connected and in what way, as well as the functionality i.e., the possibility of easy assembly and disassembly of cooler and fan. The cooler should be connected to the computer at three points, where the screw heads are intended to rest, and these are the only points on the computer where it is safe to rest other objects on the computer's motherboard (Fig. 4). All computer components on the top side where the cooler is planned to be had to be avoided, by making a hider inside the cooler construction.

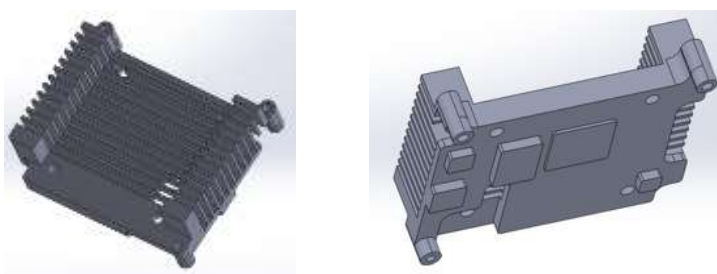


Fig 4. 3D model of cooler [4]

Assembling of the cooler, the computer and the housing was realized with two M2.5 mm screws and one M2 mm screw, through the holes on the computer into the threaded holes on the housing provided for attaching the computer. This means that already existing threaded holes were used, and no additional modification of the housing is required, which contributes to the ease of installation.

The axial fan was mounted on the upper side of the cooler and is practically "immersed" in the cooler itself and does not protrude outside the dimensions of the cooler (Fig. 5). The connection was made with four M4 mm countersunk head screws, because the screw heads are hidden inside the cooler construction.

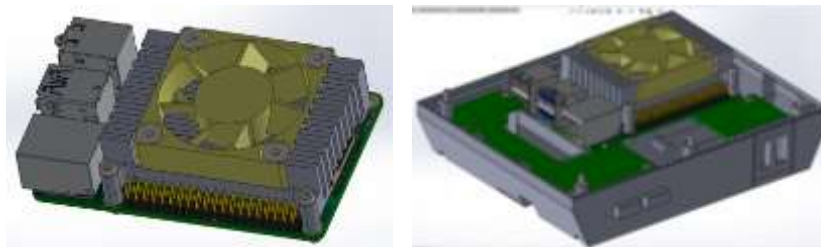


Fig 5. 3D model of assembly [4]

2.2. Producing of Cooler prototype

Producing the final product of the aluminum cooler requires the use of a CNC milling machine. Considering the relatively high costs of producing prototype on CNC milling machine, the prototype of the cooler was made using 3D printing technology, as one of the most prevalent additive technologies. In addition to the low cost of manufacturing an individual product, 3D printing allows fast prototyping, which provides the opportunity to perform functional testing of the complete assembly in a relatively short period of time. Additive technologies are based on the joining of particles or layers of material, known as the application of materials "layer by layer", in order to obtain the desired shape of the product [6, 7]. A general prerequisite for manufacturing products using additive technologies is the existence of a 3D CAD model of the product. Through the CAD-STL interface, which is mainly an integral part of the most CAD software, the conversion of the 3D CAD model into the STL file format is performed, which approximates the surface of the model using triangles [8]. In the next step, the product manufacturing process is checked and prepared by processing the STL file through the software of the rapid prototyping (RP) machine. During this step, the model is oriented in the working area of the RP machine in order to produce a high accuracy product, with appropriate mechanical characteristics and the required surface quality [8, 9]. In addition, the parameters of the RP machine are adjusted (speed, filling, manufacturing parameters, curing depth, laser power, etc.). Of course, according to the needs, supporting structures are also created whose task is to prevent the deformation of the hanging elements of the product and/or to facilitate the separation of the product from the working plate of the machine. The supporting structures are often not of the same characteristics as the product, so that they can be removed more easily during post-processing. Then, a series of cross-sections is generated using the slicing algorithm, the so-called slicer. Mainly the software of the RP machine has integrated algorithms for slicing which, in addition to the STL file, also use the characteristics of the RP machine as input data (e.g., diameter of the extruder nozzle, product material, etc.) which determines the number of layers, production time, etc. The result of the above activities is the generated program code that contains the control data for the RP machine.

The prototype of cooler with appropriate supporting structure was made of PLA material, which is a biodegradable thermoplastic polylactide produced from renewable plant resources. Due to its mechanical characteristics and low price, PLA is suitable for making prototypes and simpler functional products. However, it is not thermally stable above a temperature of $\sim 60^{\circ}\text{C}$, so it should be careful about the working conditions of the product. Considering the conditions in which the functional testing of the prototype should be performed, it was concluded that PLA can be used only for the production of the prototype. The prototype was made on a 3D printer Sindoh DP200 with FDM technology, using the 3DWox software package for setting the production parameters and generating the program code (Fig. 6).

Estimated time to build the cooler prototype was 2 hours and 55 minutes, with a material consumption of 24.5 grams and an estimated post-processing time of 30 minutes [4]. The estimated cost of making a prototype of 2€ and a very short production time, shows that the application of additive technologies for making the prototype is really profitable. When the prototype of the cooler produced, an axial fan was mounted, and then the entire subassembly was mounted on the motherboard of the Raspberry Pi 4 computer (Fig. 7).

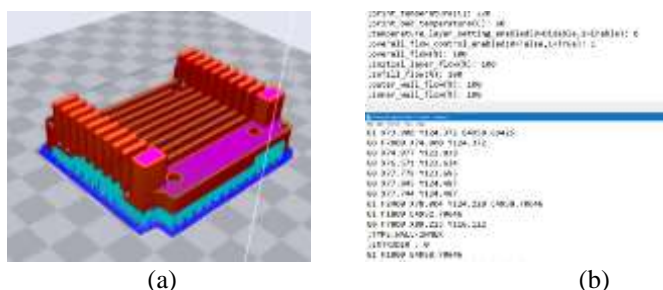


Fig. 6. Setting the production parameters and generated the program code [4]

By visual inspection, it was determined that all assembly elements are in the desired position and ratio. The axial fan was easy to assemble and disassemble, and its dimensions do not exceed the dimensions of the cooler. Also, the cooler easily approaches the computer's motherboard without contact with the computer's components, and all the desired and important clearances are achieved. The entire cooler and fan subassembly was assembled and disassembled inside the case without compromising the functionality of any part of the assembly. The functional test, which included the commissioning of the entire assembly, showed that during the operation of the device, there is no contact between the rotating parts of the fan and the cooler, which was foreseen during the design process of the active cooling system.

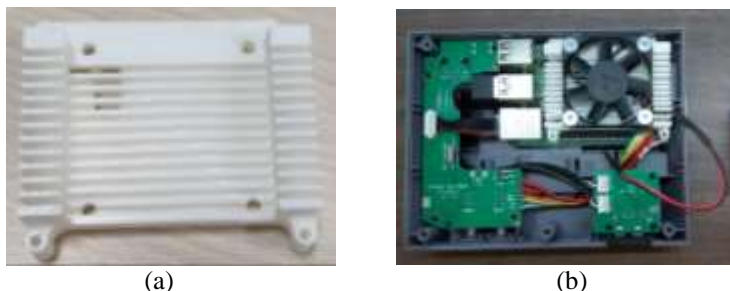
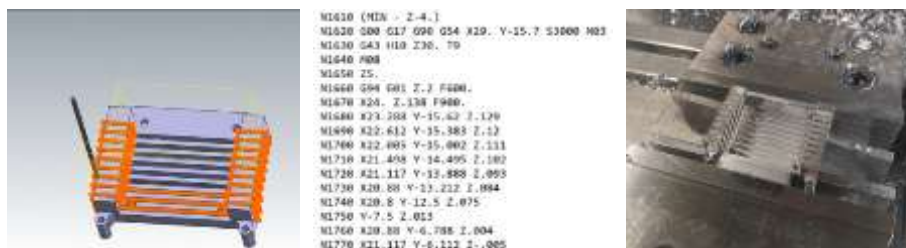


Fig. 7. (a) Prototype of cooler, (b) Assembling and testing of prototype [4]

Furthermore, the final product of the cooler was made on a three-axis CNC milling machine. Prepared material had dimensions of 80x60x25 mm, material Aluminum. The CNC machine on which the cooler was made is the Matsuura MC-600VF. It is a three-axis milling machine with strokes of 600 mm on the X axis, 490 mm on the Y axis and 470 mm on the Z axis. Spindle support VT40 standard accepts tools, with a number of revolutions from 30 to 15000 rpm. It has a tool magazine with an automatic tool change system, the magazine capacity is 20 tools. The control unit is Yasnac 180B. The machine also has a tool cooling system with emulsion and air.

The final production plan prescribes the production of the cooler in two clamps. During the first clamping, the lower side of the cooler, the sides of the cooler were processed, the necessary holes were drilled and the threads were tapped. In the second clamping, the upper side of the cooler, the seat for the axial fan and the cooler ribs were processed. For the purposes of programming and creating the program code, the appropriate CAM software package was used (Fig. 8 (a)). In this program package, the positioning of the 3D model of the cooler was done, the software tools that determine the type of processing were selected, the processing parameters were set, and the tools that will be used in the processing were defined. The entire programming procedure in the CAM software package, preparation of material, machine, cutting tools, clamps, calibration of tools and workpieces, production, and supervision, lasted 3 hours and 20 minutes (Fig. 8 (b)). Of that, the production itself on the machine took 2 hours and 20 minutes (Fig. 8 (c)). The other 60 minutes were spent on preparation operations. After finishing the producing, it was necessary to manually process all the sharp edges on the cooler with appropriate tools.



performed using the Raspberry Pi OS operating system and the Command Line Pi program where the current temperature was read and recorded. Every three minutes, a command was issued to display the current temperature and save it.

The first test was performed in conditions without a cooling system. The ambient temperature was 26 °C. The second test was performed in conditions without an active cooling system, but only with a built-in cooler, at the same value of the ambient temperature. The third test was performed in conditions with an active computer cooling system, i.e. with a cooler and fan on. The measurement results are presented in a Table 1.

Table 1. Measurement results for operating temperature

<i>The first test</i>						
Measurement No.	1	2	3	4	5	Average
Measurement result [°C]	67.6	82.3	83.7	83.2	84.2	80.2
<i>The second test</i>						
Measurement No.	1	2	3	4	5	Average
Measurement result [°C]	55.5	61.3	61.8	69.6	72	64.04
<i>The third test</i>						
Measurement No.	1	2	3	4	5	Average
Measurement result [°C]	47.7	49.6	53	54.5	56.4	52.24

By analyzing measurement results, it can be observed that without any part of active cooling system (the first test), operating temperature of computer rise over 80°C, with tendency to stay. That should be a risk for damage components of computer. When cooler without fan was present in assembly (the third test), rise of temperature was a bit slower compared to first test. However, after a long time, operating temperature was over 70°C. Results of the third test showed that active cooling system with cooler and fan contributes significantly lower temperatures, around 50°C, which allows safe use of the computer without time limits. In addition, all tests showed that heat accumulates inside the housing and leads to a slow, but gradual rise in temperature.

3.2 Noise testing

Another parameter that was tested was the noise generated by the fans of the cooling system. The reason for noise measurement was the potential impairment of the comfort of

using the complete device, i.e. the impossibility of using it at home due to the noise created by the cooling system. The noise measurement was performed in different operating modes of the cooling system. The test was performed in a room where there is partial silence (not a deaf room), at a distance of 0.1 m and at a distance of 2 m, which represents the minimum distance between the device and the user during the use (Figure 8.2.1). The noise measurement was done with an Extech HD 450 sound level meter. The expected results of the noise test are from 50 to 60 dB, which represents the level of noise generated by personal computers. Exposure to noise greater than 70 dB for a long period of time poses a risk of hearing damage for humans.

The noise measurement test was performed in two operating modes of the device. For each operating mode, one measurement was made at the set distances. All measurement results are presented in Table 2.

Table 2. Noise testing results

<i>Measurement No.</i>	<i>Active Fan</i>	<i>Distance [m] / Noise [dB]</i>	
		<i>0.1</i>	<i>2</i>
1	No	30.9	30.9
2	Yes	51	36.7

Results showed that noise without the assembly fan is 30.9 dB. It was not the noise that comes from the device, but the noise in the room where the measurement is performed. This noise level is negligible for the human. In various operating modes of the fan, it was observed an increase in the noise level, which reaches 51 dB in the close vicinity of the device i.e., at a distance of 0.1 m, and 36.7 dB at a distance of 2 m. This shows that the NESPI 4 CASE housing with a Raspberry Pi 4 computer is on par with other home devices of similar purpose in terms of the level of noise they produce, for example RetroPie consoles. That means that a device with such an active cooling system is human safe for long and continuous use.

3. CONCLUSION

Combination of CAD software, additive technologies, and CNC machines lead that the product development process has become more streamlined and efficient than ever before. Additive technologies such as 3D printing has allowed rapid prototyping of new products, testing of different materials and designs, and the ability to make quick modifications to the design if necessary. Furthermore, the use of these technologies has significantly reduced the costs associated with product development as well as greater customization and personalization of product, making it more accessible to smaller businesses and individuals. On the other side, additive technologies have some limitations such as used materials, and 3D printed product cannot be always used as final one. Therefore, CNC

machines can accurately and quickly produce complex shapes and geometries with high precision and using many different materials, ensuring that the final product meets the required specifications, but often with higher costs for one part compared to 3D printing process.

This paper presents the application of additive technologies in development process of prototype active cooling system for the Raspberry Pi 4 computer. The prototype of the cooler was produced using 3D printing technology, while final product is produced on CNC milling machine. Visual inspection and functionality testing confirmed that during the operation of the device there is no contact between the rotating parts of the fan and the cooler, which was one of the main goals in the product development process. Temperature tests showed that by using active cooling system, operating temperature of the computer was decreased about 35%, while noise tests showed that noise level was lower than one generated by personal computers, so it can be used without possibility to make damage to human health.

4. LITERATURE

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APPLICATION OF VIRTUAL MODELS IN THE DESIGN OF A ROBOTIC GRIPPER

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ABSTRACT:

The development of the design of complex mechanisms using virtual models obtained by integrating different software packages is presented in this paper. The design, analysis and simulation of movement of the considered mechanism is carried out on the example of a robotic gripper. The SolidWorks software package is used to generate the 3D model. The virtual model and the control algorithm is realized in the MATLAB software package. An analysis of the required movements in order to achieve the production cycle of the mentioned mechanism is also carried out. By analysing certain parameters of the system, optimal characteristics of individual components were selected to obtain the required characteristics of the mechanism and a simulation of its operation was performed.

Keywords: robotic gripper, virtual model, analysis, simulation, Matlab, SolidWorks

1. INTRODUCTION

The robotic gripper is the essential device or working part of an industrial robot. It has the task of picking up a work object and manipulating it during the execution of a task. [1] The gripper should be designed in such a way as to ensure the most accurate possible positioning of the object within the gripper, and therefore in relation to the entire robot. Additionally, the design of the gripper should provide a firm enough grip to maintain positioning accuracy during manipulation of the object to perform the work task. [2]

The basic function of each robotic gripper consists of a three-phase process (Fig. 1):

1. Grasping of the object;
2. Holding the object during manipulation (positioning);
3. Releasing the object.

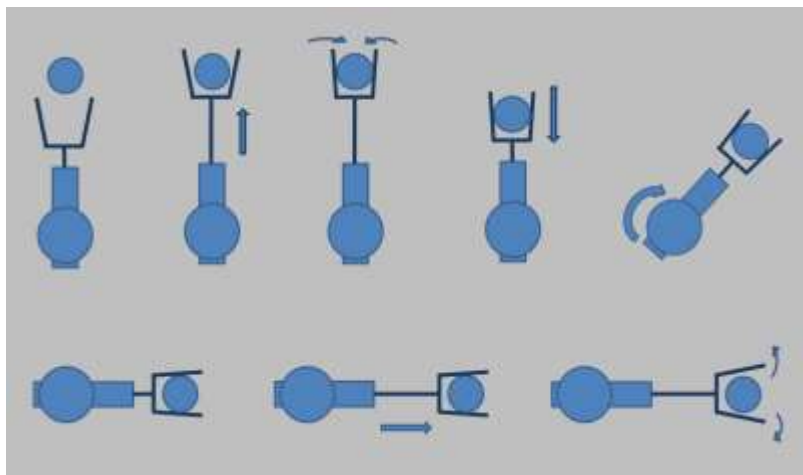


Fig. 1. Operation of the robotic gripper

Robotic grippers can be divided according to several criteria [3] (Table 1):

Table 1. Types of robotic grippers according to criteria

<i>Types of robotic grippers based on:</i>				
<i>Type of fingers</i>	<i>Numbers of fingers</i>	<i>Movement of fingers</i>	<i>Position of grasping</i>	<i>Grasping method</i>
- mechanical - vacuum - magnetic - customizable	- two - more	- linear - rotational	- outside grasping - inside grasping	- friction - geometric shape

In addition, a virtual model of a robotic gripper with two mechanical fingers, with rotary movement and external gripping of the work object with a geometric shape, was developed.

2. DESIGNING A VIRTUAL MODEL OF THE ROBOTIC GRIPPER

The *SolidWorks* software package was used to generate the model geometry. The gripper is designed so that it consists of the following elements: a base, a slider, a pneumatic or hydraulic cylinder, two connecting rods and two jaws that together form a moving mechanism.

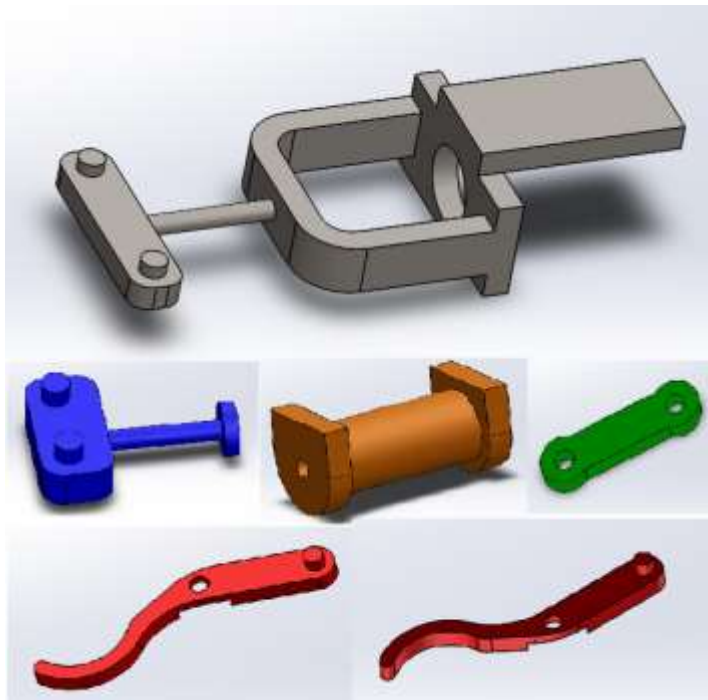


Fig. 2. Generated 3D model parts of the robotic gripper: base, slider, pneumatic/hydraulic cylinder, connecting rod, right and left jaw (respectively)

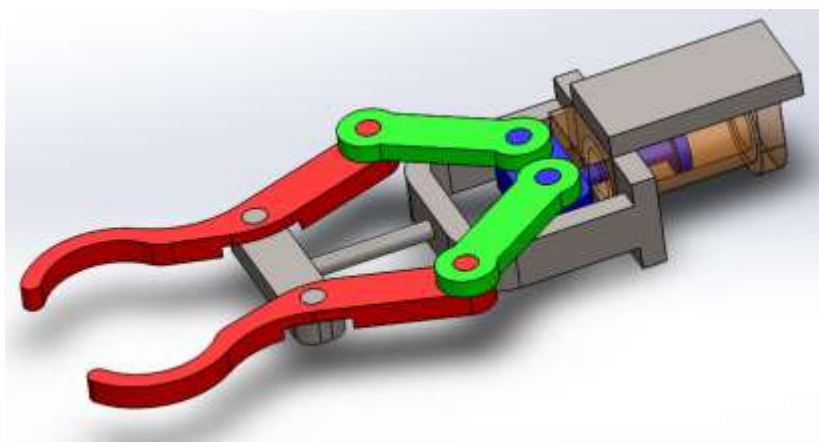


Fig. 3. 3D assembly model of the robotic gripper

Table 2 shows the masses, surfaces, volumes and moments of inertia (measured from the center of mass) of individual gripper elements.

Table 2. Geometrical and mass characteristics of gripper assembly and its elements

Part name	Base	Cylinder	Slider	Connecting rod	Left Jaw	Right jaw	Assembly
Mass (g)	886.01	405.74	176.95	91.71	164.63	164.63	1981.38
Volume (mm ³)	112867.67	51686.53	22541.76	11682.41	20972.39	20972.39	252405.56
Area (mm ²)	33534.76	17356.55	6728.12	5077.85	8516.85	8516.85	84808.83
Moment of inertia (g*mm ²)	Px	607295.76	82822.3	34213.11	4072.53	11875.28	1623505.01
	Py	3251083.75	368940.09	58400.06	49832.64	374325.33	9354402.33
	Pz	3646909.7	369372.15	84297.45	53045.42	382920.05	10533412.84

All the 3D models together with the assembly were first saved as *.stl* files (*StereoLithography* or *Standard Tessellation Language* - one of the standard formats used to describe the geometry of a three-dimensional object), before converted to *.xml* (*Extensible Markup Language*) format in order to be imported into the *Matlab* environment.

3. DEFINING THE VIRTUAL MODEL OF THE ROBOT GRIPPER

A library of standard components is available in *MatLab* for generating models of any mechanism in *Simulink*. [4] *Matlab Simulink* stores the model information necessary to run the simulation by converting *.xml* files to *.slx* (*Simulink Extension*) files.

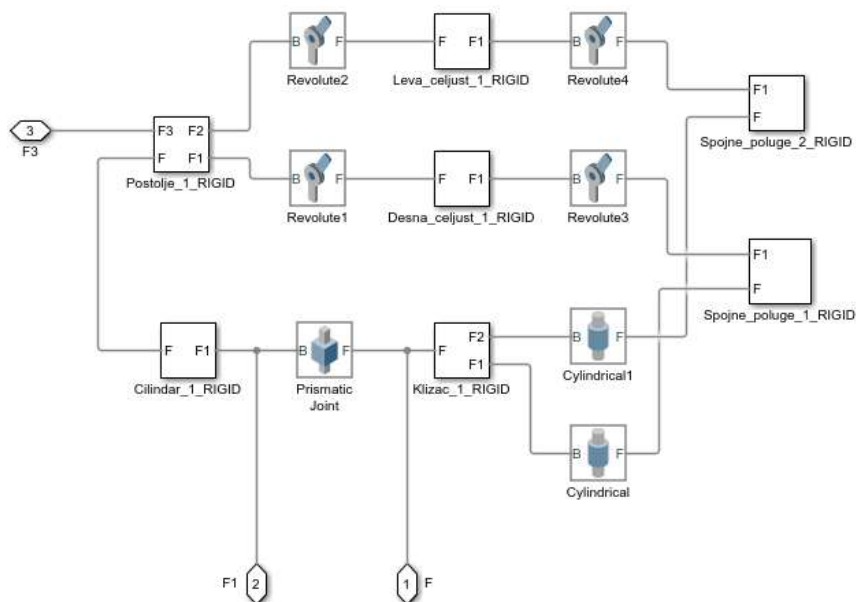


Figure 4. Block diagram of the robotic gripper subsystem

Blocks with the suffix *RIGID* shown in the Figure 4 correspond to the 3D models of the robot gripper, i.e. the base, cylinder, slider, left and right jaws and two connecting rods. The number of inputs/outputs to the blocks depends on the mutual physical connections between the parts.

Revolute type blocks define the rotary movement between the elements, *Prismatic Joint* blocks define the linear movement of the slider through the cylinder opening, while *Cylindrical* blocks define both the rotary and linear movement between the slider and the connecting rods.

The letters *B* and *F* at the blocks represent the *base* and *follower* inputs, respectively.

The hexagonal blocks marked with the letters *F* represent outputs from the subsystem, which are connected to the basic (configurational) blocks as well as to the starting blocks of the scheme.

Configuration blocks are also obtained during the conversion of the model from *.xml* to *.slx* format. They are used to define the physical connections between the elements as well as the model and the environment in which the simulation is run.

Actuator blocks are blocks that simulate a physical actuator. In this case, it is a hydraulic actuator. These blocks are manually inserted and connected into a complete scheme.

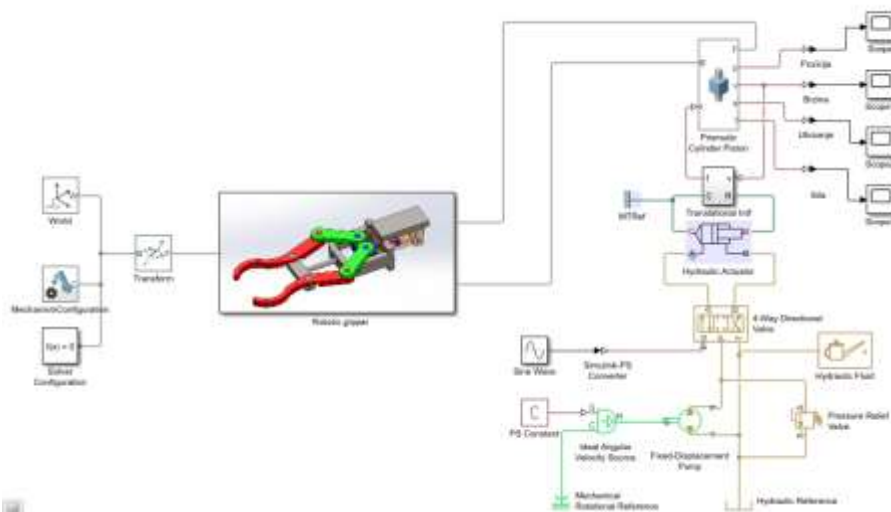


Figure 6. Robotic gripper block diagram

The *Robotic gripper* block represents the subsystem from Figure 4. On the left side of the block diagram are the basic (configuration) blocks, while on the right side are the operating blocks.

4. SIMULATION OF MOVEMENT

Before starting the simulation, a duration of the simulation needs to be defined. After that, a *Simulink* model can be activated by pressing the command *Run*. [8], [9] Simulation is set to 15 seconds, which is enough to complete two cycles of closing and opening of jaws. Figure 7 shows screenshots of the simulation in moments where the piston is in starting position (gripper jaws are fully open) and where the piston is in its last position (gripper jaws are fully closed). During that period, the signals such as physical values, i.e. force, position, velocity and acceleration of the hydraulic piston actuator can be monitored and analysed by using the standard *Scope* block (Fig. 8).

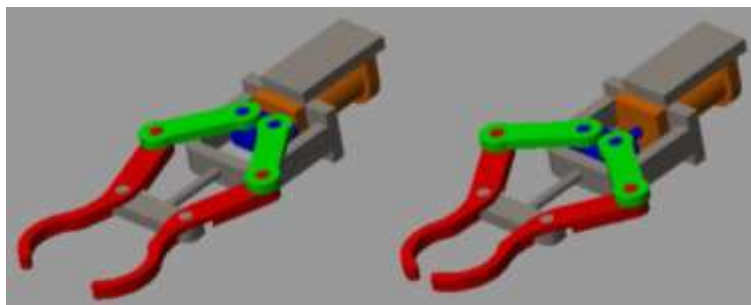


Figure 7. The position of the jaws in the end positions of the piston in cylinder

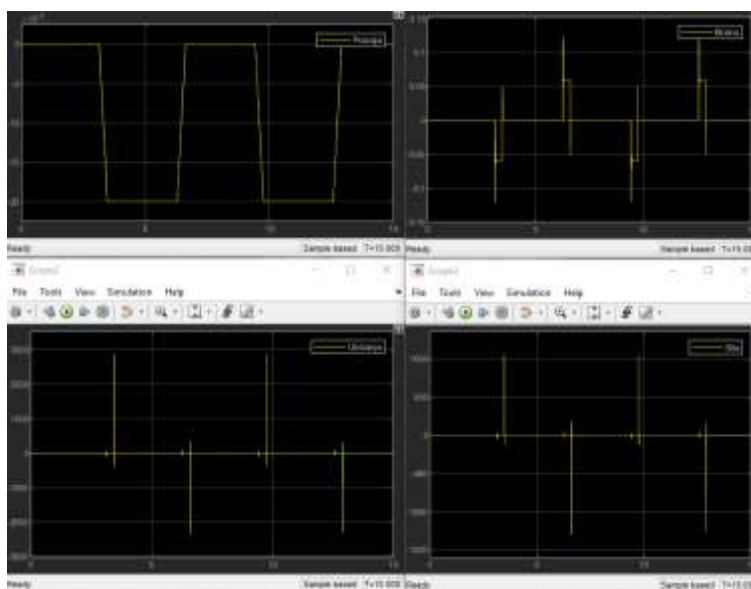


Figure 8. Diagrams of piston position, velocity, acceleration and force as a function of time

5. CONCLUSION

The application of two different software tools enables the analysis of all required elements, their dimensioning, the selection of materials, as well as movement analysis of the entire mechanism.

In the machine designing process, the application of virtual models with an integrated control algorithm enables the simulation of operation and verification of the system

properties, before the realization of the physical model. This approach in designing not only provides a visual representation of the design of the individual parts of the mechanism but also enables description and simulation of its physical behaviour. This is of great importance for accurately defining and dimensioning individual segments of the system, as well as observing how the whole mechanism functions. In this way, it is possible to achieve a significant reduction of time and resources required for the production and modification of the physical model.

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NUTRITIVNI I FUNKCIONALNI PROFIL SREMUŠA OSMOTSKI DEHIDRISANOG U MELASI ŠEĆERNE REPE

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SAŽETAK:

*Sremuš (*Allium ursinum* L.) se od davnina koristi u tradicionalnoj medicini kao lekovita biljka, a poslednjih godina sve više dobija na značaju, jer su brojna naučna istraživanja potvrdila njegova izuzetna nutritivna i antioksidativna svojstva. Funkcionalnim svojstvima sremuša najviše doprinose u velikoj mera prisutna sumporna i fenolna jedinjenja, a takođe i minerali, vitamini, prehrambena vlakna, isparljiva jedinjenja itd. Melasa koja zaostaje nakon industrijske prerade šećerne repe je visokokoncentrovana tečna mešavina šećera i mnogih vrednih jedinjenja poput minerala i polifenola. Usled jednostavne i jeftine implementacije u procesu osmotske dehidracije i zbog svog povoljnog nutritivnog sastava koji obogaćuje dehidrisani materijal, pokazala se kao odlična alternativa uobičajenim osmotskim rastvorima. Osmotskom dehidracijom listova sremuša potopljenih u melasu, na sobnoj temperaturi u trajanju od 4 sata se na energetski i ekonomski efikasan, a pre svega ekološki podoban način postiže smanjivanje vlage u listovima sremuša (preko 50%). U radu su analizirani osnovni hemijski sastav, mineralne materije (Mg, K, Ca, Fe, Zn i Cu), ukupni fenoli, flavonoidi i tiosulfinati u listovima sremuša pre i posle osmotske dehidracije. Rezultati su pokazali da je melasa šećerne repe kao osmotski rastvor uticala na porast ukupnih fenola za oko 10% i flavonoida za oko 15%, u dehidrisanim listovima sremuša, putem masenog transfera ovih bioaktivnih jedinjenja iz melase u tkivo sremuša tokom procesa. Takođe, zbog svog bogatog mineralnog sastava, melasa je doprinela povećanju Ca i Mg za oko 1,2 puta, Cu i Zn oko 1,8 puta, K 3,56 puta i Fe 6 puta u osmotski dehidrisanom sremušu.*

Ključnereči: osmotska dehidracija, sremuš, melasa šećerne repe, minerali, fenoli

1. UVOD

Sremsuš (*Allium ursinum* L.) se kao lekovita biljka od davnina koristi u tradicionalnoj medicini, ali je u poslednje dve decenije povećano interesovanje naučnika i upotreba sremsuša u ishrani, zbog izuzetnih nutritivnih i antioksidativnih svojstava koje poseduje [1, 2]. Antioksidativna aktivnost sremsuša povezuje se sa brojnim sumpornim jedinjenjima i njihovim prekursorima, kao i drugim prisutnim bioaktivnim komponentama kao što su polifenoli, minerali, terpenoidi, karotenoidi, vitamini, prehrambena vlakna [2, 3]. U dosadašnjim istraživanjima iz sremsuša je izolovano nekoliko klasa bioaktivnih jedinjenja, među kojima su kvantitativno i kvalitativno najdominantnija sumporna i fenolna jedinjenja [4]. Iako je potvrđeno da svi anatomske delovi sremsuša poseduju antioksidativna svojstva, najveća aktivnost izmerena je u listovima, pre svega zbog visokog sadržaja flavonoida [5]. Takođe, na antioksidativnu aktivnost i fenolni profil sremsuša utiče sezona branja, stepen zrelosti, fiziološke promene i vremenski uslovi u periodu razvoja biljke, agrotehničke mere, kao i vreme i uslovi skladištenja sremsuša [6]. Bogat i raznolik sastav mineralnih komponentata u sremsušu uslovljava njegovu visoku fiziološku vrednost, što je posebno značajno sa nutritivnog aspekta, jer se sremsuš najčešće konzumira u svezem stanju [7]. Prema procentu zastupljenosti mineralnih materija u sremsušu, najzastupljeniji su makroelementi kalijum (68%), kalcijum (19%), fosfor (8%) i magnezijum (4%). Pored nutritivno značajnih makroelemenata u sremsušu je prisutno i ukupno oko 1% svih mikroelemenata kao što su: mangan, cink, kobalt, hrom, selen, nikl, molibden [8]. Iako se za sumporna jedinjenja smatra da najviše doprinose terapeutskom potencijalu ove biljke, ona su termolabilna, pa je poželjno da se ekstrakcija i sušenje odvijaju na sobnoj temperaturi, kako bi se očuvala funkcionalna vrednost listova sremsuša [9].

Brojne studije su pokazale da se osmotskom dehidracijom dobijaju delimično osušene namirnice u kojima je početna vlaga smanjena i do 50%, sa minimalnim oštećenjima ćelija i strukture tkiva i visokim nivoima zadržavanja ukusa i nutritijenata [10, 11]. Ovaj proces podrazumeva potapanje svežeg biljnog materijala u visokokonzentrovane osmotske rastvore, pri čemu nastaje fenomen multikomponentnog masenog transfera između materijala i rastvora, usled razlika u njihovim koncentracijama [11, 12]. Osmotska dehidracija je energetski nezahtevan proces koji se može efikasno odvijati i na sobnoj temperaturi, a s obzirom da se voda iz prehrambenog materijala uklanja u tečnom stanju, nije potrebna dodatna energija za fazni prelaz [13].

Melasa koja zaostaje nakon industrijske prerade šećerne repe je visokokonzentrovana tečna mešavina šećera i preko 200 raznovrsnih nešećernih jedinjenja. Pored brojnih nutritivno vrednih jedinjenja poput minerala, u melasi zaostaju i antioksidativne komponente iz šećerne repe, kao što su fenolna jedinjenja [13, 14]. Takođe, antioksidativna jedinjenja mogu da se generišu i tokom procesa industrijske prerade, što se pre svega odnosi na melanoidine (obojene proizvode), za koje je potvrđeno da imaju antioksidativne sposobnost [14].

Melasa je jeftina sirovina, dostupna u velikim količinama, a pored visokog sadržaja suve materije (i do 90%) se nalazi u tečnom stanju, pa je sa tehnološkog stanovišta njena implementacija u procesu osmotske dehidracije jednostavna [15]. Ipak, kao odlična

alternativa uobičajenim osmotskim rastvorima, melasa se pokazala pre svega zbog svog povoljnog nutritivnog sastava kojim obogaćuje dehidrisani materijal [15, 16].

Cilj ovog rada bio je da se ispita uticaj melase šećerne repe na komponente osnovnog hemijskog sastava, mineralne materije i ukupne fenole, flavonoide i tiosulfinate u listovima sremuša tokom četvoročasovnog procesa osmotske dehidracije.

2. MATERIJAL I METODE

2.1. Materijal

Sremuš, biljna sirovina potrebna za istraživanja, sakupljen je u aprilu, u šumskoj oblasti obronaka planine Fruške gore (45°08'34.6"N; 19°36'55.0"E). Ručno su birani neoštećeni listovi sremuša, koji su nakon ubiranja odneti u laboratoriju, oprani i u svežem stanju upotrebljeni u procesu osmotske dehidracije. Melasa šećerne repe, sa sadržajem suve materije 85,04% je dobavljena iz šećerane u Crvenki i čuvana u zatvorenim plastičnim posudama na sobnoj temperaturi, pre nego što je upotrebljena kao osmotski rastvor.

2.2. Postupak osmotske dehidracije

Listovi sremuša su ručno odvajeni od stabljike, temeljno oprani i osušeni uz pomoć papirnih ubrusa, a zatim isečeni makazama na komadiće dimenzija približno 1x1 cm. Nakon toga, prethodno odmereni uzorci svežih listova sremuša potopljani su u laboratorijske čaše prethodno napunjene sa melasom, pri čemu je maseni odnos biljne sirovine i osmotskog rastvora u svakoj čaši iznosio 1:20, kako bi se tokom dehidracije sremuša sprečilo prekomerno razređivanje melase i omogućilo da uzorak bude dobro potopljen i prekriven osmotskim rastvorom. Proces se odvijao na sobnoj temperaturi, atmosferskom pritisku, za vreme trajanja od 4 sata. Na svakih 15 minuta pristupalo se ručnom mešanju, radi bolje homogenizacije rastvora i difundivane vode iz potopljenih uzoraka, i poboljšanja masenog transfera koji se odvija tokom procesa. Nakon 4 sata uzorci se izdvojeni iz osmotskog rastvora, isprani tekućom vodom radi uklanjanja melase koja se zadržala na površini sremuša, a zaostala voda sa površine dehidrisanih uzoraka je upijana papirnim ubrusima. Ovako dobijeni uzorci su odmereni i čuvani u frižideru za dalje analize.

2.3. Metode određivanja hemijskog sastava

Određivanje sadržaja odabranih hemijskih komponenti uslovljeno je nastojanjem da se prate promene u hemijskom sastavu sremuša uzrokovane masenim transferom tokom osmotske dehidracije. Sadržaj analiziranih komponenti je određivan u skladu sa standardnim AOAC metodama [17]: proteini (metod No. 950.36), lipidi (metod No. 935.38), celuloza (metod No. 973.18), skrob (metod No. 996.11), ukupni šećeri (metod No. 80-68), pepeo (metod No. 930.22). Svako merenje je izvedeno u tri ponavljanja.

2.4. Metode određivanja sadržaja minerala

Sadržaj sledećih mineralnih materija – kalijum (K), kalcijum (Ca), cink (Zn), bakar (Cu), magnezijum (Mg) i gvožđe (Fe), u ispitivanim uzorcima je određen praćenjem standardnih AOAC metoda [17]. Navedene mineralne komponente su analizirane atomskom apsorpcionom spektrofotometrijskom tehnikom (metod No. 984.27) na instrumentu Varian Spectra AA 10 (Varian Techtron Pty Ltd., Mulgware Victoria, Australija). Za svaki ispitivani mineral merenje je ponovljeno tri puta.

2.5. Određivanje sadržaja ukupnih fenola, flavonoida i tiosulfata

2.5.1. Priprema ekstrakata za određivanje sadržaja fenolna i flavonoida

Za određivanje fenola u uzorcima osmotski dehidrisanih listova sremuša ispitivani uzorci su pripremljeni kao metanolni ekstrakti, upotrebom 80% metanolu, u odnosu 1:10 (m/V). Ekstrakcija se odvijala na sobnoj temperaturi uz mućkanje u trajanju od 24h. Posle toga, dodatno je izvedena ultrazvučna ekstrakcija pomoću ultrazvučnog kupatila (EUP540A, Eustruments, Francuska) u trajanju od 10 min. Zatim je uzorak profltriran i dalje korišćen za analize.

2.5.2. Spektrofotometrijsko određivanje sadržaja ukupnih polifenola

U dobijenim ekstraktima, sadržaj ukupnih fenola određen je spektrofotometrijskom metodom po Folin–Ciocalteu, merenjem intenziteta plave boje koji nastaje nakon reakcije redukujućeg anjona Folin-Ciocalteu reagensa i fenoksidnog anjona iz polifenolnih jedinjenja [18].

0,1 ml odgovarajućeg metanolnog ekstrakta je pomešan sa 7,9 ml destilovane vode, 0,5 ml Folin-Ciocalteu reagensa i 1,5 ml 20% Na_2CO_3 . Za pripremu slepe probe je umesto 0,1 ml uzorka dodato 0,1 ml ekstragensa. Reakciona smeša je inkubirana 1 h na sobnoj temperaturi, nakon čega je izmerena apsorbanca na spektrofotometru (model 6300, Jenway, Velika Britanija) na talasnoj dužini od 750 nm.

Sadržaj ukupnih fenola izračunat je na osnovu kalibracione krive standardnog rastvora galne kiseline i izražen kao ekvivalent galne kiseline (EGK) u 100 g suve materije ispitivanog uzorka.

2.5.3. Spektrofotometrijsko određivanje sadržaja ukupnih flavonoida

Određivanje sadržaja ukupnih flavonoida izvedeno je pomoću spektrofotometrijske metode po Markham-u, koja je zasnovana na sposobnosti flavonoida da sa metalima grade odgovarajuće metalo-organske komplekse [18].

Priprema reakcione smeše obuhvata mešanje 1 ml uzorka (odgovarajućeg metanolnog ekstrakta) sa 4 ml destilovane vode i 0,3 ml 5% natrijum nitrita (NaNO_2). Nastala smeša je 6 minuta inkubirana na sobnoj temperaturi, nakon čega joj je dodato 0,3 ml aluminijum hlorid heksahidrata ($\text{AlCl}_3 \times 6\text{H}_2\text{O}$) i posle 5 minuta još 2 ml 1 M natrijum hidroksida

(NaOH), i na kraju je dopunjena destilovanom vodom do ukupne zapremine od 10 ml. Na spektrofotometru (model 6300, Jenway, Velika Britanija) merena je apsorbanca uzorka, na talasnoj dužini od 510 nm.

Sadržaj ukupnih flavonoida izračunat je na osnovu kalibracione krive standardnog rastvora katehina i izražen kao ekvivalent katehina (EK) u u 100 g suve materije ispitivanog uzorka.

2.5.4. Određivanje ukupnih tiosulfinata

Ukupni tiosulfinati određeni su na osnovu metode opisane u radu Han i sar. (1995), uz izvesne modifikacije [19].

Metoda se zasniva se na indirektnoj reakciji L-cisteina u višku sa jedinjenjem 5,5'-ditiobis-(2-nitrobenzeva kiselina) (DTNB), prilikom čega nastaje jedinjenje 2-nitro-5-tiobenzoatom (TNB²⁻). Ovako nastalo jedinjenje jonizuje u sredini koja je neutralna do alkalna, dajući žuto obojenje. Ukupni tiosulfinati su u korelaciji sa nastalim jonizovanim jedinjenjem. Liofilizacijom osušeni uzorci (2,5 g), ekstrahovani su sa 20 ml HEPES (4-(2-hidroksietil)-1- piperazinetanesulfonska kiselina) pufera (50 mM, pH 7,5) uz mešanje na orbitalnoj mešalici (300 o/min), tokom 15 min, na sobnoj temperaturi. Nakon ekstrakcije, dobijeni ekstrakt je centrifugiran na 10000 o/min, u trajanju od 10 min i profiltriran. Dobijeni ekstrakt (1 ml) pomešan je sa 1 ml L-cisteina (5 mM u HEPES puferu). Formirana reakciona smeša je razblažena do 50 ml i ostavljena 15 min na sobnoj temperaturi. 9 ml dobijene smeše reaguje sa 1 ml rastvora DTNB (1,5 mM u HEPES puferu). Na talasnoj dužini od 412 nm, očitana je apsorbanca, nakon 15 minuta.

Za slepu probu je umesto ekstrakta upotrebljen čist rastvarač (HEPES pufer).

Sadržaj ukupnih tiosulfinata izražen je kao ekvivalent alicina (EAC) u 100g suve materije ispitivanog uzorka i izračunat po sledećoj formuli:

$$C_{\text{tiosulfinata}} = (\Delta A * 100) / (2 * 14150) \quad (1)$$

ΔA – razlika između apsorbanca slepe probe i probe, 14150 – molarnikoeфицијent za DTNB, 2 – broj molova cisteina koji su potrebni za nastajanje tiosulfinata.

3. REZULTATI I DISKUSIJA

Od ukupnih 7,91% suve materije u svežem sremušu, hemijskom analizom je utvrđeno da proteini učestvuju sa 33,97%, celuloza sa 32,12%, masti sa 0,11% i pepeo sa 9,80% (tabela 1.). Slično prezentovanim rezultatima, Piatkowska i sar. (2015), su izvestili da je sadržaj suve materije u svežem sremušu iznosio 7,9%, od kojih sadržaj proteina čini 17,72% , 34,05% vlakana, 7,08% masti i minerali izraženi kao pepeo 11.26% [7].

Tabela 1. Hemijski i mineralni sastav svežih i osmotski dehidrisanih listova sremuša u melasi šećerne repe

	Svež sremuš	Dehidrisan sremuš

Proteini (% s.m.)	33,97 ± 1,27 ^a	28,04 ± 1,11 ^c
Skrob (% s.m.)	0,00 ± 0,00 ^a	0,00 ± 0,00 ^a
Šećeri (% s.m.)	0,00 ± 0,00 ^a	9,77 ± 0,94 ^b
Celuloza (% s.m.)	32,12 ± 1,81 ^a	26,47 ± 0,74 ^c
Lipidi (% s.m.)	0,11 ± 0,01 ^a	0,09 ± 0,01 ^b
Pepeo (% s.m.)	9,80 ± 0,51 ^a	10,05 ± 0,71 ^a
Mg (mg/kg)	911,77 ± 89,19 ^a	896,12 ± 49,71 ^b
K (mg/kg)	4692,01 ± 83,71 ^a	13806 ± 94,20 ^c
Ca (mg/kg)	1432,01 ± 93,91 ^a	1461,68 ± 40,35 ^c
Fe (mg/kg)	18,71 ± 2,01 ^a	95,53 ± 7,49 ^b
Zn (mg/kg)	5,31 ± 0,37 ^a	8,01 ± 0,59 ^c
Cu (mg/kg)	1,63 ± 0,10 ^a	2,45 ± 0,39 ^c

^{a-c} Različita slova u eksponentu u istom redu tabele ukazuju na statistički značajnu razliku između vrednosti, pri nivou značajnosti od $p < 0,05$ (na osnovu post-hoc Tukey-evog HSD testa), s.m.-suva materija

U slučaju osmotski dehidrisanih uzoraka sremuša, ukupan procenat sadržaja ispitivane komponente je umanjen za 17,5% suve materije usvojene iz melase u odnosu na procentualni sadržaj iste komponente u svežem sremušu. Na osnovu ovog proračuna uočava se da sadržaj proteina, celuloze i masti ostaje nepromenjen u uzorcima sremuša nakon osmotske dehidratacije u melasi. S druge strane, rezultati prikazuju da je osmotska dehidratacija dovela do inkorporacije značajne količine ukupnih šećera iz osmotskih rastvora (9,77% iz melase) u dehidrisani sremuš. Takođe, sadržaj pepela u osmotski dehidrisanim uzorcima je povećan u odnosu na svež sremuš za oko 2% nakon dehidratacije, kao posledica inkorporacije mineralnih materija iz melase.

U istraživanju autora Vučić i sar. (2018), sadržaj ispitivanih makroelemenata u uzorcima sremuša sa različitih lokacija je bio u proseku: 326 mg/kg Mg, 32 mg/kg za Na, 1545 mg/kg Ca, a sadržaj ispitivanih mikroelemenata u opsegu: 15 mg/kg Fe, 2,4 za Zn i 1,7 mg/kg za Cu [20]. Podaci su u saglasnosti sa prezentovanim rezultatima (tabela 1), ali su utvrđene količine za Mg, Fe i Cu u okviru ovog istraživanja bili veće.

U odnosu na svež sremuš, sadržaj Ca i Mg u uzorku osmotski dehidrisanom u melasi je povećan oko 1,2 puta, Cu i Zn oko 1,8 puta, K 3,56 puta i Fe 6 puta. Očigledno je da je melasa kao osmotski rastvor, zbog svog bogatog mineralnog sastava doprinela povećanju svih ispitivanih komponenti. Najdominantniji makroelement u melasi je K koji se gotovo potpuno akumulira u melasi tokom proizvodnje šećera u opsegu od 2190mg/100g do čak 6000mg/100g, dok je Fe dominantan mikroelement koji u melasi varira u količini od 27

do 117mg/kg suve materije [15, 21]. Nakon osmotske dehidracije u melasi, u listovima sremuša uočen je najveći porast upravo ove dve mineralne komponente.

Sadržaji ukupnih fenola i flavonoida u analiziranom uzorcima svežeg sremuša (tabela 2) u saglasnosti su sa istraživanjem autora Pejatović i sar. (2017), gde je pokazano da su veće vrednosti sadržaja ukupnih fenola i flavonoida određene u 80% metanolnom ekstraktu suvog lišća sremuša, u odnosu na vrednosti dobijene analiziranjem 70% etanolnog ekstrakta. U okviru ovog istraživanja autori su potvrdili da ukupni sadržaj fenola zavisi od lokacije sa koje potiče sremuš, ekotipa, kao i polarnosti rastvarača upotrebljenog za ekstrakciju, i kretao se u rang od 1,03 do 2,11 g EGK/100g s.m [1].

Tabela 2. Ukupni fenoli, flavonoidi i tiosulfinati svežih i osmotski dehidrisanih listova sremuša u melasi

	Ukupni fenoli (g EGK/100g s.m.)	Ukupni flavonoidi (g EK/100g s.m.)	Ukupni tiosulfinati (g EAC/100g s.m.)
Svež sremuš	2,739 ± 0,043 ^a	2,044 ± 0,018 ^a	1,792 ± 0,028 ^a
Dehidrisan sremuš	3,016 ± 0,025 ^c	2,366 ± 0,034 ^c	1,747 ± 0,031 ^a

EGK- ekvivalent galne kiseline, EK- ekvivalent katehina, EAC- ekvivalent alicina

^{a-c} Različita slova u eksponentu u istoj koloni tabele ukazuju na statistički značajnu razliku između vrednosti, pri nivou značajnosti od $p < 0,05$ (na osnovu post-hoc Tukey-evog HSD testa)

Melasa šećerne repe kao osmotski rastvor tokom procesa dehidratacije sremuša, ne samo da je očuvala početni sadržaj ispitivanih fenola i flavonoida, nego je uticala i na njihovo povećanje. Primetan je porast ukupnih fenola za oko 10% i flavonoida za oko 15%, u odnosu na svež sremuš. Više studija je potvrdilo da melasa šećerne repe predstavlja bogat izvor fenola i flavonoida, pa je očekivano da je inkorporacija rastvorenih supstanci iz melase u tkivo sremuša, obuhvatala i neke od ovih bioaktivnih jedinjenja, što objašnjava povećan sadržaj fenola u krajnjem produktu [22, 23].

Rezultati pokazuju da nakon četvoročasovne osmotske dehidracije listova sremuša u melasi nije uočena statistički značajna razlika u pogledu sadržaja ukupnih tiosulfinata. Značajniji gubitak ukupnih tiosulfinata izbegnut je time što je kao vid sušenja odabrana osmotske dehidratacija na sobnoj temperaturi, jer je poznato da su ova jedinjenja termolabilna. Na višim temperaturama, koje su uobičajene za konvektivno sušenje dolazi do ometanja aktivnosti enzima alinaze, odgovornog za stvaranje tiosulfinata i konverziju aliina u alicin, ili do potpune inaktivacije ovog enzima [24]. Pored toga, izlaganje sremuša visokim temperaturama može uticati na razgradnju formiranih tiosulfinata na disulfide [25]. Negativan uticaj temperature na tiosulfinate prisutne u sremušu potvrđen je u radu Tomšik i sar. (2016), gde je dobijeni sadržaj ukupnih tiosulfinata u sremušu konvektivno osušenom na 60°C (0,61 g AEC/100 g s.m) za oko 40% niži u poređenju sa istim uzorkom kada je temperatura konvektivnog sušenja bila 40°C (1,01 g AEC/100 g s.m) [18].

4. ZAKLJUČAK

Rezultati su pokazali da je melasa šećerne repe kao osmotski rastvor uticala na očuvanje ukupnih tiosulfata i komponenata osnovnog hemijskog sastava, a doprinela povećanju ispitivanih minerala i ukupnih fenola i flavonoida u dehidrisanim listovima sremuša. Do povećanja je došlo putem masenog transfera minerala i bioaktivih jedinjenja iz melase u tkivo sremuša tokom procesa. Može se zaključiti da se osmotskom dehidratacijom u melasi, na energetski i ekonomski efikasan, a pre svega ekološki dobar način postiže poboljšan nutritivni i funkcionalni profil listova sremuša.

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NUTRITIONAL AND FUNCTIONAL PROFILE OF WILD GARLIC OSMOTICALLY DEHYDRATED IN SUGAR BEET MOLASSES

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ABSTRACT:

Wild garlic (Allium ursinum L.) has been used in traditional medicine since ancient times, but in recent years numerous studies confirmed its exceptional nutritional and antioxidant properties. Sulfuric and phenolic compounds contribute the most to the functional properties of wild garlic, as well as minerals, vitamins, dietary fibers, and volatile compounds. The molasses that remains after the industrial processing of sugar beet is a highly concentrated liquid mixture of sugar and many valuable compounds such as minerals and polyphenols. Due to the simple and cheap implementation in the process of osmotic dehydration and due to its favorable nutritional composition that enriches the dehydrated material, it has proven to be an excellent alternative to the usual osmotic solutions. By osmotic dehydration in molasses, at room temperature for 4 hours, in an ecologically, energetically and economically efficient way, the moisture content of wild garlic is reduced (over 50%). The paper analyzes the basic chemical composition, mineral substances (Mg, K, Ca, Fe, Zn and Cu), total phenols, flavonoids and thiosulfates in the wild garlic before and after osmotic dehydration. The results showed that molasses as an osmotic solution influenced the increase of total phenols by about 10% and flavonoids by about 15%, in dehydrated leaves, through the mass transfer during the process. Also, due to its rich mineral composition, molasses contributed to the increase of Ca and Mg by 1.2 times, Cu and Zn by 1.8 times, K by 3.56 times and Fe by 6 times in osmotically dehydrated wild garlic.

Keywords: osmotic dehydration, wild garlic, sugar beet molasses, minerals, phenols

RAČUNARSTVO I INFORMACIONE TEHNOLOGIJE

***COMPUTER SCIENCE AND INFORMATION
TECHNOLOGY***

PREDICTION OF HOTEL RESERVATION CANCELLATION BASED ON MACHINE LEARNING MODELS

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ABSTRACT:

With the ever-increasing global focus on the tourism industry, the need to obtain different types of information from a large amount of data has emerged. This can be achieved by employing different machine learning (ML) models. The goal of this study is to design the specialized ML model that can successfully predict the outcome of a hotel reservation, based on its main characteristics, in order to establish better and more efficient decision-making process. This research is based on the assumption that there are hotel reservation parameters that can have a positive or negative impact on their realization. In this paper, a real hotel reservation data was used, which includes the basic characteristics of reservations in two hotels in Lisbon, Portugal. The methodology in this research included several steps of data preprocessing in order to transform the data into a suitable form for model training. In addition, comparison of ML models based on their results obtained through the conducted experiments was performed. Several different ML models with different hyperparameter values were designed and tested (Random Forest, C4.5, and K-nearest neighbors). The highest accuracy was achieved using the Random Forest algorithm (88.70%). The results show the potential of machine learning application in hotel management, especially when determining the optimal occupancy schedule of hotel capacities. This represents a significant business advantage, and it is critical in the period of increased tourist demand. Also, the information and knowledge derived from designed ML models can be used to improve planning, management, and marketing activities.

Keywords: Machine Learning, Random Forest, C4.5, K-nearest neighbors, Tourism

1. INTRODUCTION

With the development of information and communication technologies, there has been an increase in the amount of data stored daily in various databases across all spheres of life. As there is an exponential growth in the global focus on the tourism industry, there is a need to obtain different types of information from large amounts of data, which is achieved through the application of different Artificial Intelligence (AI) techniques. AI represents a way of reasoning and acting on derived conclusions, applying logic, where the reasoning and acting is not done by humans or any other living organism, but rather by machines in

the broadest sense [1]. Machine learning (ML), as a branch of AI, deals with techniques and methods that allow computer systems or machines to learn based on experience, i.e. to react to changes in the external environment without explicit programming [2]. The goal is to use collected data or information in the best possible way and obtain results that will help in identifying specific patterns or templates, predicting certain outcomes or behaviors, and many other things in different business areas. ML is often used in data analysis and extracting hidden knowledge from raw data. By collecting different information and accessing different sources of knowledge, new information is created, and scientific knowledge is expanded in specific areas.

One of the significant applications of ML is in the tourism and hospitality industry field. Authors [3] conducted research using K-Nearest Neighbors (KNN) algorithm, logistic regression, artificial neural networks, decision tree algorithm, etc., to predict reservation cancellations that may occur. When comparing the results, KNN and Random Forest algorithms were found to be the best solutions to the problem - both with an accuracy of 85%. In paper [4] classification methods and ML algorithms were applied to hotel reservation data. The aim of this research is an evaluation of hotel services based on typical hotel attributes. The focus of this work was comparing ML algorithms and finding the one that can achieve the highest accuracy. In research [5] authors applied ML techniques to predict a cancellation rate, achieving an accuracy of 98%. The proposed methodology allows not only predicting of the cancellation rates, but also identifying which client is likely to cancel the reservation. Based on these predictions, organizations could strengthen their action protocols related to tourist arrivals. As hotel reservation cancellations have a significant impact on demand management decisions in the hospitality industry, authors presented a solution in [6] by introducing the technique of oversampling to solve the class imbalance problem, along with the KNN algorithm. The results of this study show that the SMOTE method with the KNN algorithm performs the best in predicting hotel reservation cancellations.

The goal of this study is to design a specialized ML model that can successfully predict the outcome of hotel reservations based on their basic characteristics, in order to establish a better and more efficient decision-making process. This research is based on the assumption that there are hotel reservation parameters that can positively or negatively affect their realization. This research question can be classified as a supervised classification ML problem. In this study, several different ML models were tested with different parameter values, the results were compared, and the best algorithm for reservation outcome prediction was proposed. This model can be used in the hospitality industry to optimize hotel capacity occupancy, especially during periods of increased tourist demand. Real hotel reservation data was used that includes basic reservation characteristics in two hotels in Lisbon, Portugal [7].

2. THE CONCEPT OF MACHINE LEARNING

AI is taking an increasingly prominent role when it comes to daily innovations and progress. AI is defined as a branch of computer science that deals with designing systems that possess human-like learning capabilities, language understanding, reasoning, problem-solving, and more. ML, as a branch of AI, implies using techniques and methods that allow computer systems, or machines, to learn based on experience, and to react to changes in the external environment without explicit programming. In order to derive conclusions or extract information from vast amounts of data, certain techniques must be applied. ML includes several techniques:

- **Classification** - This technique is used for obtaining relevant information about data in order to classify data into different classes based on a certain criteria. Classification aims to assign a class label to future unlabeled records. If the class label is familiar, the type of classification is known as supervised learning. This classification process generates a set of classification rules that can be used for classifying future data and developing a better understanding of each class in the database. There are several classification models: decision trees, neural networks, genetic algorithms, and statistical models [8].
- **Clustering** – This is the process of dividing information into groups of related objects, i.e. detecting data groups based on their similarities. This technique helps in identifying differences and similarities between data and its applications are focused on areas such as scientific data exploration, text handling, web analysis, computational biology, medical diagnosis, etc. The goals of clustering data are to discover natural groups, generate hypotheses about data, and find a consistent and valid organization of data [8].
- **Regression** - Regression analysis is used for identifying and analyzing the relationships between independent variables and outcome. This is a predictive technique used to predict the continuous outcomes. Regression is a method that is commonly used for forecasting, planning and modelling.

ML algorithms that will be presented in this study are following:

- **KNN algorithm** - The KNN classifier is based on calculating the distance between a new instance and k instances from the training set [9]. The variable k represents the number of neighbors, i.e., the number of closest instances considered for classification. The best choice of k depends on the data. Generally, larger values of k reduce the effect of noise, but make the boundaries between classes less clear [10]. Many techniques for estimating k have been proposed. Usually, the value of k is determined as the square root of the total number of instances [11]:

$$k = \sqrt{n}$$

Euclidean distance, Chebyshev distance, Hamming distance, Manhattan distance, Minkowski distance, and similar metrics can be used to calculate the distance. The class of the observed instance is determined by the dominant class among its nearest neighbors. Different search algorithms, such as linear search or various decision trees, can be used within the KNN algorithm.

- Naive Bayes algorithm - Naive Bayes classifier greatly simplifies learning by assuming that all features are equally important and independent. It is a classification technique based on Bayes' theorem [12]. To calculate the posterior probability, a frequency table is required for each attribute. These tables show the number of occurrences of each attribute value in each possible class. The next step is to transform the frequency tables into probability tables. Probability is calculated as the ratio of class and total frequency. Based on these values, prior probabilities of class and predictor are calculated. The posterior probability can be calculated as follows:

$$P(H|E) = \frac{P(E_1|H) * P(E_2|H) * ... * P(E_n|H) * P(H)}{P(E)}$$

where H is the hypothesis, E is the predictor, i.e., the test point on which prediction needs to be made, P(H) is the prior probability of the class, P(E) is the prior probability of the predictor, P(E_i|H) is the probability, and P(H|E) is the posterior probability [13]. When this formula is applied to each class, the results can be compared and the class with the highest probability can be chosen.

- C4.5 algorithm – This is a classification algorithm that generates decision trees using information gain and entropy. This algorithm supports continuous and discrete attribute values, as well as missing values [14]. The implementation of the C4.5 algorithm in the Java programming language is called J48. Decision trees are built from samples and their attributes. At each node of the tree, C4.5 chooses the attribute that most effectively divides the sample set into subsets enriched with one or another class [15]. The resulting information gain is used as a criterion for the splitting process. One of the advantages of the C4.5 algorithm is the ability to reduce the size of the decision tree. "Pruning" is performed at a node when the error reduction becomes statistically insignificant due to the subtree [16].
- Random Forest algorithm – This is an algorithm in which a set of decision trees is created, the performance of each of them is measured, and the average, mode, or another summary statistic is calculated as the final result. Since individual decision trees tend to overlap, the random forest algorithm is used to overcome this problem

and achieve more accurate results and better overall performance. This algorithm uses bootstrap aggregation, which involves taking a random sample from the dataset and generating a decision tree based on the derived sample. This is an iterative process in which one element can be used multiple times. The final result is typically calculated as the average of individual results, but there are other methods that can be used, such as choosing the most frequent class. For a classification problem with N features, the square root of the number of N features is usually chosen for each iteration [17].

3. RESEARCH METHODOLOGY

In this work, ML algorithms were used to predict the hotel reservation outcomes. The methodology applied in this research includes data preprocessing, followed by testing of multiple different algorithms with hyperparameter tuning. In the following subchapter, a description of the data set is given, then the details of software and hardware are presented, the preprocessing techniques applied to the data are explained, and in the final subchapter, the model training process is described.

3.1. Dataset

The dataset used in this paper contains the most important information about reservations for a city hotel and a resort hotel, including information such as the date of booking, length of stay, number of adults/children, number of available parking spaces, and other. All personal information has been removed from the data. The data was originally collected for purposes of the research [7]. The dataset was obtained for this research from the online Kaggle data repository [18]. The structure of the dataset includes 31 variables describing 40,060 records of reservations for the city hotel and 79,330 records for the resort hotel. The dataset includes reservations between July 1, 2015, and August 31, 2017, including both realized and canceled reservations. Since these are real hotel reservation data, all data elements related to hotel or user identification have been removed. Due to the lack of real business data for scientific and educational purposes, this dataset can have an important role in revenue management, ML, data mining, and other fields. The dataset contains 32 attributes in total, including the reservation status as the output attribute, which can have values "No" if the reservation was finalized and "Yes" if it was canceled.

3.2. Software and hardware details

The data preprocessing phase was conducted using Microsoft Office Excel 2019 and Weka 3.8.6 software. Weka is open-source software issued under the GNU General Public License [19]. Weka is a collection of machine learning algorithms for data mining tasks. It contains tools for data preparation, classification, regression, clustering, association rules mining, and visualization. Model training was performed using Weka. The hardware configuration used in this research included an AMD Radeon (TM) RX Vega 10 GPU,

AMD Ryzen 7 3700U with Radeon Vega Mobile Gfx 2.30 GHz central processing unit and 12 GB of random-access memory.

3.3. Data preprocessing

Several data preprocessing steps were necessary to obtain an adequate dataset for the implementation of ML algorithms. These steps included deleting unnecessary columns and transforming numeric data into nominal. The dataset contained three columns indicating the reservation status and providing information on whether the reservation was fulfilled or canceled:

- Res_status – Reservation status;
- Res_status_date – Reservation status date;
- Is_canceled – Is the reservation canceled?

The Res_status and Res_status_date columns were redundant and were therefore deleted from the dataset, while the Is_canceled column was retained and represents the output attribute. After this preprocessing step, the dataset contained 30 columns, where 29 attributes represented inputs, and one attribute represented the output. The Is_canceled column originally contained values 0 and 1, which were recognized as numeric data in the Weka tool. In order for the classification analysis to be successfully performed, it was necessary to transform this column into nominal data type. The value 0 denoting a successful reservation was transformed into the value "No", while the value 1 indicating that the reservation was canceled was transformed into the categorical value "Yes". The variable transformation process was performed in Weka using the Numeric to Nominal filter. In the next phase of the research, ML algorithms were trained on the preprocessed data.

3.4. Model training

The algorithms used in this research were KNN, Random Forest, Naive Bayes, and J48, with 10-fold cross-validation. Cross-validation involves dividing the original dataset into k equal parts, setting one part aside for validation, training on the remaining k-1 parts, measuring performance, and repeating the process k times by using a different part for validation each time.

3.4.1. KNN

The hyperparameter that is adjusted within the KNN algorithm is the number of nearest instances N used to determine the class membership of a new instance. Linear search with Euclidean distance was used to calculate the distance between instances. Table 1 shows the results for N=2, N=4, and N=6. The highest accuracy achieved using KNN is 83.85%.

Table 1. Performance metrics of KNN algorithm

N	Accuracy (%)	TP rate	FP rate	Precision	F-measure	MCC	ROC Area	PRC Area
2	83.85	0.839	0.221	0.839	0.835	0.648	0.893	0.878
4	83.39	0.834	0.219	0.833	0.831	0.637	0.902	0.893
6	83.05	0.830	0.220	0.829	0.828	0.630	0.903	0.899

3.4.2. J48

For the training of J48 algorithm, two hyperparameters were tuned: the minimum number of instances in each leaf of the decision tree (M) and the confidence factor used in the decision tree pruning process (C). The values tested for the confidence factor were 0.15 and 0.25, and for the number of instances in the leaves were 2 and 4. Table 2 shows the results of training this algorithm for different hyperparameter values (C and M). The highest accuracy achieved using J48 is 87.17%.

Table 2. Performance metrics of J48 algorithm

C	M	Accuracy (%)	TP rate	FP rate	Precision	F-measure	MCC	ROC Area	PRC Area
0.25	2	87.17	0.872	0.162	0.871	0.871	0.722	0.908	0.891
0.25	4	87.08	0.871	0.161	0.870	0.870	0.720	0.922	0.915
0.15	2	87.01	0.870	0.162	0.869	0.869	0.719	0.919	0.911
0.15	4	86.89	0.869	0.164	0.868	0.868	0.716	0.924	0.921

3.4.3. Naive Bayes algorithm

Naive Bayes algorithm was applied without kernel estimator and supervised discretization. The best result had a 76.52% accuracy.

3.4.4. Random Forest algorithm

The hyperparameters that were tuned during the model training for Random Forest algorithm are the maximum depth of the tree (MD), and the number of attributes used in a single tree (NM). The number of trees in the algorithm, i.e. iterations was set to 50. The

results of this algorithm for the mentioned parameters are shown in Table 3. The best result achieved an accuracy of 88.70%.

Table 3. Performance metrics of Random Forest algorithm

MD	NM	Accuracy (%)	TP rate	FP rate	Precision	F-measure	MCC	ROC Area	PRC Area
5	2	78.60	0.786	0.360	0.833	0.760	0.556	0.916	0.922
10	4	88.34	0.883	0.165	0.885	0.881	0.748	0.953	0.957
10	6	88.70	0.887	0.152	0.887	0.886	0.755	0.954	0.958

4. RESULTS AND DISCUSSION

In this study, multiple data preprocessing techniques and several different algorithms were tested. Table 4 shows the performance metrics for all four algorithms. The performance metrics showed that the best results were achieved using the Random Forest algorithm, with the accuracy of 88.70%. The best accuracy achieved by the KNN algorithm was 83.85% for the parameter $n=2$, while the best accuracy achieved by the J48 algorithm was 87.17% for the parameters $c=0.25$, and $m=2$. The Naive Bayes algorithm had a lower accuracy compared to the other algorithms (76.52%).

Figure 1 shows a comparison of accuracy for all tested algorithms.

Table 4. Performance metrics of the tested algorithms

Algorithm	Accuracy (%)	TP rate	FP rate	Precision	F-measure	MCC	ROC Area	PRC Area
KNN	83.85	0.839	0.221	0.839	0.835	0.648	0.893	0.878
J48	87.17	0.872	0.162	0.871	0.871	0.722	0.908	0.891
Naive Bayes	76.52	0.765	0.310	0.761	0.759	0.482	0.824	0.824
Random Forest	88.70	0.887	0.152	0.887	0.886	0.755	0.954	0.958

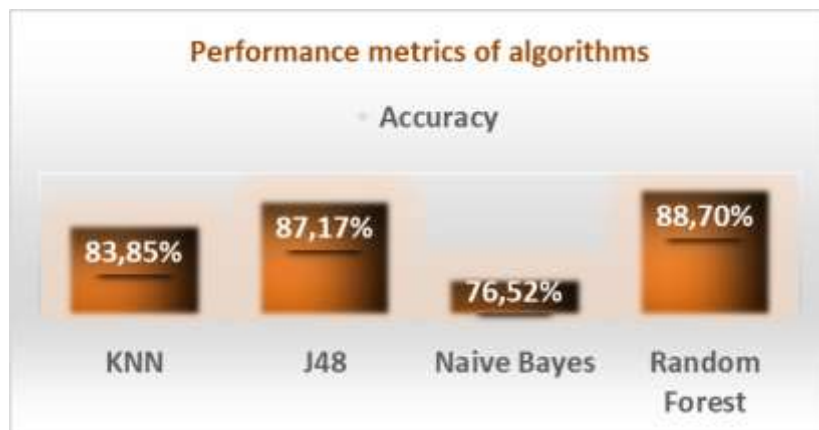


Fig. 1. Performance metrics of algorithms

5. CONCLUSION

In this study, several data preprocessing techniques and several different algorithms were tested, as previously stated, to create an appropriate model for classifying hotel reservation outcomes. The choice of algorithms was based on available literature and the authors' experiences with similar issues. Additionally, the algorithms were tested with default parameter values, and further testing was performed on those that provided favorable initial results. A barrier that emerged during this study was the inability to execute certain algorithms due to technical limitations. With fewer resource constraints, other algorithms could be implemented, or the utilized algorithms could be trained with more demanding parameter values. Nevertheless, it should be noted that increasing algorithm complexity does not necessarily result in better outcomes. The final results showed that the Naive Bayes algorithm provided the lowest accuracy rate comparing to the other algorithms (76.52%). Further, the J48 (87.17%) and KNN (83.85%) algorithms achieved high accuracy and had a favorable performance-complexity ratio. High accuracy was achieved using these algorithms, even though their optimization and training were simple and fast. The highest accuracy was obtained by applying the Random Forest algorithm (88.70%). Simpler methods provided good results in this study because the dataset included a large number of instances, while the dimensionality was relatively small. With such a dataset, Random Forest, KNN, or C4.5 (J48) decision tree should generally provide results close to the best possible. Overcoming the above-mentioned barriers can be a good guideline for future work to achieve better outcomes. As the results indicate the potential of applying ML in hotel management, especially in determining the optimal occupancy capacity schedule of the hotel, this represents a significant business advantage and is critical during a period of increased tourist demand. Additionally, the information and knowledge gained

from designed ML models can be used to improve planning, management, and marketing activities.

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THE USE OF VIRTUAL AND AUGMENTED REALITY IN DIGITAL MARKETING

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ABSTRACT:

In recent years, virtual reality (VR) and augmented reality (AR) technologies have advanced quickly, and they have many potential uses in digital marketing. This paper offers a summary of the acceptance and use of VR and AR in the field of digital marketing, as well as a case study of an effective marketing campaign that has made use of these technologies. The research also looks at the advantages of VR and AR in digital marketing, including improved customer engagement and elevated brand loyalty. The possible effects and difficulties of VR and AR in digital marketing are also discussed in the paper, including the necessity for specialized knowledge and tools as well as the potential for significant expenses. The discussion of future trends and opportunities in VR and AR for digital marketing, including the growing usage of these technologies in e-commerce and the potential for VR and AR to alter how brands connect with customers, finishes the paper. Overall, the paper offers advice for companies looking to integrate VR and AR into their digital marketing strategies. These recommendations include the significance of investing in specialized knowledge and tools as well as keeping up with the most recent trends and advancements in VR and AR technologies.

Keywords: *Virtual Reality, Augmented Reality, Digital Marketing, Virtual reality brand experiences, Increased brand loyalty*

1. INTRODUCTION TO VIRTUAL AND AUGMENTED REALITY IN DIGITAL MARKETING

Virtual Reality (VR) and Augmented Reality (AR) are technologies that have gained momentum in recent years and have begun to be adopted by various industries and have wide applications in medicine, rehabilitation, education, engineering, the entertainment industry, tourism, architecture, culture and arts, military, media, working from home. This includes digital marketing to "enhance consumer experiences, increase their satisfaction, shape their behavior and increase company revenue" [1]. According to PwC Report, by

2030, it is predicted that augmented reality (AR) and virtual reality (VR) would have generated \$1.5 trillion in net economic gains [2].

Virtual reality means “presenting our senses with a computer-generated virtual environment that we can explore in some way” [3]. Augmented reality (AR) improves or extends the physical environment of the real world by adding virtual, computer-generated elements in real-time [4]. The difference between VR and AR is that whereas AR adds more computer-generated information to the experience of the real world, VR bases the perception of reality on virtual information [5]. Both technologies have the potential to revolutionize the way digital marketing is conducted by providing more engaging and interactive experiences for consumers.

According to *Statista* (2022), data show that there were 7.1 billion mobile users worldwide in 2021, and that number is expected to increase to 7.49 billion by 2025 which demonstrates AR’s increasing acceptance and popularity. Data from *GSMA Intelligence* shows that there were 8.63 million cellular mobile connections in Serbia at the start of 2022 [6] while at the end of January 2023, the number of mobile phone users in Montenegro was 1,269,428 [7]. This was significantly influenced by the COVID-19 pandemic, brands grappling with shop closures, and the evident necessity for innovation to thrive in a competitive climate. Businesses have begun to invest in augmented reality technology and appear to be racing to adopt the newest fashions.

Increasing competition among companies, the growth of global markets, and the ever-shortening life cycle of products have influenced a new approach to sales management. Modern sales are becoming highly dependent on information and communication technologies. The new digital environment also brings new trends in sales. Businesses have started investing in augmented reality technology and seem to be racing to adopt the latest trends.

Virtual and Augmented Reality (VR/AR) are quickly becoming popular tools for digital marketers. With the help of these technologies, brands can create immersive experiences that engage their customers and make them feel connected to the brand. From interactive product demos to virtual tours of stores and offices, VR/AR can be used to give customers an authentic experience without leaving their homes. Brands can also use these technologies to create engaging marketing campaigns that capture the attention of their target audience.

For example, *IKEA* launched an AR app *IKEA Place* that allows users to virtually “try out” furniture in their own homes before buying it. This helps customers make better decisions and strengthens their connection with the brand. Other companies are using VR/AR for interactive product demos, immersive storytelling, and even virtual events. These examples show how powerful Virtual and Augmented Reality can be in Digital Marketing when used correctly. Similarly, in the automotive industry, car manufacturers can create virtual showrooms that allow customers to explore their cars in a virtual environment and customize it as per their preferences. Additionally, in the beauty industry, *Sephora* has created a virtual reality experience allowing customers to try makeup virtually before purchasing it.

VR and AR technology can be used to create immersive and interactive experiences for customers across various industries, from retail to automotive to beauty, providing customers with an opportunity to interact with products and services in new and innovative ways, which in turn can lead to increased brand loyalty and sales.

2. ADOPTION AND APPLICATIONS OF VIRTUAL AND AUGMENTED REALITY IN THE DIGITAL MARKETING

The adoption of VR and AR in the digital marketing industry has been on the rise in recent years, with companies from various industries starting to incorporate these technologies into their marketing strategies. VR can create realistic simulations of products or services, enabling customers to engage with them in a lifelike manner. This can be particularly effective for products that are challenging to showcase through traditional marketing materials, such as automobiles, properties, or furniture. Similarly, AR can overlay digital information, such as product specifications or instructions, onto the real world. This can be useful for products requiring assembly or complex features that are difficult to convey through text or images.

IKEA, Gucci, Amazon, ASOS, Sephora, etc. are successfully adding AR experiences to product pages. According to *Shopify* research, products with AR content convert 94% more often than those without it [8]. Such technologies are being adopted by more companies in a variety of industries for employee training, the testing of new or current processes, and the development of new products: *Oreo*, (*The World of a Flavored Cookie 360deg*), *Samsung* (*A Moon for All Mankind VR*), *Volvo* (*Virtual Reality Test Drive*), *McDonald's* (*Happy Goggles*) and much more.

AR and VR have entered the world of e-commerce. According to a *Google* study, half of the consumers use *Google* to research products before purchasing [9]. Virtual try-on or virtual fitting rooms with AR allow consumers to make better choices. As a positive side effect, this could ultimately help reduce the excessive return rate of clothing ordered online. Also, stores that have adopted AR/VR in this way can "produce additional brand value, simplify the consumer decision-making process, stimulate brand engagement, and lead to a stronger consumer desire to buy" [10].

With more customers turning to online shopping, businesses are seeking new ways to create engaging and interactive digital experiences. VR and AR can provide customers with a sense of immersion and interactivity that is difficult to replicate through traditional digital marketing channels. This can be particularly important for businesses that depend on physical experiences to drive sales, such as theme parks, museums, or real estate companies.

However, the adoption of VR and AR in digital marketing requires high investments to create VR and AR experiences that are engaging and effective. It's also important to consider that not all products or services are suitable for VR or AR marketing, and not all customers are comfortable using these technologies. So, companies need to carefully evaluate if VR or AR can add value to their marketing efforts before investing in it.

VR and AR technology can be used in various ways in digital marketing to create immersive and interactive experiences for customers. Product demonstrations are among the most common applications of VR and AR in digital marketing. For example, Nike, the sportswear company has developed a *Nike Fit* app that uses augmented reality technology to help customers find the perfect fit for their shoes. The app allows customers to see how different sizes and styles of shoes would look on their feet, helping them make informed purchasing decisions. This provides customers with an opportunity to interact with the product more engagingly and realistically, leading to increased brand loyalty and sales.

Another application of VR and AR in digital marketing is virtual reality advertising. This type of advertising allows customers to interact with the brand in a virtual environment, providing a more engaging and memorable experience. For example, *Coca-Cola* has used VR technology to create a virtual reality vending machine that allows customers to interact with the brand in a new and innovative way.

VR and AR in digital marketing are also demonstrated through virtual reality shopping. *Walmart* has developed a virtual reality shopping platform that allows customers to explore products in a virtual environment. The platform provides an immersive and interactive shopping experience, allowing customers to see how products would look in their homes, try on clothes, and even purchase products directly through the VR platform. It allows customers to shop in a virtual environment, providing a more immersive and interactive shopping experience.

Finally, virtual reality brand experiences are another application of VR and AR in digital marketing. This type of application allows customers to interact with the brand in a virtual environment, creating a more memorable and engaging brand experience. For example, in the travel industry, companies such as *Thomas Cook* have used VR technology to create virtual reality travel experiences, allowing customers to explore destinations before booking a trip.

3. CASE STUDY: TOMS SHOES

In 2006, entrepreneur Blake Mycoskie founded *TOMS*, driven by a desire to give back. Initially named *Shoes for Tomorrow*, the company was inspired by Mycoskie's trip to Argentina and the children he observed without shoes. Mycoskie collaborated with a local shoemaker to create a modified version of the shoe and implemented a One for One model, giving out one pair of shoes for each pair sold and, through relationships with other organizations, supporting bigger initiatives in health, education, and community development.

This model, along with the support of Hollywood celebrities, generated significant 'buzz' around the brand, leading to its widespread popularity. The *TOMS* slip-on canvas shoe became a hero product for the company, and its branding and marketing strategies were highly effective. *TOMS* was one of the first companies to utilize the "buy one, give one" philosophy, which appealed to consumers who sought both fashionable footwear and companies that demonstrated corporate social responsibility [11].

TOMS, the popular shoe, and accessory brand is known for its "One for One" giving model has had great success with its virtual giving trip campaign. The campaign, which utilizes virtual reality technology, allows customers to experience the impact of their purchases and see where their donations are going.

The *TOMS Virtual Giving Trip* campaign was available in select *TOMS* retail stores and online and allowed customers to take a virtual trip to different countries where *TOMS* has given shoes, sight, water, safe birth, and bullying prevention services. Customers were able to see the direct impact of their purchases and learn about the different giving programs *TOMS* supports.

The campaign was met with positive reception and was able to effectively communicate the brand's message and mission to customers. The use of VR technology in the campaign helped to create an immersive and impactful experience for customers, allowing them to truly understand and connect with the brand's giving model. This made the campaign more effective in communicating *TOMS'* mission and values [12].

Numerous reasons contributed to the *TOMS Virtual Giving Trip* campaign's success. First off, the utilization of VR technology made it possible for customers to have an engaging and memorable experience that helped them better comprehend and relate to the brand's giving model. Additionally, the campaign's emphasis on informing consumers about *TOMS'* giving initiatives and the effects of their purchases aided in strengthening their bond with the company.

Finally, the campaign produced a lot of discussion on social media and was featured in several important news publications, which helped to raise brand recognition and boost sales. The *TOMS Virtual Giving Trip* campaign, which effectively communicated the brand's goal and values and deepened the relationship between customers and the company, was a huge success overall.

4. BENEFITS OF USING VIRTUAL AND AUGMENTED REALITY IN DIGITAL MARKETING

This revolutionary technology lays out a unique opportunity to tap into human emotions like never before. Although the modern concept has existed for over a decade (2011), in recent years, it has made significant advancements and, for that matter, is being increasingly used in various industries - as we mentioned just a few. The ability to create immersive experiences that enhance customer engagement and satisfaction is one of the substantial benefits of using VR/AR in digital marketing. VR/AR technologies have transformed the way brands interact with their audience. By leveraging these technologies, brands can create unique and engaging experiences that capture their customers' attention, resulting in increased brand awareness, engagement, and loyalty.

According to *Vibrant Media*, brands can make their goods come to life in front of consumers with AR advertisements. Their research team discovered that to increase consumer engagement, nearly seven out of ten media managers and buyers (67 percent) want more augmented reality (AR) and virtual reality (VR) advertisements integrated into digital marketing campaigns [13]. We mentioned the *IKEA Placed* app which focuses on

bringing its products to life, but one of the most recognizable and influential brands of all time has repeatedly shown its interest in VR/AR solutions to improve its customer experience - *Nike*. We are going to cover three examples in which this brand has flirted with this innovative tech.

The first one is focused on using AR. According to *Nike*: "Three out of every five people are probably wearing the wrong shoe size." Michael Martin - their Vice President of direct product, growth, and innovation is highlighting the problem by revealing the following: "Every year we're getting more than half a million complaints about size and fit from our consumers - which makes them unhappy and costs *Nike* time and money, particularly as its direct-to-consumer sales keep growing" [14]. To resolve this problem, *Nike* introduced the *Nike Fit* app [15]. This amazing fusion of AR technology was developed by *Invertex Ltd* company (Computer Vision Leader from Tel Aviv, Israel which *Nike* acquired in 2018). In announcing the acquisition, Adam Sussman, the Chief Digital Officer of *Nike*, expressed that the integration of *Invertex* into their business operations would augment their digital talent pool and bolster their proficiency in the areas of computer vision and artificial intelligence. This strategic move aligns with *Nike's* overarching objective of infusing novel technological advancements to effectively enhance their consumer experience across all touchpoints.

The runner-up example is *Nike's* focused efforts to blur out the line between physical and digital even more. We're talking about another *Nike* acquisition. This time, it was *RTFKT*, a digital fashion company creating virtual sneakers and collectible NFTs, acquired by *Nike* in 2021. This move allowed *Nike* to create limited-edition virtual sneakers for video games and social media platforms. The *CRYPTOKICK* sneaker collection is the perfect example of how, in combination, VR/AR and technologies such as blockchain and NFTs [16] can be used to create unique and engaging experiences that generate excitement and "buzz" around a product - which inevitably, with the adoption of these technologies is becoming a norm in the space.

The essential takeaway from this part is the enormous blank space of opportunity for the digital marketing industry to re-write its ideas, view, and focus on new market expectations which are: the power of community in a mix with a personalized and immersive experience.

5. IMPACT AND CHALLENGES OF VIRTUAL AND AUGMENTED REALITY IN DIGITAL MARKETING

The use of VR and AR in digital marketing has the potential to provide more engaging and interactive experiences for customers, leading to increased brand loyalty and sales. However, there are also challenges to be addressed such as the high cost of development and lack of standardization in VR and AR technology.

The high cost of development can be a significant barrier for small and medium-sized businesses that may not have the resources to invest in VR and AR technology. In addition, the lack of standardization in VR and AR technology can make it difficult for businesses

to know which platform to invest in and how to properly implement VR and AR in their marketing strategies.

Another challenge is that there is still a lack of research on the effectiveness of VR and AR in digital marketing, and more research is needed to understand the optimal ways to use these technologies in a marketing context. This lack of research makes it difficult for businesses to properly implement VR and AR in their marketing strategies and measure the return on investment.

Additionally, there are technical challenges associated with VR and AR such as the need for specialized hardware and software, which can be limiting for some customers and businesses. Moreover, the limited availability of VR and AR technologies in certain regions and the lack of awareness among customers may also hamper the adoption of VR and AR in digital marketing.

Augmented Reality (AR), made possible by mobile computer technology, is growing as a user interface for digital marketing tools that seamlessly incorporate interactive digital content into a person's perception of the physical environment. Despite the documented utilization of Augmented Reality Marketing (ARM) throughout various stages of the customer journey, as well as its impact on purchase decisions and brand attitudes, the widespread adoption of ARM remains uncertain. This uncertainty is partly attributed to a lack of clear conceptualization of ARM and inadequate differentiation from traditional marketing methods. This has resulted in many companies failing to effectively implement ARM strategies that are well-received by customers.

The limited conceptualization of ARM can be attributed to a limited understanding of it as a specialized medium, which limits how managers approach ARM. Many companies are becoming hesitant to invest in ARM, believing that they lack the necessary knowledge and capabilities to effectively engage and connect with customers. Specifically, managers struggle with making informed decisions regarding user experience and content offerings that would position ARM as a mainstream technology. This highlights the need for a more comprehensive managerial understanding of ARM experiences, including how ARM creates and delivers valuable experiences that are distinct from other marketing approaches [17].

6. FUTURE TRENDS AND OPPORTUNITIES IN VIRTUAL AND AUGMENTED REALITY FOR DIGITAL MARKETING

Future trends will undoubtedly reflect the traits, requirements, and preferences of younger generations as well as the needs and demands of the modern era. Thus, future trends aim to create a world where ideas of race, nationality, ethnicity, or gender do not serve as justifications for conflicts and divisions but rather for respect for variety and inter-harmony. Opportunities for marketing and company growth are created by technologies like Virtual Reality, Augmented Reality, Web3, Metaverse, NFT, and Virtual Ownership. Every business can benefit from participating in emerging trends, so it's critical to educate oneself to prepare oneself and one's organization for emerging business practices [18]. Those are rapidly growing technologies that have already shown their potential in digital

marketing. The trend is just picking up, and there are many opportunities to take advantage of this technology to promote products and services.

Event-based marketing has also integrated AR/VR. For example, tech can offer a fresh, interactive method of engaging attendees. Virtual concerts have become more popular in the music business, enabling people to attend live performances without having to leave their homes. To organize virtual events, launch advertising campaigns, and build communities around their brands, marketers can use the Metaverse. Metaverse rises to the top of new trends and technologies for the coming years. The ability for brands to design immersive, interactive experiences for their audience thanks to the Metaverse has the potential to be a potent marketing weapon. The Metaverse can be used by businesses to display their products and services more interestingly and interactively, as well as to develop a distinctive brand identity. Due to its global accessibility and participation, the Metaverse also gives businesses the chance to reach a larger population [19].

Smart Insights is a publishing and learning platform that uses downloadable planning templates, guides, and interactive learning tools to help members plan, manage, and improve their marketing. According to their research, the answers to the question regarding the digital marketing technique that will provide the greatest commercial growth have shown that content marketing is the most effective form of marketing. Any type of company, regardless of industry or size, can use content marketing to support interactions at every touchpoint of the customer lifecycle if the right strategy is used. It powers all digital marketing platforms, including social media, email, and search [20].

Social media, content marketing, search engine optimization (SEO), pay-per-click (PPC), and other aspects of digital marketing are constantly evolving, causing major changes every year. Companies must recognize the impact of the digital environment and determine the best strategy and timing for online audience marketing. Many social media users shop online. This is the main reason why social media should play a significant role in digital marketing strategies [21]. As of January 2023, there were 5.16 billion internet users worldwide, which is 64.4 percent of the global population. Of this total, 4.76 billion, or 59.4 percent of the world's population, were social media users [22].

As more informational content is created, marketers must search for new content formats to convey messages as quickly and efficiently as possible. As we have already mentioned the huge number of users who spend more time on their smartphone devices watching videos, it is expected that advertisers will spend considerable money on creating video content for mobile devices. The use of VR and AR technology creates unique and customized content for users.

Influencers are today's first business ambassadors. Working with influencers is a novel approach to increasing the audience and spreading positive electronic word of mouth (eWOM), especially for small and medium-sized businesses. (SME) [21]. AR and VR influencer marketing already exists to some level. Branded filters are available on platforms such as *Snapchat* and *TikTok*, as well as *Instagram* and *Facebook*, and brands can pay influencers to post content with these filters. but the big growth in the VR and AR influencer marketing industry is yet to come.

The application of AR/VR can also be used to improve training initiatives for employees. Health and safety training can be simulated, and employees can be trained in better responses to dangerous scenarios without putting themselves at risk. Educational programs can also be enhanced using augmented reality. Many studies have shown that VR engagement rates are extremely high when compared to other types of training, making it more likely that employees will use it in the workplace, resulting in improved productivity. In terms of engagement, VR training has a 75% engagement rate, outperforming all other forms of instruction except teaching others [23].

From personalized advertising to improved product testing, VR/AR can help companies to stay ahead of the curve and connect with customers in new and exciting ways. As technology advances, we can anticipate more growth in the AR/VR industry. To fully capitalize on this trend, businesses must be innovative in their approach and create creative methods to stand out in this increasingly competitive marketing environment.

7. CONCLUSION AND FUTURE OUTLOOK FOR VIRTUAL AND AUGMENTED REALITY IN DIGITAL MARKETING

Virtual Reality (VR) and Augmented Reality (AR) are technologies with the ability to change the way digital marketing is performed. The adoption of VR and AR in digital marketing has been on the rise in recent years, with companies from various industries starting to incorporate these technologies into their marketing strategies. VR and AR technology can be used in various ways in digital marketing to create immersive and interactive experiences for customers, such as product demonstrations, virtual reality advertising, virtual reality shopping, and virtual reality brand experiences.

However, there are also challenges to be addressed such as the high cost of development and lack of standardization in VR and AR technology. Additionally, there are technical challenges associated with VR and AR such as the need for specialized hardware and software, which can be limiting for some customers and businesses. Moreover, the limited availability of VR and AR technologies in certain regions and the lack of awareness among customers may also hamper the adoption of VR and AR in digital marketing.

The proliferation of virtual and augmented reality technologies is hindered by several challenges. One of the most significant challenges is the reluctance of consumers to share personal information and data with companies due to privacy concerns. Additionally, the lack of familiarity with these technologies, as well as the potential for users to experience discomfort or sickness during usage, may also impede adoption. Furthermore, imperfections in the rendering of size, color, or spatial placement of products may result in a poor user experience, which may further hinder adoption. To address these challenges, companies need to prioritize transparency and ethical data practices to alleviate privacy concerns. Additionally, ongoing efforts to improve user experience and address technical challenges such as VR sickness and rendering imperfections are necessary for the continued diffusion and adoption of these technologies [24].

Despite the challenges, the future outlook for VR and AR in digital marketing is promising. With advancements in technology and a growing interest in VR and AR, the

use of these technologies in digital marketing is likely to rise in the coming years. Businesses will better understand how to properly implement VR and AR in their marketing strategies as more research on the effectiveness of VR and AR in digital marketing is conducted.

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THE INFORMATICS ASPECT INTEGRATION OF PROCESSING APPROACH OF QMS

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ABSTRACT:

The processing approach is a basic principle of a management quality system. Monitoring and measuring are the requirements of the management quality system. Introducing the indicators as well as their further development and control should be one of the essential tasks of each organization. Therefore, while projecting the database, it is necessary to predict the connection between the very process and its indicators which are used for measuring since it is the only relevant indicator of success. The paper presents the informatics aspect for the development model of transactional base that integrates business processes QMS and their indicators.

Keywords: *the processing approach, QMS, integration*

1. INTRODUCTION

The standard ISO 9001 for quality management rightly emphasizes the application of the process approach, as the ground for the development and implementation of the quality management system. It is the process approach itself that makes it possible to balance the relationship between the functions in the organization, route everyone in the organization towards the needs of the users and the comprehensive fulfillment of the defined goals. Each process is characterized by appropriate performance and it is necessary to define at least one process performance indicator in order to monitor the success of the process and to see possible ways of improving it.

2. PROCESS APPROACH

The process approach is one of the eight principles of the ISO 9001 quality management system, which states that the desired result is achieved more efficiently when related resources and activities are managed as a process [1].

The quality management system requires the acceptance of a process approach, where the processes are connected in a single system, where as a rule, the output from one system is the input to another system. The importance of focusing on processes is reflected in the

focus on monitoring the results of the organization's work (finished products and services provided) on the processes by which the organization realizes the product or services.

Processes consist of a logically ordered sequence of related activities. Activities can be further divided into tasks (or operations in the technological process) which represent the detailing of activities. One process activity consists of several tasks or operations performed with the same resources [2].

3. PROCESS PERFORMANCE INDICATOR

The quality management system requires the acceptance of a process approach, where each process is characterized by appropriate performance and it is necessary to define at least one performance indicator in order to monitor the success of the process and consider possible ways of improving it.

Business performance is an indicator in which the product, process or system achieved the established goals/characteristics/requirements [2]. The ISO 9001 standard requires organizations to establish and implement their own approaches to measuring and continuously improving process performance. In the standard SRPS ISO 9004 - Guidelines for improving performance, guidelines are given for establishing them.

The operation of the organization depends on the measurement and analysis of performance for which the value indicators are defined [3]. Each business process is characterized by appropriate performance, i.e. features that define the efficiency and effectiveness of the process, i.e. quality of process execution. A process performance indicator is a measurable parameter.

4. INFORMATICS INTEGRATION OF BUSINESS PROCESSES

At the beginning of each year, general goals, strategic goals and special goals arising from general goals are defined, which are applied to the goals of each process in organizational units, which are being documented by plans. Plans are documents that determine how to achieve goals, including the allocation of resources, programs, and other necessary actions to achieve goals.

Planning sets goals, determines the necessary means, time and method of achieving goals. Planning is a creative thought process, i.e. activity that makes assumptions about the future, which reduces uncertainty and risk in business and company development [4]. From the general goals at the organization level, the process owners determine the process goals and activity plans for their achievement.

The owners of the process monitor the effectiveness and efficiency of the process according to the defined indicators in certain time intervals given in the process sheets [2].

Therefore, it is necessary to have plans integrated with the processes in order to establish the monitoring of the success of the processes and consider possible ways of their improvement.



Fig. 1. Logical data model

In the displayed logical model, the process entity defines the hierarchy of the process and is connected to the plan/activity entity, in which the given attributes describe the activities for the realization of the process within the given plan, which will fulfill the integration. The activity goal attribute represents the performance that is monitored for a certain process, and the activity is the performance indicator, while the quantity is the planned value of the indicator.

A record is a document that shows the results obtained or provides evidence of the activities performed. Evidence for the realization of the process is generated record documenting the completion of the process. The reason for establishing records is to provide information needed to manage processes, achieve goals and demonstrate

compliance with requirements - both the requirements of standards and laws, and customer requirements. Because records are the result of a process, the generic label of the process is also the label of the record.

Defining subcontract performance indicators and defining data collection methods must be adequate, reliable and valid. Therefore, one of the most important tasks in this context is establishing and developing of an information system, which will ensure, on the one hand, the efficient collection and processing of various data on the functioning of business processes, and on the other, suitable ways of organizing, presenting and using those data [5].

By realizing the entry of the given logical data model into the database and by implementing the user interface, the obtained values of the process indicators can be monitored from the records of the monitored and realized process of the planned indicators for the respective one.

The screenshot shows a software window titled "Q4.3.11.01.2 Plan ciljeva kvaliteta". At the top, there is a search bar labeled "Pretraži: Plan ciljeva" and a button "Unos novog cilja". Below this, there are four rows, each representing a quality objective. Each row contains the following fields:

- CiljPlana:** A text field describing the objective.
- OpštiCilj:** A dropdown menu.
- FaktorCilja:** A numeric field.
- Pozicija:** A dropdown menu.
- Predhodni:** A dropdown menu.
- JM:** A dropdown menu.
- Ocena skale:** A dropdown menu.
- Zainteresovana strana:** A dropdown menu.
- Cilj po OJ:** A dropdown menu.
- PlaniranPocetak:** A date field.
- PlaniranKraj:** A date field.
- Odobrio:** A dropdown menu.
- Period izveštavanja:** A dropdown menu.

The four rows are:

- CiljPlana:** Smanjiti broj žalbi korisnika. **OpštiCilj:** [empty]. **FaktorCilja:** 25. **Pozicija:** Pozicija. **Predhodni:** JM. **JM:** [empty]. **Ocena skale:** [empty]. **Zainteresovana strana:** [empty]. **Cilj po OJ:** [empty]. **PlaniranPocetak:** [empty]. **PlaniranKraj:** [empty]. **Odobrio:** [empty]. **Period izveštavanja:** [empty].
- CiljPlana:** Smanjiti broj primedbi korisnika. **OpštiCilj:** [empty]. **FaktorCilja:** 27. **Pozicija:** Pozicija. **Predhodni:** JM. **JM:** [empty]. **Ocena skale:** [empty]. **Zainteresovana strana:** [empty]. **Cilj po OJ:** [empty]. **PlaniranPocetak:** [empty]. **PlaniranKraj:** [empty]. **Odobrio:** [empty]. **Period izveštavanja:** [empty].
- CiljPlana:** Povećati zadovoljstvo korisnika. **OpštiCilj:** [empty]. **FaktorCilja:** 13. **Pozicija:** Pozicija. **Predhodni:** JM. **JM:** [empty]. **Ocena skale:** [empty]. **Zainteresovana strana:** [empty]. **Cilj po OJ:** [empty]. **PlaniranPocetak:** [empty]. **PlaniranKraj:** [empty]. **Odobrio:** [empty]. **Period izveštavanja:** [empty].
- CiljPlana:** Povećati ocenu vrednovanja nastave. **OpštiCilj:** [empty]. **FaktorCilja:** 15. **Pozicija:** Pozicija. **Predhodni:** JM. **JM:** [empty]. **Ocena skale:** [empty]. **Zainteresovana strana:** [empty]. **Cilj po OJ:** [empty]. **PlaniranPocetak:** [empty]. **PlaniranKraj:** [empty]. **Odobrio:** [empty]. **Period izveštavanja:** [empty].

Fig. 2. User interface

Performance indicators enable comparison of achieved values with target values/ with values from previous measurement periods, i.e. established standards, and even with the performance of competitors.

The process of monitoring and measuring indicators takes place over time, and the obtained results serve as a basis for improvement. The obtained indicator values (special field) are used for comparison with the results of previous measurements (previous field) for determining the trend or setting the target values of the indicator. The results of the comparison are further used for appropriate corrective measures and activities to improve and achieve the planned values of the indicators. This provides the necessary methodological framework for drawing significant conclusions about the success of the process or for making decisions about concrete measures for gradual and continuous improvement.

5. CONCLUSION

The quality management system is created, established, maintained and improved by applying a process model to different processes for the realization of products or services, as well as for the maintenance and improvement of the system itself. Each business process is characterized by appropriate performance indicators that are monitored and measured over time and on the basis of which the success of the process is monitored. Based on the obtained values, possible ways of improvement can be seen.

With the existence of an information model that integrates the organization's business processes with planning, a methodology for monitoring the value of business process indicators can be established in order to reduce uncertainty and risk in the business and development of the company. Process indicators, designed, monitored and measured in an adequate way, with IT support, provide a strong potential in the process of evaluating the organization's quality performance. However, within the requirements of the mentioned standards, voluntary application and complete freedom in the choice of parameters and success criteria were left.

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USING 3D PRINTERS TO IMPROVE SPATIAL VISUALIZATION IN TEACHING ENGINEERING GRAPHICS

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ABSTRACT:

3D printing is a modern technology of three-dimensional objects and generally it represents faster, cheaper and easier solution than the other technologies of 3D objects production. 3D printing found its implementation in a lot of areas, especially in education. With the introduction of SolidWorks program and 3D printing in engineer graphics teaching, students can use 3D printed models and develop their spatial abilities. The students could only see the model on the computer before, and now, thanks to 3D printing, they can touch the final result, which makes huge difference in their engagement in classes.

Keywords: 3D modeling, 3D printing, SolidWorks, education, spatial visualization

1. INTRODUCTION

At The Faculty of Technical Sciences in Čačak, in the mechanical engineering department, students get to know the basics of 3D modeling in the first year of vocational studies. They learn to work in CAD software through the familiarization with virtual 3D space and basics of designing. Within the Engineering graphics course, the students are planned to familiarize with the basics of 3D printing in order to be able to solve certain problems in engineering, during their studies as well as in their professional career.

Essentially, 3D printing is a process in which a material is put in thin layers and the 3D object is formed in that way. One can say that the production in this case is conveyed in a completely different way than usual. While in the largest number of cases, the final object is obtained by subtraction of certain amount of material (by cutting some parts, making some holes and so on), in 3D printing the process is reversed – the material is added until the final shape is created. The basis for 3D printing is digital in nature: it is a file created in a CAD or CAM program [1].

3D printing takes part more and more in a lot of different production industries, educational institutions, entrepreneur jobs and housework. In order to implement 3D printing in the production process in all these industries, it is necessary to provide some form of education and training of the basics of 3D printing for the staff or, much earlier,

for the students in educational institutions. Therefore teachers need adequate training, practice and eventually good curriculum [2].

In the second chapter 3D printing in education will be discussed. The third chapter is devoted to FELIX Tec 4 printer. In the fourth chapter the way of 3D model production on FELIX Tec 4 printer is described. In the fifth chapter improving spatial ability through 3D printed models will be discussed.

2. 3D PRINTING IN EDUCATION

As a specific kind of digital technology, the appearance of more available, cheaper 3d printer opened the potential for its acquiring within the educational system. Although its initial implementation is described as a novelty to some extent, it is considered that 3D printer is going to become omnipresent as the photocopier [3].

3D printing is revolutionary and innovative technology which carries new methods of studying and understanding the concepts that have been very difficult with traditional methods [4]. The student of 21st century is a person who seeks new interesting solutions and for whom there are no obstacles, where modern equipment, technology or applications are used. Working in graphic programs and 3D modeling enables the development of spatial thinking [5]. The introduction of 3D printing into the didactic process encourages the development of thinking, develops creativity and activity of students [6].

3. FELIX TEC 4 PRINTER

3D printers also use different printing technologies as the ones used by traditional printers. The printing technologies of the printer FELIX Tec 4 is FDM technology, which is often called FFF. That technology implies melting of ABS, PLA or some other thermoplastics which is applied in liquid condition on the specific locations in 3D space. The characteristics of this printing procedure are: fast and cheap generation of layers, the safety process which means easy data manipulation and minimum material loss. The failure of this kind of printing is inconvenience for model making with openings, recesses and protrusions, as well as relatively small precision of measures and shapes of models. The printer FT 4 is shown on Figure 1, and the printer's characteristics are in chart 1.



Fig. 1. FELIX Tec 4 printer

Table 1. Features of the FELIX Tec 4 printer

<i>The chosen parameters of the printer</i>	<i>Values</i>
Dimensions of printer	410 x 450 x 520 mm
Working area	Heating platform maximum temperature 90 °C
Leveling	Half automatic
Speed movement of printer's head	200 mm/s
Diameter of nozzles	0,35 mm (optional 0,5mm)
Temperature of nozzles	275 °C
Diameter of wire	1,75mm
Wire material	PLA, PETG, ABS, PVA, FLEX
Software	Simplify3D, Repetier-Host
Supported operation system	Windows 7, Mac OS X, Linux
Supported files	STL, AMF, OBJ, 3DS
Connection	USB micro SD card

4. THE EXAMPLE OF MAKING 3D MODEL ON THE PRINTER

The workflow of 3D printing is presented on a concrete example of printing a model of the Eiffel Tower (Figure 2).

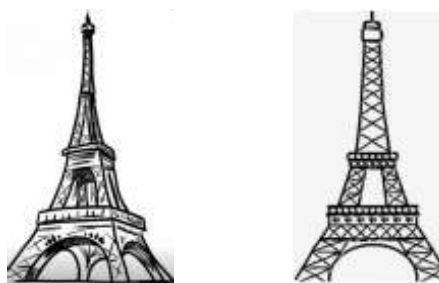


Fig. 2. Model for 3D printing

After the formulating of printed model before opening of printers software it is necessary to convert model created in Solid Works into STL file (Figure 3).



Fig. 3. Model in SolidWorks and STL file

After converting in software of printer Repetier Host the file for printing is input and then the card slicer is chosen. Here the model is “cut” into layers and then within each layer, the program determines the trace of printer's head which melts and pours plastics. These data are finally transformed in G code - a code that 3D printer understands. After setting the parameters in Print Preview window, it is seen how the model should look after the printing (Figure 4).

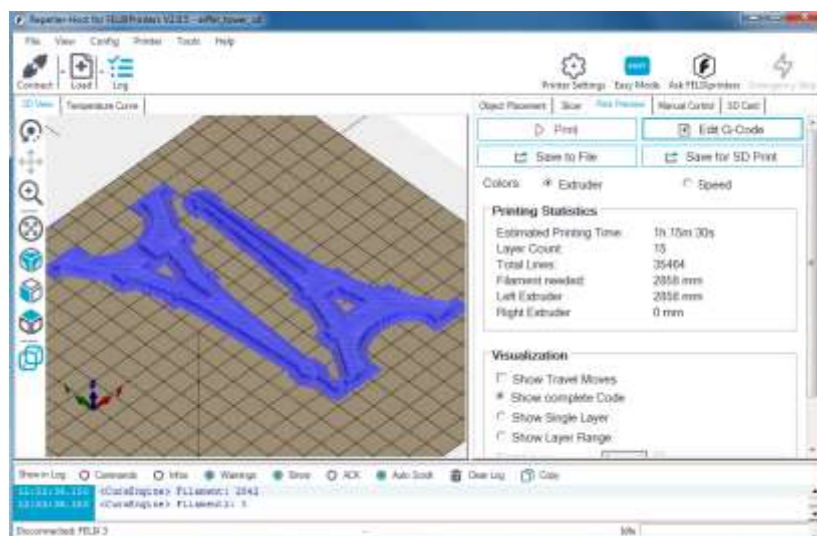


Fig. 4. Model in software Repetier-Host

The printing is conveyed by motor movement of printer's head left- right and back- forth to the extent that is needed to describe a certain line. During that time, the printer's head melts the plastic and leaves the trace of 0,2mm thickness. When the needed lines in the first layer are written, the printer's head is lifted for approximately 0,2mm and over the printed lines it prints the next layer. In that way, by printing layer to layer, the model represented on Figure 5 is obtained.

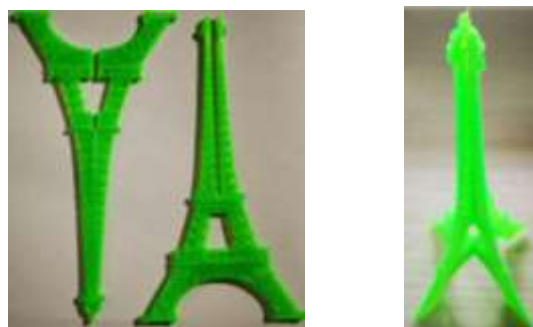


Fig. 5. The look of printed model

The typical working procedure of 3D printing (Figure 6) is performed within next six steps:

1. The concept formulation of model which is printed
2. Concept transformation into the solid model (virtual model) by using CAD software
3. Transformation of solid CAD model in STL file which can be read by the appropriate 3D printing system
4. Transformation of STL data set into the set of mechanical instructions (e.g. G-code) for layer-by-layer movement of printer's head
5. Export of machine instructions into 3D printer and execution printing process
6. Final operations (e.g. pad removing, polishing, paint and alike) of 3D printed object.

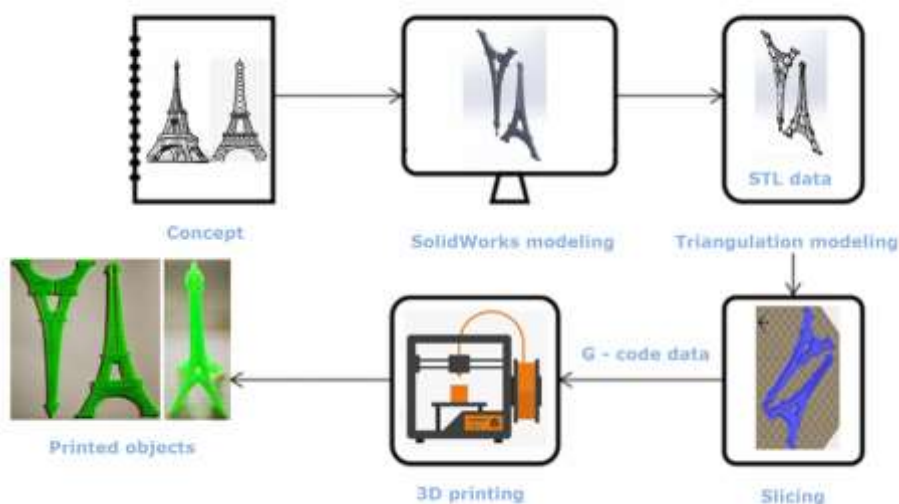


Fig. 6. A typical working procedure of 3D printing

5. IMPROVING SPATIAL ABILITY USING 3D PRINTERS

Visual-spatial abilities are cognitive skills which are considered to be necessary for solving plenty to of everyday tasks. These abilities are very important for success in the field of machine engineering studies [7]. The ability of spatial visualization is generally considered as indicator of intelligence, which means the kind of intelligence specialized for work with three-dimensional areas.

A lot of studies have tried to improve spatial intelligence of students by enlarging spatial abilities with the work in the field of engineer graphics. It has also been suggested complementary usage of 2D sketches and 3D printing models in engineer graphics teaching [8]. It has been studied what effect has the environment for learning based on virtual reality really had on students who attend engineer graphics teaching [9]. The teaching for improvement of spatial abilities based on 3D CAD modeling for the students of engineering has been suggested [10].

The comparative analysis has been conveyed in order to test the influence of manipulating different model types, such as 2D sketches, 3D drawings or 3D printed models [11]. In a recent study, the positive effect that 3D printing has on the visualization ability of students who study machine engineering has been confirmed [12].

In engineering graphics teaching, although the hand drawings are still the component of learning process, the students can improve their understanding of three-dimensional space by 3D printing. What is the most important to emphasize when it comes to 3D printing is that it allows students practical exposure, which means the contact with real 3D models. Learning by contact with models become faster and more efficient and the ability of spatial visualization is improved at the same time.

6. CONCLUSION

3D printing technology is uprising new technology which significantly changed the process of teaching and learning. Instead of imagining some 3D objects, it can be represented in its actual real size now. A lot of time was needed in the past to transform conceptual - level model into 3D model or a prototype. Today it is a question of minute or hours.

The making of one model is presented in this work, starting from creating three-dimensional model in Solid Works program, to printing on 3D printer. It can be concluded that learning by contacting with a model becomes faster and more efficient, while the use of models increases the students' involvement in classes.

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GRAFIČKA INTERPRETACIJA KARAKTERISTIKA MAGNETNIH KOLA, ASINHRONE MAŠINE I PRIKAZ STANDARDNIH TIPOVA ELEKTROMOTORNIH POGONA PRIMENOM GEOGEBRA SOFTVERSKJE PODRŠKE

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SAŽETAK:

U radu su opisane aplikacije razvijene u softveru GeoGebra kao pomoć realizaciji nastave iz električnih mašina i elektromotornih pogona. Jedan set razvijenih aplikacija odnosi se na analizu magnetnih kola sa vazдушnim procepom pobuđenih jednosmernom ili naizmeničnom strujom, kao i magnetnih kola sa stalnim magnetima. Drugi set aplikacija odnosi se uporedni grafički prikaz mehaničkih karakteristika asinhronne mašine kao i na prikaz različitih standardnih tipova elektromotornih pogona. Razvijene aplikacije prvenstveno su namenjene studentima FTN u Čačku kao pomoć u savladavanju dela nastave iz oblasti električnih mašina i pogona. Takođe, aplikacije su javno dostupne i mogu im pristupiti svi zainteresovani u cilju jednostavnog interaktivnog sagledavanje i razumevanje principa rada sa mogućnošću brzog dobijanja ili provere rezultata pri projektovanju magnetnih kola ili analizi rada elektromotornih pogona.

Ključne riječi: magnetna kola, stalni magneti, GeoGebra, karakteristike asinhronne mašine, intermitencija, zagrevanje mašine.

1. UVOD

Proces nastave i prenosa znanja u oblasti elektrotehnike često zahteva rešavanje izazova vezanih za objašnjavanje složenih fizičkih pojava i procesa. U poslednje dve tri decenije u velikoj meri intenzivirana je upotreba različite softverske podrške kao pomoć u izvođenju nastave i savladavanju gradiva od strane studenta [1, 2].

GeoGebra je besplatno dostupan i koristan matematički softver koji je originalno nastao i dizajniran tako da pomogne u nastavi i učenju matematike. Nastavnici, studenti i istraživači ga široko koriste za kreiranje interaktivnih i dinamičnih matematičkih vizualizacija i za istraživanje matematičkih koncepta na veoma intuitivan i zanimljiv način. Sa GeoGebrom, korisnici mogu da kreiraju 2D i 3D grafikone, konstruišu geometrijske figure, vrše numeričke proračune i animiraju raznovrsne matematičke modele. Kao takav GeoGebra predstavlja odličan alat za vizuelizaciju složenih

matematičkih koncepata i istraživanje međusobnih matematičkih relacija omogućavajući lakše razumevanje matematičkih zavisnosti na intuitivniji i zanimljiviji način.

GeoGebra može biti koristan alat i za razumevanje fizičkih principa u oblasti električnih mašina i elektromotornih pogona, posebno kada je u pitanju vizuelizacija i razumevanje složenih elektromehaničkih pojava [3]. Korišćenjem GeoGebra softverskog alata moguće je kreirati interaktivne simulacije iz kojih se mogu razumeti principi rada i kao i najvažnije karakteristike motora i generatora. Na primer, GeoGebra se može koristiti za modeliranje i analizu karakteristika različitih tipova motora i generatora, odnosno mašina jednosmerne i naizmenične struje. GeoGebra alat se pokazao jako koristan kao pomoć u realizaciji nastave na daljinu kao dodatak ili alternativa tradicionalnom izvođenju nastave. Ovo poslednje pokazalo se kao neophodno i deficitarno u cilju obezbeđenja kontinuiteta nastavnog procesa tokom brze tranzicije na onlajn nastavne metode za vreme Covid pandemije.

2. GEOGEBRA U OBLASTI ELEKTRIČNIH MAŠINA I ELEKTROMOTORNIH POGONA

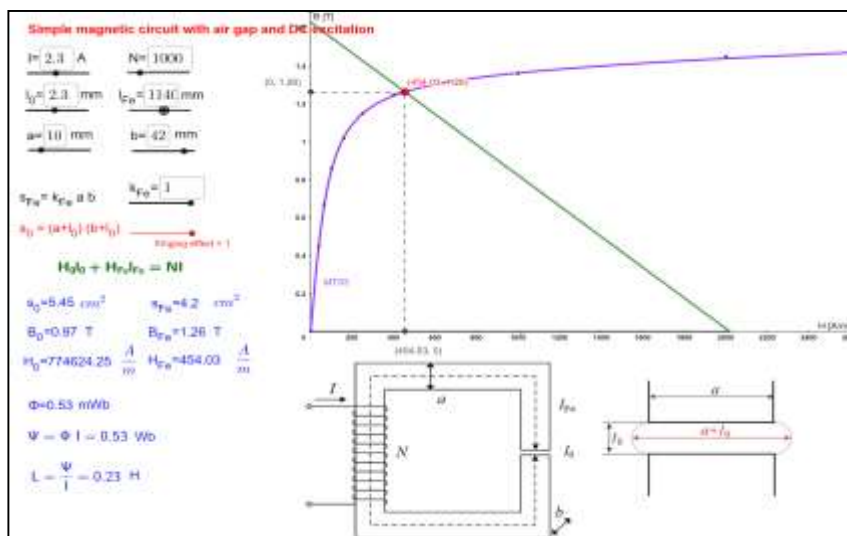
Poseban doprinos korišćenjem GeoGebre može se ostvariti u prezentovanju i objašnjenju složenih, i često međusobno zavisnih karakteristika koje definišu osobine rada električnih mašina. U ovom radu dat je prikaz razvijenih GeoGebra aplikacija za potrebe nastave iz predmeta Električnih mašina i Elektromotornih pogona na Fakultetu tehničkih nauka u Čačku. Pored postojećeg repozitorijuma GeoGebra aplikacija [4], novo razvijene aplikacije odnose se na karakteristike magnetnih kola i asinhrona mašine, kao i na prikaz različitih standardnih tipova elektromotornih pogona (prema standardu IEC 60034-1) [5]. Razvijene aplikacije su javno dostupne preko svih uređaja koji omogućavaju izlaz na internet i za njihovo pokretanje nije potrebna instalacija posebnih programa ili dodataka što omogućava jednostavno pokretanje aplikacija sa bilo kog mesta u bilo koje vreme preko web stranice EMPA laboratorije Fakulteta tehničkih nauka u Čačku [6].

2.1. Karakteristike magnetnih kola

Izučavanje karakteristika magnetnih kola sa ili bez vazdušnog procepa, kao uvod u kurs Električnih mašina, posebno je značajan za studente sa stanovišta razumevanja međusobnih zavisnosti osnovnih parametara magnetnog polja (magnetna indukcija, jačina magnetnog polja, induktivnost, struja magnećenja...). Određivanje radne tačke magnetnog kola (magnetne indukcije B i jačine magnetnog polja H) kao preseka radne prave i karakteristike magnećenja magnetnog kola moguće je jednostavnim grafičkim putem koristeći Amperov zakon i poznajući parametre magnetnog kola kao što su broj namotaja, jačina struje, magnetna permeabilnost i geometrija magnetnog kola itd.

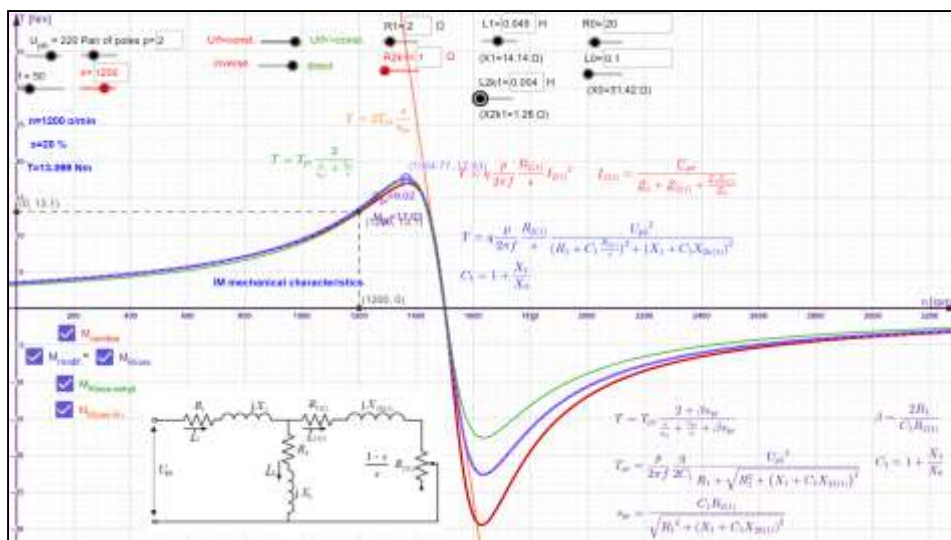
Tri aplikacije koje omogućavaju rešavanje magnetnih kola pobuđenih jednosmernom strujom, naizmeničnom strujom ili stalnim magnetima razvijene su tako da korisniku jednostavno definisanje navedenih parametara (Slike 1 i 2). Kao rezultat dobija se grafički prikaz radne tačke magnetnog kola sa odgovarajućim vrednostima magnetne indukcije i

jačine magnetnog polja u gvožđu i vazдушnom procepu kao i rezultujuće vrednosti magnetnog fluksa i induktivnosti. Posebno je uvažen uticaj ivičnog efekta u vazдушnom procepu (eng. *fringing effect*) koji uvažava tačnije određivanje magnetne indukcije magnetnog fluksa u vazдушnom procepu.



Slika 1. Analiza magnetnog kola sa procepom pobuđenog jednosmernom strujom ([link](#))

Aplikacija određivanja radne tačke magnetnog kola sa stalnim magnetom (u konkretnom slučaju magnet NdFeB – N55) pored do sada navedenog omogućava i prikaz trenutne gustine energije magnetnog polja u zavisnosti od aktuelno podešenih parametara kola. Takođe, u prvom kvadrantu jasno je naznačena tačka maksimalne gustine energije magnetnog kola w_{max} koja se može postići odgovarajućim podešenjem parametara kola (Slika 2).



Slika 3. Poređenje karakteristika AM dobijenih kompleksnim računom, i različitim verzijama Klosovog obrasca ([link](#))

Posebnu vrednost ove aplikacije čini mogućnost definisanje odnosa napona i frekvencije takav da je $U/f = \text{const}$. Pri tome je moguće dobiti set mehaničkih karakteristika mašine pri skalarnom U/f upravljanju karakterističan za frekventne pretvarače koji su sve više zastupljeni u savremenim industrijskim procesima sa AM kao pogonskom mašinom. Na taj način student (korisnik) može odrediti i analizirati dobijene karakteristike kao i vršiti poređenje tačnosti određivanja karakterističnih tačaka pri različitim tipovima proračuna – od najkompleksnijeg do najjednostavnijeg. Suština je da korisnik softvera na najočigledniji način poredeem nacrtanih karakteristika razume u kojoj radnoj oblasti se koji način proračuna može koristiti. Tako se na primer sa Slike 3 može zaključiti da greška određivanja prevalnog momenta u generatorskom režimu rada može biti i blizu 100% ukoliko se koristi uprošćeni Klosov obrazac a ne tačan kompleksan proračun.

2.3. Standardni tipovi elektromotornih pogona

Standard *International Electrotechnical Commission* za obrtne električne mašine IEC 60034-1 pored ostalog definiše i različite klasifikacije pogona u pogledu tipa njihovog opterećenja za vreme rada (eng. *duty types*). Ovi tipovi opterećenja obeležavaju se velikim slovom S i uzimaju prateće brojeve od 1 do 10. Prema standardu definisani su sledeći tipovi pogona odnosno opterećenja (prevod u skladu sa srpskim standardom SRPS IEC 60050-411) [7]:

- S1 – trajni pogon

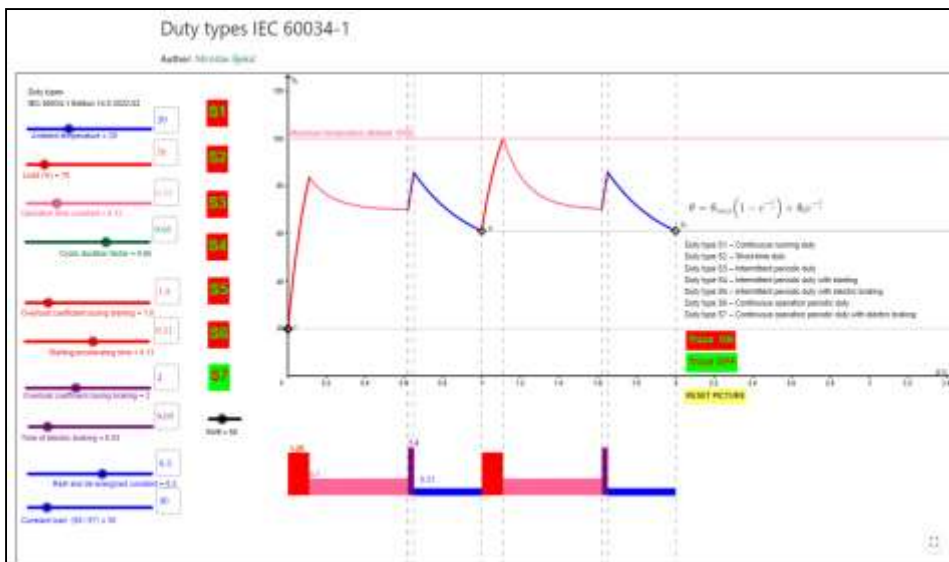
- S2 – kratkotrajni pogon
- S3 – Intermitentni periodični pogon
- S4 – Intermitentni periodični pogon sa uticajem zaletanja
- S5 – Intermitentni periodični pogon sa uticajem zaletanja i električnog kočenja
- S6 – Trajni periodični pogon
- S7 – Trajni periodični pogon sa uticajem zaletanja i električnog kočenja
- S8 – Trajni periodični pogon sa međusobno zavisnim promenama opterećenja i brzine
- S9 – Pogon sa neperiodičnim promenama opterećenja i brzine
- S10 – Pogon sa unapred određenim stalnim opterećenjima i brzinama

U zavisnosti od tipa pogona zagrevanja električne mašine su različita. Opšte poznati zaključak Montsingerove termičkog modela degradacije [8, 9] govori da se pri radu sa samo 8 °C iznad dozvoljene temperature izolacije namotaja radni vek električne mašine skraćuje za pola. Stoga, potrebno je voditi računa o maksimalnoj dozvoljenoj temperaturi namotaja mašine kako ona ne bi premašila dozvoljenu temperaturu određenu klasom izolacije namotaja mašine. U tom cilju razvijene su aplikacije koje omogućavaju poređenje rezultujućih temperatura mašine u zavisnosti od tipa pogona odnosno njegove intermitencije i uticaja zaleta i kočenja. Razvijene aplikacije odnose se na pogone od S1 do S7.

Na Slici 4 prikazan je S7 tip pogona. Ovaj tip pogona definiše se kao pogon sa jednakim nizom radnih ciklusa, od kojih se svaki sastoji od perioda zaletanja, perioda rada sa stalnim opterećenjem i perioda električnog kočenja, bez perioda mirovanja i beznaponskog stanja. S7 tip pogona izabran je kao najkompleksniji gde se mogu menjati:

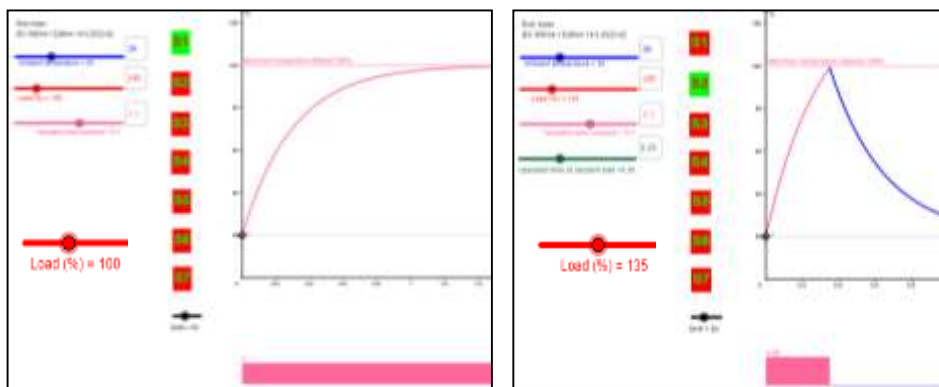
- Temperatura okoline (ambijenta)
- Opterećenje motora i njegova termička vremenska konstanta
- Intermitencija
- Preopterećenje motora prilikom zaletanja i vreme zaletanja
- Preopterećenje motora prilikom kočenja i vreme kočenja
- Termička vremenska konstanta i gubici motora u režimu praznog hoda

Sa Slike 4 može se u zavisnosti od definisanih parametara jasno videti oblast ubrzanog zagrevanja mašine pri startu pogona kao i pri električnom kočenju na kraju ciklusa. Takođe u zavisnosti od opterećenja u stacionarnom stanju i temperature ambijenta mašina će se dodatno zagrevati ili hladiti. Ukoliko se pak postavi visoka temperatura okoline, može se zapaziti da i u režimu neopterećenog motora njegova temperatura raste, kako bi se izjednačila sa temperaturom okoline.



Slika 4. Zagrevanje mašine pri odabranom S7 tipu pogona ([link](#))

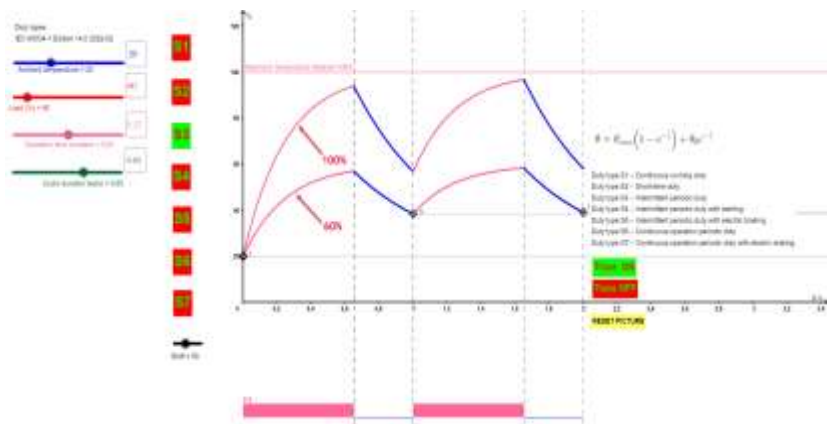
Posebno je zanimljivo pratiti način promene temperature za različite vrednosti odabranih parametara. Na primer može se demonstrirati kako je moguće motor koji je određen kao S1 pogon dodatno opteretiti za 35% ukoliko je potrebno da radi u kratkotrajnom pogonu (S2) pri tom ne premašujući maksimalnu dozvoljenu temperaturu – Slika 5.



Slika 5. Poređenje S1 i S2 tipa pogona

Na Slici 6 prikazano je zagrevanje mašine pri odabranom S3 tipu pogona. Bitno je primetiti i da se za periodične pogone kao što je S3 tip, jednakost temperatura na počecima

ciklusa postiže već posle dva ili tri ciklusa. Tako da je opravdano pisanje programa samo za dva ciklusa, kako se inače i prikazuje u odgovarajućim standardima.



Slika 6. Zagrevanje mašine pri odabranom S3 tipu pogona

Za svaki od prikazanih tipova pogona ispod dijagrama zagrevanja mašine nalazi se i prikaz trenutno definisane intermitencije pogona sa numeričkom vrednošću opterećenja. Aktiviranjem opcija *Trace* u desnom delu aplikacije omogućava se prikaz više karakteristika za različite ulazne parametre. Ovo predstavlja veoma korisnu opciju ukoliko je potrebna uporedna analiza zagrevanja istog tipa pogona pri različito definisanim intermitencijama ili opterećenjima kao što je prikazano na Slici 6.

3. ZAKLJUČAK

Ovaj rad opisuje nekoliko razvijenih aplikacija baziranih na GeoGebra softverskoj platformi kao podrška u izvođenju nastave iz predmeta Električnih mašina i Elektromotornih pogona. U radu su predstavljene aplikacije koje analiziraju magnetna kola sa vazдушnim procepom pobuđenih jednosmernim ili naizmeničnim strujama kao i stalnim magnetima. Mehaničke karakteristike asinhronne mašine dobijene uz pomoć nekoliko različitih proračuna prezentovane su u drugoj aplikaciji omogućavajući uvid u nivo uticaja odabranog tipa proračuna na tačnost dobijenih karakterističnih vrednosti. Treći set aplikacija fokusiran je na prikaz različitih standardizovanih tipova elektromotornih pogona prema standardu IEC 60034-1. Sve aplikacije omogućavaju intuitivno i jednostavno podešavanje parametara magnetnog kola, mašine ili pogona uz pomoć klizača ili direktnim unosom numeričkih vrednosti. Trenutno generisani grafici omogućavaju poređenje dobijenih rezultata i izvođenje adekvatnih zaključaka koji znatno olakšavaju proces učenja i razumevanja relevantnih i složenih fizičkih procesa.

Aplikacije su javno dostupne svim zainteresovanim korisnicima preko web stranice EMPA laboratorije Fakulteta tehničkih nauka u Čačku. Njihovo korišćenje ne zahteva

instalaciju posebnih softvera i dodataka već se mogu direktno pokrenuti preko pametnih telefona, tableta ili PC računara odnosno svih uređaja koji omogućavaju pristup internetu, čineći ovaj vid izvođenja nastave i učenja posebno zanimljivim.

4. ZAHVALNICA

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GRAPHICAL INTERPRETATION OF CHARACTERISTICS OF MAGNETIC CIRCUITS, INDUCTION MACHINES AND STANDARDIZED TYPES OF ELECTRICAL DRIVES USING GEOGEBRA SOFTWARE SUPPORT

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ABSTRACT:

The paper describes applications developed in GeoGebra software as an aid in teaching electrical machines and drives. One set of developed applications pertains to the analysis of magnetic circuits with an air gap excited by direct or alternating current, as well as magnetic circuits with permanent magnets. The second set of applications concerns the comparative graphical representation of the torque vs speed characteristics of induction machines, as well as the analysis of the heating of different types of electrical drives with the possibility of selecting different duty cycles (intermittent periodic duty) with or without the influence of starting and electrical braking. The developed applications are primarily intended for students at the Faculty of Technical Sciences in Čačak as an aid in mastering a part of the teaching material on electrical machines and drives. Additionally, the applications are publicly available and can be accessed by anyone interested in easily and interactively understanding the basic operation principles, with the ability to quickly obtain or verify results when designing magnetic circuits or analysing the operation of electrical drives.

Keywords: magnetic circuit, permanent magnets, GeoGebra, induction machines characteristic, electrical machine duty types, electrical machine heating.

INDUSTRIAL ROBOT SELECTION BY USING FUZZY WISP METHOD

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ABSTRACT:

Industrial robots are computer-controlled mechanisms used in manufacturing to perform various tasks. They play an important role in production and have several significant advantages, such as: increasing efficiency and productivity; cost reduction; improving safety, improving product quality and overall improving production process. Therefore, selection of an industrial robot is a major problem of modern manufacturing companies. Multi-criteria decision-making method (MCDM) is exactly suitable for solving such problems. Aim of this paper is to provide a model for industrial robot selection. Regarding to that, a newly-developed fuzzy WISP method will be employed for industrial robot selection.

Keywords: industrial robots; robot selection; fuzzy WISP, MCDM

1. INTRODUCTION

The evaluation of industrial robots using multiple criteria decision-making (MCDM) methods can be recognized as a topical area of MCDM. As some of the most cited or recently published articles regarding the evaluation of industrial robots using MCDM methods, the following articles can be mentioned: Chatterjee et al. [1] applied two MCDM methods, *Visekriterijumska Optimizacija i Kompromisno Resenje* (VIKOR) and an outranking method *ELimination and Et Choice Translating REALITY* (ELECTRE), for evaluating industrial robots. Athawale and Chakraborty [2] applied *Weighted Product* (WP), *Technique for Order of Preference by Similarity to Ideal Solution* (TOPSIS) and *Grey Relational Analysis* (GRA) methods for evaluation and also observed that all these methods give almost the same ranks of the evaluated robots. Parameshwaran *et al.* [3] applied *Analytical Hierarchical Process* (FAHP), TOPSIS and VIKOR methods in the fuzzy environment for evaluation, while Ghorabae [4] considered the use of the VIKOR method, in a group fuzzy environment using Interval type-2 fuzzy sets.

Karande and Zavadskas [5] applied several MCDM methods, i.e. *Weighted Sum* (WS), *WPM*, *Weighted Aggregated Sum Product Assessment* (WASPAS) method, *Multi-*

Objective Optimization on the basis of Ratio Analysis (MOORA) method, and Multi-Objective Optimization on the basis of Ratio Analysis plus Full multiplicative form (MULTIMOORA) for selecting real time industrial robot. In this article, Karande and Zavadskas applied a newly proposed multi-criteria decision-making method, the WASPAS method [6]. Yalçın and Nuşin [7], and Rashid et al. [8], also applied a newly proposed MCDM method, an Evaluation based on Distance from Average Solution (EDAS) method [9], for optimal industrial robot selection.

In this article the use of fuzzy extension of the Simple Weighted Sum-Product (WISP) method [10] for evaluation industrial robots is presented. Therefore, the article is organized as follows: In Section 2, a fuzzy extension of the Simple WISP method is presented. The usability of the proposed approach is considered in Section 3. Finally, the conclusions are given at the end of the article.

2. FUZZY EXTENSION OF THE SIMPLE WISP METHOD

The procedure of the fuzzy extension of the simple WISP method (Fuzzy WISP) can be presented using the following steps [10]:

Step 1. Form a fuzzy initial decision-making matrix based on the opinions of the experts involved in the evaluation.

Step 2. Determine criteria weights.

Step 3. Construct a normalized fuzzy decision-making matrix as follows:

$$\tilde{r}_{ij} = \tilde{x}_{ij} \frac{1}{\max_i u_{ij}}, \quad (1)$$

where: \tilde{x}_{ij} denote fuzzy rating and \tilde{r}_{ij} denotes a normalized fuzzy rating of alternative i in regards to criterion j , respectively.

Step 4. Calculate the values of four fuzzy utility measures \tilde{u}_i^{sd} , \tilde{u}_i^{pd} , \tilde{u}_i^{sr} , and \tilde{u}_i^{pr} , as follows:

$$\tilde{u}_i^{sd} = \sum_{j \in \Omega_{\max}} \tilde{r}_{ij} w_j - \sum_{j \in \Omega_{\min}} \tilde{r}_{ij} w_j, \quad (2)$$

$$\tilde{u}_i^{pd} = \prod_{j \in \Omega_{\max}} \tilde{r}_{ij} w_j - \prod_{j \in \Omega_{\min}} \tilde{r}_{ij} w_j, \quad (3)$$

$$\tilde{u}_i^{sr} = \frac{\sum_{j \in \Omega_{\max}} \tilde{r}_{ij} w_j}{\sum_{j \in \Omega_{\min}} \tilde{r}_{ij} w_j}, \text{ and} \quad (4)$$

$$\tilde{u}_i^{pr} = \frac{\prod_{j \in \Omega_{\max}} \tilde{r}_{ij} w_j}{\prod_{j \in \Omega_{\min}} \tilde{r}_{ij} w_j}, \quad (5)$$

where: Ω_{\max} and Ω_{\min} denote a set of beneficial and a set of non-beneficial criteria, respectively.

Step 5. Recalculate values of four utility measures, as follows:

$$\tilde{v}_i^{sd} = \frac{1 + \tilde{u}_i^{sd}}{1 + \max_i u_i^{sd}}, \quad (6)$$

$$\tilde{v}_i^{pd} = \frac{1 + \tilde{u}_i^{pd}}{1 + \max_i u_i^{pd}}, \quad (7)$$

$$\tilde{v}_i^{sr} = \frac{1 + \tilde{u}_i^{sr}}{1 + \max_i u_i^{sr}}, \text{ and} \quad (8)$$

$$\tilde{v}_i^{pr} = \frac{1 + \tilde{u}_i^{pr}}{1 + \max_i u_i^{pr}}, \quad (9)$$

where: \tilde{v}_i^{sd} , \tilde{v}_i^{pd} , \tilde{v}_i^{sr} , and \tilde{v}_i^{pr} denote recalculated values of \tilde{u}_i^{sd} , \tilde{u}_i^{pd} , \tilde{u}_i^{sr} and \tilde{u}_i^{pr} , respectively, and $\max_i u_i^{sd}$, $\max_i u_i^{pd}$, $\max_i u_i^{sr}$ and $\max_i u_i^{pr}$ denote the maximum values of the right *endpoints* of four fuzzy utility measures, respectively.

Step 6. Determine the overall fuzzy utility \tilde{v}_i of each alternative as follows:

$$\tilde{v}_i = \frac{1}{4}(\tilde{v}_i^{sd} + \tilde{v}_i^{pd} + \tilde{v}_i^{sr} + \tilde{v}_i^{pr}). \quad (10)$$

Step 7. Determine the crisp overall utility v_i of each alternative, rank the alternatives and select the most suitable one. The alternatives are ranked in descending order, and the alternative with the highest value of v_i is the most preferred one.

3. NUMERICAL ILLUSTRATION

This section presents the application of the Fuzzy WISP method for the evaluation of four industrial robots based on three criteria:

- C_1 - Technical characteristics,
- C_2 - Maintenance time and costs, and
- C_3 -Investment costs.

The evaluation matrices obtained from three experts are shown in Tables 1 to 3, while the linguistic variables used for evaluation are shown in Table 4.

After transforming the linguistic variables into crisp numerical values, a group fuzzy decision-making matrix, shown in Table 5, was formed using Eqs (11) to (13):

$$l_{ij} = \min_k l_{ij}^k \quad (11)$$

$$m_{ij} = \frac{1}{K} \sum_{k=1}^K m_{ij}^k \quad (12)$$

$$u_{ij} = \max_k u_{ij}^k \quad (13)$$

where l_{ij} , m_{ij} , and u_{ij} denote left endpoint, mode, and right endpoint of the fuzzy rating $\tilde{x}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ of alternative i concerning the criterion j , and K denotes the number of experts involved in the evaluation.

Table 1. The ratings obtained from the first of three experts

<i>Criteria Alternatives</i>	C_1	C_2	C_3
A_1	VH	MH	H
A_2	H	M	H
A_3	MH	M	VH
A_4	H	M	H

Table 2. The ratings obtained from the second of three experts

<i>Criteria Alternatives</i>	C_1	C_2	C_3
A_1	VH	M	H
A_2	H	M	H
A_3	MH	ML	VH
A_4	MH	M	H

Table 3. The ratings obtained from the third of three experts

<i>Criteria Alternatives</i>	C_1	C_2	C_3
A_1	EH	M	VH
A_2	VH	ML	VH
A_3	VH	ML	EH
A_4	VH	ML	H

Table 4. The ratings obtained from the first of three experts

<i>Linguistic variable</i>	<i>Abbreviation</i>	<i>Numeric value</i>
Extremely high	EH	9
Very high	VH	8
High	H	7
Moderate high	MH	6
Moderate	M	5
Moderate low	ML	4
Low	L	3
Very Low	VL	2
Extremely Low	EL	1

Table 5. The group fuzzy decision-making matrix

Criteria Alternatives	C ₁	C ₂	C ₃
A ₁	(8.0, 8.3, 9.0)	(5.0, 5.3, 6.0)	(7.0, 7.3, 8.0)
A ₂	(7.0, 7.3, 8.0)	(4.0, 4.7, 5.0)	(7.0, 7.3, 8.0)
A ₃	(6.0, 6.7, 8.0)	(4.0, 4.3, 5.0)	(8.0, 8.3, 9.0)
A ₄	(6.0, 7.0, 8.0)	(4.0, 4.7, 5.0)	(7.0, 7.0, 9.0)

Normalized fuzzy decision matrix, formed by applying Eq. (1), is shown in Table 6.

Table 6. The normalized group fuzzy decision-making matrix

Criteria Alternatives	C ₁	C ₂	C ₃
w _j	0.4	0.3	0.3
optimization	Max	min	min
A ₁	(0.89, 0.93, 1.00)	(0.83, 0.89, 1.00)	(0.78, 0.81, 0.89)
A ₂	(0.78, 0.81, 0.89)	(0.67, 0.78, 0.83)	(0.78, 0.81, 0.89)
A ₃	(0.67, 0.74, 0.89)	(0.67, 0.72, 0.83)	(0.89, 0.93, 1.00)
A ₄	(0.89, 0.93, 1.00)	(0.83, 0.89, 1.00)	(0.78, 0.81, 0.89)

Table 6 also shows the weights of the criteria and the direction of the optimization of the criteria. Based on Table 6, using Eqs. (2) to (5), the values of the four utility measures, shown in Table 7, were calculated.

Table 7. The values of the four utility measures

	\tilde{u}_i^{sd}	\tilde{u}_i^{pd}	\tilde{u}_i^{sr}	\tilde{u}_i^{pr}
A ₁	(-0.21, -0.14, -0.08)	(0.28, 0.31, 0.34)	(0.63, 0.72, 0.83)	(4.44, 5.68, 6.86)
A ₂	(-0.21, -0.15, -0.08)	(0.24, 0.27, 0.31)	(0.60, 0.68, 0.82)	(4.67, 5.71, 7.62)
A ₃	(-0.28, -0.20, -0.11)	(0.19, 0.24, 0.30)	(0.48, 0.60, 0.76)	(3.56, 4.92, 6.67)
A ₄	(-0.21, -0.14, -0.08)	(0.28, 0.31, 0.34)	(0.63, 0.72, 0.83)	(4.44, 5.68, 6.86)

The recalculated values of the four utility measures, determined using Eqs. (6) to (9), are shown in Table 8

Table 8. The recalculated values of the four utility measures

	\tilde{u}_i^{sd}	\tilde{u}_i^{pd}	\tilde{u}_i^{sr}	\tilde{u}_i^{pr}
A ₁	(0.86, 0.93, 0.99)	(0.95, 0.97, 1.00)	(0.89, 0.94, 1.00)	(0.86, 0.93, 0.99)
A ₂	(0.86, 0.92, 1.00)	(0.93, 0.95, 0.98)	(0.88, 0.92, 1.00)	(0.86, 0.92, 1.00)
A ₃	(0.78, 0.87, 0.96)	(0.89, 0.92, 0.97)	(0.81, 0.88, 0.96)	(0.78, 0.87, 0.96)
A ₄	(0.78, 0.92, 1.00)	(0.89, 0.94, 0.98)	(0.81, 0.91, 1.00)	(0.78, 0.92, 1.00)

Based on Table 8, the overall fuzzy utility of each alternative is calculated using Eq. (10) as it is shown in Table 9, as well as the ranking order of the alternatives.

Table 9. The overall fuzzy utility, overall utility, and ranking order of alternatives

	\tilde{v}_i	v_i	Rank
A ₁	(0.832, 0.906, 0.976)	0.22619	2
A ₂	(0.831, 0.891, 0.993)	0.22624	1
A ₃	(0.752, 0.838, 0.947)	0.21140	4
A ₄	(0.752, 0.886, 0.993)	0.21919	3

The crisp values of the overall utility of the considered alternatives, calculated using Eq. (14), proposed by Opricovic and Tzeng [11], are as follows:

$$df(\tilde{A}) = \frac{1}{3}(l + m + u), \quad (14)$$

where l , m , and u denote left endpoint, mode, and right endpoint, respectively, of triangular fuzzy number \tilde{A} .

From Table 9 it can be seen that alternative A₂ is slightly better compared to alternative A₁. However, the rankings of the alternative concerning l_i , m_i , and u_i of the overall fuzzy utility, shown in Table 10, show that in the case of rankings based only on u_i , i.e. optimistic ranking, two alternatives A₂ and A₄ are ranked first, that is, as the most acceptable.

Table 10. The ranking orders based on l_i , m_i , and u_i

	\tilde{v}_i	Rank l_i	Rank m_i	Rank u_i
A ₁	(0.832, 0.906, 0.976)	1	1	3
A ₂	(0.831, 0.891, 0.993)	2	2	1
A ₃	(0.752, 0.838, 0.947)	3	4	4
A ₄	(0.752, 0.886, 0.993)	3	3	1

4. CONCLUSION

This article presents the use of the Fuzzy WISP method for evaluating industrial robots. In the proposed approach, experts evaluate alternatives using linguistic variables. On the

basis of individual evaluation matrices, a group fuzzy decision matrix is formed, which represents the basis for the use of the Fuzzy WISP method.

The considered example in the article, as well as previously solved problems using the Fuzzy WISP method, did not point to any weaknesses of the presented approach, which indicates that the mentioned approach can also be used for solving different multiple criteria decision-making problems.

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CREATION OF ANIMATIONS AND MOVEMENT CONTROL IN FLASH

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ABSTRACT:

The paper discusses the multimedia tool Adobe Flash, in which it will be shown the process of creating animations using software tools for drawing and animating along the time axis. Animations consist of a series of individual images (frames), which are animated on a timeline. The timeline allows us to control the content of the movie, which means controlling when it will appear, move and change. Control and interactivity are achieved using ActionScript, Flash's internal script.

Today, Flash is one of the most popular tools for creating interactive and animated content on the web. One of the most reliable ways to download a Flash movie is to use vector graphics instead of bitmaps. By converting bitmap to vector graphics, you can save on file size and achieve interesting effects.

Keywords: Adobe Flash, animation, ActionScript, frames.

INTRODUCTION

Adobe (Macromedia) Flash is considered one of the most popular technologies on the Web today. With its modernized graphics, which offers rich content for creating interactive and animated websites. Flash has great capabilities for setting up movies, creating shared libraries, designing and controlling graphics, converting bitmaps to vector graphics. When creating animations, we work with Flash format .fla, and for use on the Web, animations are most often transferred in a compressed format called Shockwave Flash .swf.

FLASH ENVIRONMENT

When Flash is started, it is necessary to familiarize yourself with its working environment, which is shown in the following picture:

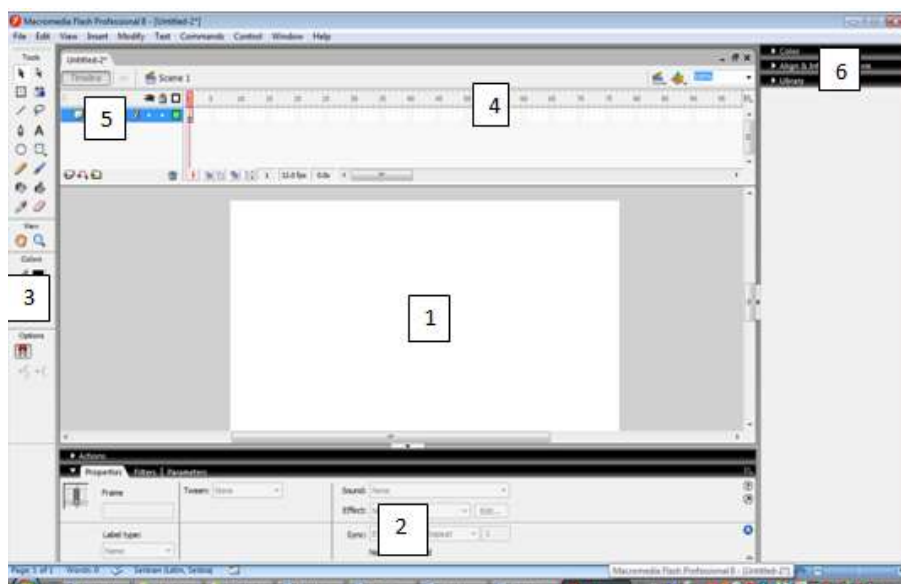
1. Stage (eng.Stage) the place where graphics are drawn, content is composed, paint is applied. All graphic elements placed in this area are visible to the designer

2. Panel Properties displays the properties of the currently selected object, which enables additional settings.

3. The Tools panel contains a large number of tools for drawing and editing already drawn objects.

4. The timeline contains a series of images that make up the animation.

5. Layers can simultaneously display several different animations, where a graphic element can be placed above or below another. 6. Side-by-side anchored panels allow setting attributes for elements.



The Flash environment

One of the most reliable ways to download a Flash movie is to use vector graphics instead of bitmaps. By converting bitmap to vector graphics, you can save on file size and achieve interesting effects. Once a bitmap is imported into Flash, the Trace Bitmap command (Modify/Trace Bitmap) can be used to convert it to vector graphics.



The image on the left is in bitmap format, has more details, and the image on the right is converted to vector graphics, has less details.

CONVERTING TEXT INTO GRAPHICS

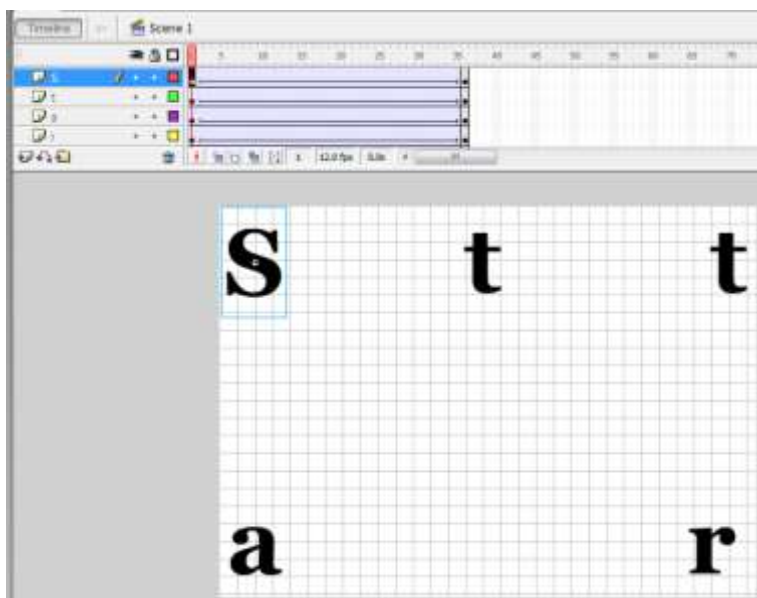
Various interactive elements, animations and everything we see in the movie are made of images, which is made possible by the graphic nature of Flash. Converting text to graphics opens up a whole range of possibilities:

adding text to a button, creating promotional messages with moving text, creating static and animated text, etc. Once the text is converted to a graphic, you can do anything with it that you can do with other graphics.

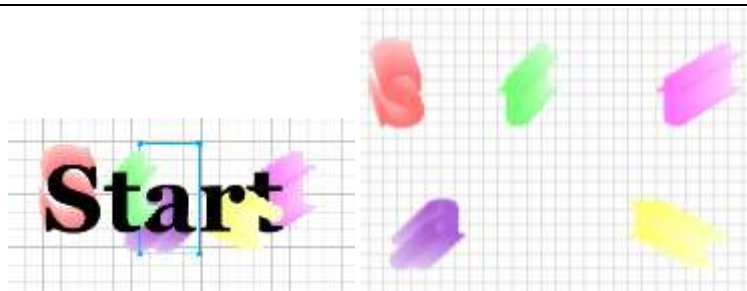
In order to work with text as with graphics, we must first break it apart. In the following example, we will describe a word that is formed on stage from letters that fly from different sides. For this animation we will show intermediate shapes, color, effects.

1. Open a new movie, select the Text tool and create a text field on the stage, select the font size (Select Window/Properties,
2. In the field we wrote Start, a word of five letters that will come from different directions,
3. Then with the tool Arrow drag the text field to the place where we want the text to appear at the end of the movie,
4. Choose Modify/Break Apart to turn the text into graphic objects

5. Choose Modify/Timeline/Distribute To Layers, to create a layer for each letter.
6. Click on all the layers in turn and choose the Modify/Group command for each. This will make all the letters on their layers become grouped objects that can be tween. When any layer is activated, the letter on it should automatically be selected.
- 7 . We press point 36 on the time axis of layer S, and then use Insert/Keyframe (F6) to convert it to a keyframe. So the animation will last three seconds at the default frame rate. If we want the animation to last longer we can o choose another point on the time axis.
8. The next step is to place the letter in the position from which it should start animating, drag the letter to the upper left corner of the stage, then double-click the time axis between the letter and point 36 to select the points between them, at the same time the intermediate movement is entered.



9. Select Insert/Create Motion Tween to add intermediate motion to the letters.
10. Let's repeat the steps for each of the other layers, to set the initial position of each letter. The image shows the animation of all layers and the display of Onion Skin with the addition of colors.



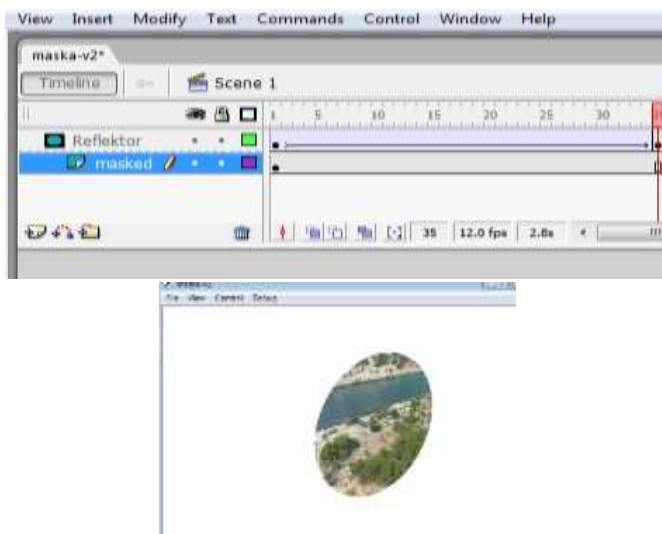
11. Use the Control/Test Movie command to test the movie.



MASKING IN FLASH

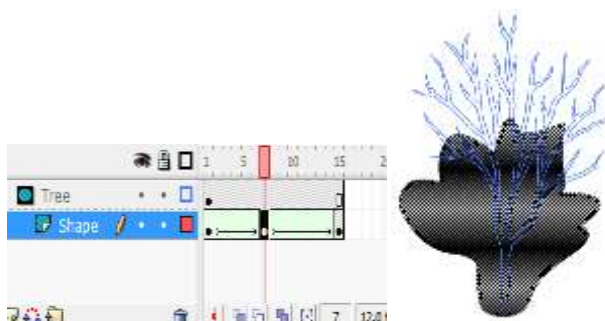
Masking in Flash is a process with two or more layers. We have a layer mask and a layer or layers that are masked. Masks are almost always used in conjunction with animation. We can apply animations to the mask itself, to objects on the masked layer or to both layers. In the next example, we will animate the mask. The effect is created as if the directional light moves over the masked layer, illuminating the objects. The manufacturing process is as follows:

1. Open a new movie and add a mask layer by pressing Insert/Layer, create a background image or enter a ready one,
2. Place a new layer above the first one, select it and give the command: Modify/Layer/Masked Type. The topmost layer becomes the mask layer, the bottom layer is masked.
3. In the first layer, we create a circle, give it a name (Reflector) and define movement, define transformations, color and range of frames (1-35).



4. The picture on the left shows the mask layer and masked, and on the right the mask effect (Test Movie).

The following example shows the effect of a mask on a drawing of a tree, the production process is similar to the previous example. The transformation and range of frames is from 1-15, the changes are visible in the seventh frame.



MOTION CONTROL USING ACTIONSCRIPTA

Controlling the movement of objects on the stage can be done using ActionScript. If we want to control the movement of the ball with the cursor keys, (up, down, left and right),

we will use the on Frame Enter method, which is located wherever there is some action. We generate events by pressing a key, we use the Key object (keyboard button). The Key object is at the very top of the object hierarchy, meaning we don't need to create an instance of it before using it. What we are interested in is whether the key was pressed at all. For this, we use the Key.is Down (keycode) method, where the keycode argument represents a specific numerical or symbolic value assigned to a specific key (in our case, Up, Down, Right and Left).

Three layers are created in the ball file: Ball, Buttons and Actions.

1. In order to be able to control the sequence Ball, we select it and assign it in Properties ball_mc. When the sequence is first loaded, the speed of the ball on the stage is 0. It is at rest. When writing code, it is important to initialize variables at the beginning.

2. Select the Actions layer and enter the program code in the Actions panel:

```
ball_mc.speedX = 0;
ball_mc.speedY = 0;
ball_mc.onEnterFrame = function(){
    if (Key.isDown(Key.RIGHT)) {
        ++this.speedX;
```

3. In the following, we will add the rest of the code to the ball and its on Enter Frame method all the actions intended to move the ball.

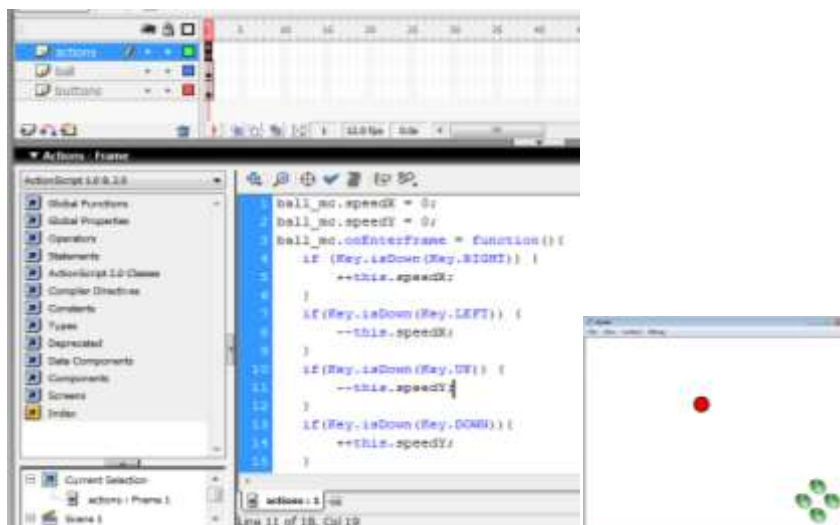
If the right arrow cursor key is pressed, we will increase the speed in the X direction and the X position of the ball on the stage will change. The on Enter Frame code should look like this:

```
        ball_mc.onEnterFrame = function(){
            if (Key.isDown(Key.RIGHT)) {
                ++this.speedX;
            }

            this._x += this.speedX;

            this._y += this.speedY;
```

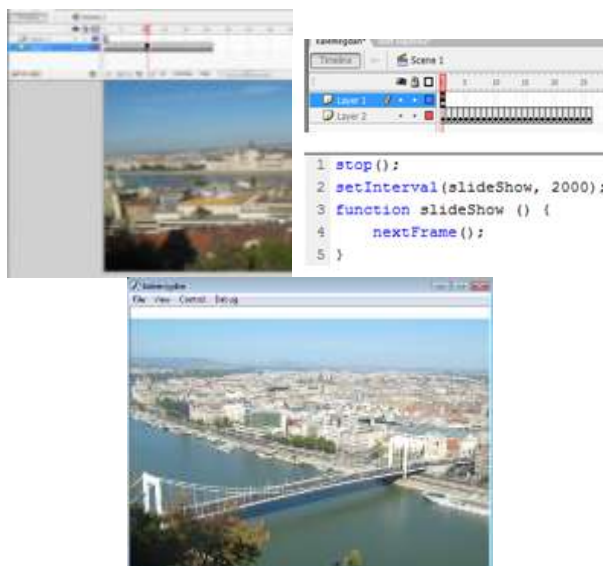
4. Next comes the film testing, if we hold down the button longer, the acceleration of the ball increases. The lowercase letter "a" in the first Actions layer indicates that we used code.



The image on the left shows three layers with the Actions code and on the right an embroidered movie, where the ball is moved from the center to the top by pressing the UP key.

COMMUNICATION WITH EXTERNAL IMAGES

The image shows a slideshow, a presentation of images, which are displayed one after the other. The presentation is controlled using ActionScript. There is one image in each key frame. The speed at which the images change is 2000 milliseconds, that is, 2 seconds.



All selected photos are in jpg format with dimensions of 640x480 pixels. When we select Control/Test Movie, the movie starts from the first keyframe and stops at 26.

CONCLUSION

Flash is one of the most popular programs. It is especially important for creating multimedia applications, vector animations. Graphics, images, animation, sound, text can be controlled using Flash tools. In the paper we show converting bitmaps to vector graphics, converting text to graphics, masking, using ActionScript and slideshow. All applications were tested in Macromedia Flash Professional 8.

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CLICKER: AN ONTOLOGY DRIVEN PLATFORM FOR E-ASSESSMENT

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ABSTRACT:

Assessment represents particularly sensitive segment of the overall e-education process. Hence the need for as much agile as possible technology platforms for e-assessment while generic and scalable in the same time. The foundational proposition of the paper is that, being knowledge intensive task, assessment should benefit from automatic knowledge management technologies, primarily semantic technologies. The research question addressed in this paper is whether leveraging semantic representations of different types of assessment can be beneficial when it comes to agile development of e-assessment platforms, including customization, extension, management and deployment. The goal is to empower not necessarily IT-savvy course administrators to quickly and conveniently develop e-assessment platform (referred to as “Clicker” in this paper) customized for their specific scientific field with appropriate question types by applying automatic code generation. The approach is cloud-ready and scalable on a number of courses, a number of students and different knowledge domains. According to the evaluation results, the proposed approach dramatically speeds up the development and extension of e-assessment platforms, especially when it comes to inclusion of more complex question types.

Keywords: *e-assessment platform, ontology, semantic web*

1. INTRODUCTION

Ever changing development in higher education with plethora of new technologies brings new possibilities for teaching, learning and assessment. As an important part of learning, assessments can be designed as an on-going process (formative) or they can be designed to be used at the end of a prescribed period of learning (summative). Through years, traditional pen and paper method of assessment are gradually being suppressed by e-assessment [1]. Existing e-assessment platforms that use already established databases are mixed blessing for teachers. On one side teachers are not obliged to create question by themselves, but on the other side they are limited to the particular types of question that are already in the database. When a new type of question is needed, it is necessary for

administrator to perform several software development-related activities that can be labour-intensive, time-consuming and requires extensive programming skills. One solution that could provide both coverage and easy-to-use is based on semantic technologies and ontologies. Indeed, ontologies have already been used for automatic question generation for over a decade [2-7], etc. However, all of these ontology-based systems are mostly focus on one type of question, primarily MCQ, and they do not allow teachers to add different types of questions themselves.

In this paper, a novel approach to development of e-assessment platforms is proposed, that helps teachers who may not have IT-related skills to quickly and conveniently develop e-assessment platform according to their specific needs. The resulting platform is referred to as “Clicker” in this paper. “Clicker” platform is customized for a specific scientific field with appropriate question types by applying automatic code generation based on question ontologies and also by providing insertion of new question types by teachers. As question ontology, Medical Assessment Methods Ontology (MAMO) [8] is adopted. It covers most of the computer-based questions in medical education, but can be applied to other educational fields as well.

2. BACKGROUND

E-learning and online education has made a great impact on educational system in the recent decade. It has moved from a knowledge transfer model to a highly intellect, swift and interactive proposition capable of advanced decision-making abilities [9]. The broadness of the assessment field and its richness of several application domains raise problems when it comes to develop e-assessment platforms. One of the solutions is application of ontologies for automatic question generation. Literature review shows significant interest for this field over the last two decade. However, most of the papers focus on ontology-based systems for MCQ automatic generation [2-11]. They address different techniques and strategies for MCQ items selection, such as iteration over all entities (combinations of viable statements) in the ontology [2], or string similarity measures between sentences in the datasets for distractors [3]. Authors in [4] proposed techniques based on the node and edge label sets of the instances in an ontology in order to generate two new categories of MCQ types. In [5] is used domain and granular ontologies to determine relevant subtopics and subtopics for items generation. Authors in [6] designed system to help students generate self-assessment questions about laboratory materials related to products and safety rules. With similar agenda, personalized feedback algorithm was created in [7] which provide students with appropriate type of feedback after answering questions. Apart from MCQ questions, medical schools use different types of questions such as Script concordance test (SCT) [10] and Comprehensive integrative puzzle (CIP) [11] that assess clinical reasoning. Authors in [12] describe a SCTonto ontology [12] for automatic question generation of SCT. The main goal was to create a significant number of SCT question with the help of ontologies thus enabling teachers to reduce the workload during the SCT construction. SPARQL queries was used for ontology

testing and confirmed that SCTonto is suitable for the development of user-friendly and effective automatic assessment generation process. They also proposed approach for ontology based automatic question generation of CIP assessment method in [13]. OntoCIP ontology is developed to semantically represent structure and methodology of the CIP assessment method. Conducted evaluation shows that proposed approach significantly reduces teachers' time for CIP generation.

3. “CLICKER”: AN ONTOLOGY E-ASSESSMENT PLATFORM

Recent dramatic changes in the global society due to pandemic have imposed radical challenges for education systems around the world. New very hard requirements have emerged that should be fulfilled in a very short time. Assessment represents particularly sensitive segment of the overall e-education process. Hence the need for as much agile as possible technology platforms for e-assessment while generic and scalable in the same time. The foundational proposition of the paper is that, being knowledge intensive task, assessment should benefit from automatic knowledge management technologies, primarily semantic technologies. The research question addressed in this paper is whether leveraging semantic representations of different types of assessment (in the form of question ontologies) can be beneficial when it comes to agile development of e-assessment platforms, including customization, extension, management and deployment.

Architecture of proposed e-assessment platform is illustrated in Fig. 1. The question ontologies are stored inside a semantic RDF triple store. Ontology-driven code generator is executing SPARQL queries against the semantic triple store in order to retrieve the necessary parameters that are required for generation of the corresponding customizable software assets of the base of the e-assessment platform. In the implementation, HTML/CSS/JavaScript is used on the frontend, while PHP is used on the backend. MySQL server is used for the database that holds the data about platform users (teachers, students), questions, tests, answers and results. While the part of the database API that is responsible for user management and login is common for all the derived e-assessment platforms, the part related to question insertion is generated according to the question ontologies during the code generation process. For that purpose, the extension of the original database schema with additional tables or columns might be required. When it comes to PHP and HTML pages, both the question input forms and visualization functions have to be generated as a result of platform customization.

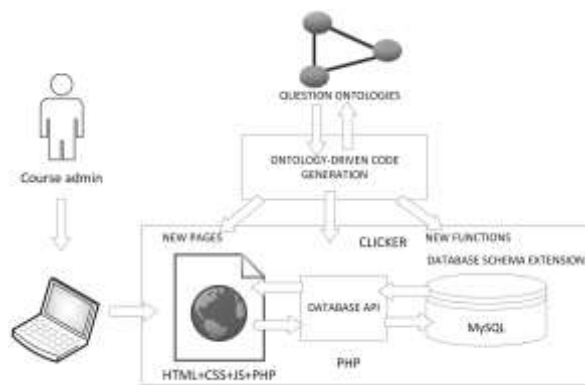


Fig. 1. Architecture of “Clicker” platform

During the test creation, for each question they add to the test, the teachers have to select the desired question type. The list of available question types consists of different ontologies for semantic question structure representation defined within the semantic triple store. For the purpose of this work, MAMO ontology was used (Fig. 2). It is application ontology, grounded in the gUFO ontology [14].

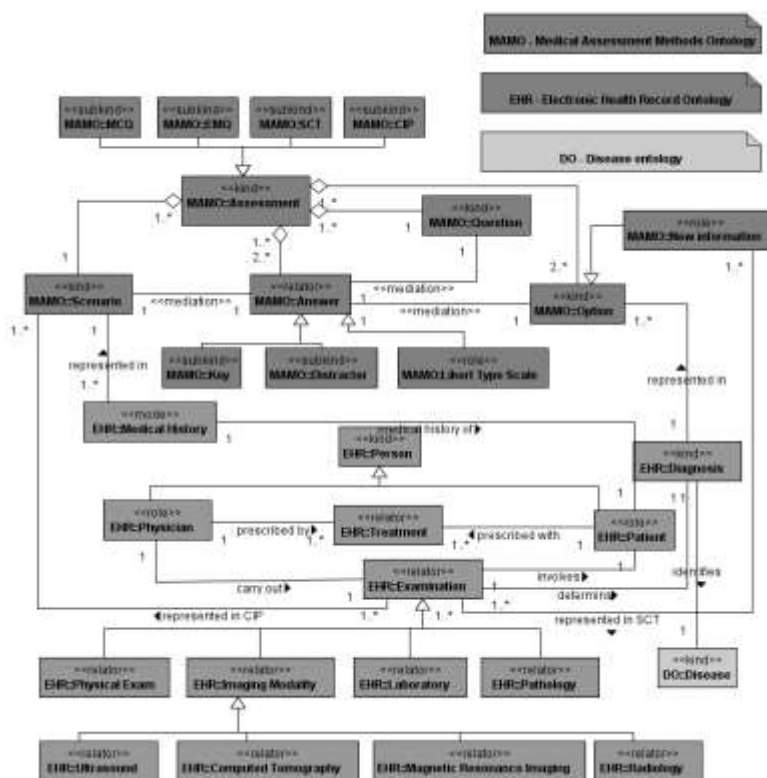


Fig. 2. Main classes of MAMO ontology

Besides the list of available question types in the MAMO ontology, the users are also able to define new question types or import other existing ontologies that represent a structure of a particular question type. Once the question type is selected, the corresponding semantic representation (user-created or imported) is used in order to perform the automated code generation of a question input form which consists of HTML/JavaScript code. The generated form is further used as an interface to the teachers to specify values of question elements and insert new questions this way. The service responsible for the question insertion (in form of RDF triplets) in the semantic knowledge base is called via REST API from the generated input form. The triplet insertion service is universal for all question types and doesn't need any modification when new question type is considered. After that, the new questions are also stored within the semantic knowledge base according to the form of the selected ontology. Finally, the semantic representation of these new questions is used to generate the tests within the e-assessment platform, once the teacher

decides to finish the test creation. The previously described mechanism is illustrated in Figure 3.

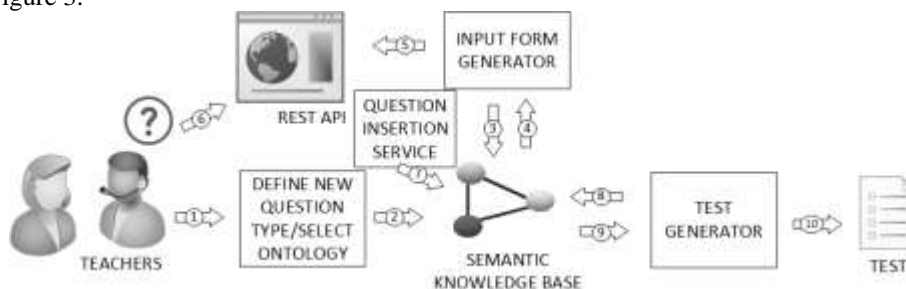


Fig. 3. Working principle of ontology-driven question insertion mechanism

4. EVALUATION CASE STUDY – TRADITIONAL VS. THE ONTOLOGY-DRIVEN QUESTION GENERATION

In the traditional e-assessment platforms (Figure 4a), when new type of question has to be inserted, it is necessary to perform several software development-related activities. First, it is needed to modify the existing database schema, so it could capture the aspects of these new questions that were not covered before. The database modification includes inserting new tables, columns and rows. After that, it is needed to manually create the corresponding HTML web page that will enable the insertion of that question type, containing all the necessary fields. In most cases, it is also needed to define the corresponding backend scripts manually that will work behind the insertion forms. And, finally, the previously created web page and backend scripts need to be deployed to the e-assessment platform server before the user is given the ability to insert a question that belongs to the new type that was inserted.

In the ontology-driven approach (Figure 4b), using the automated form generation based on semantic annotations gives the ability to avoid the steps such as web page and backend script development, database schema modification and deployment of the developed artifacts, as the new question type forms will be generated automatically and dynamically, avoiding the need to perform the mentioned steps manually. If the ontology for a particular question type already exists, then it is enough just to import the ontology. Otherwise, the user is able to define the fields that describe the question structure that is translated to a semantic representation. In that scenario, that would be the only effort needed in order to extend the platform with new question type, without involving any kind of programming and IT-related skill, enabling the teachers to define question types directly themselves.

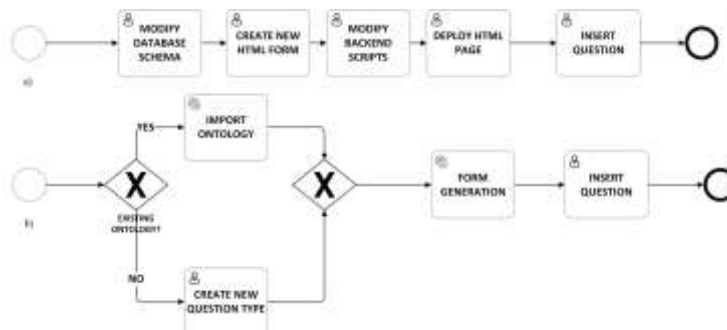


Fig. 4. Process of extending the e-assessment platform with new question types: (a) using traditional approach and (b) using ontology-driven approach given in BPMN notation.

The tasks that have to be taken to extend the platform with the new question type in case of the traditional approach are all manual. However, in case of ontology-based approach, the steps of page creation, modification of backend scripts and deployment are covered by the form generation task that is completely automatic and relies on code generation mechanisms in order to create the necessary artifacts to enable the insertion of new types of questions. The only step that has to be done in the case of ontology-driven approach is simply importing the question ontology. If the appropriate question ontology does not exist, guided creation of the ontology for a new question type would be needed. An overview of the tasks that have to be performed in case of insertion of new question types in case of traditional and ontology-based extension of the system is given in Table 1. The final column shows the task duration estimate based on empirical results (an average of 20 tries for each of the tasks).

Table 1. Task overview in case of traditional and ontology-based approach of e-assessment platform extension with new question types

<i>Traditional</i>	<i>Task type</i>	<i>Duration estimate [s]</i>	<i>Ontology-based</i>	<i>Task type</i>	<i>Duration estimate [s]</i>
Modify database schema	manual	600	Import ontology	automatic	2
			Guided question type creation	manual	100
Create new HTML form	manual	300	Form generation based on	automatic	5

Modify backend scripts	manual	1000	semantic annotations		
Deploy HTML page	manual	600			
Insert new question	manual	40	Insert new question	manual	40

From Table 1, it should be noted that the process of e-assessment platform extension with new question types can be highly automatized if using the ontology-based approach, especially in the case when there are already existing question ontologies. Moreover, the question ontologies can be exchanged not only between users, but also between machines, giving the ability to import them within other educational platforms and environments, so they can be further leveraged.

In Table 2, an overview of time needed for extension of e-assessment platform with new question types in case of traditional and ontology-based approach in case when there are existing question ontologies and in case when they need to be created is given for different types of questions used in medical education.

Table 2. Overview of time needed for extension of e-assessment platform for different question types

Question type	Traditional [min]	Ontology-based with existing ontologies [s]	Ontology-based with new ontology creation [s]	Speed-up [times]
MCQ	55	15	142	23-220
SCT	82	18	205	24-273
CIP	79	16	189	25-296

As it can be seen, the speed up is more relevant when there are already existing question ontologies available. However, the question ontologies are reusable and need to be created only once and shared between different platforms afterwards. The creation of new question types leveraging the ontology-based approach, in case when there aren't corresponding ontologies for a target question type available takes more time, but the speed-up is still up to 25 times with respect to the traditional approach. The speed up is most significant for the complex type of questions with the existing ontologies, such as CIP and SCT.

5. CONCLUSION

The primary aim of this paper was to propose an innovative ontology-driven e-assessment platform called "Clicker" which is envisioned to help teachers to reduce their workload during assessment development, especially teachers who may not have all the necessary IT skills. The whole development of the platform was described in detail. Besides MAMO

ontology semantic RDF triple store can store other question ontologies as well. Also, it is possible for the teacher to create new type of question by following guided question type creation process, which is explained in detailed in the paper. In order to evaluate proposed approach, the ontology-driven question generation was compared to traditional question generation. Evaluation show that the process of e-assessment platform extension with new question types can be highly automatized if using the ontology-based approach, especially in the case when there are already existing question ontologies. Additionally, time needed for extension of e-assessment platform for different question types when new ontology is needed is greater than when ontology already exist. However, once created ontology can be reused many times.

Future work includes applying “Clicker” platform across several educational fields such as engineering, biology, language learning, etc. This will help in evaluating the quality of auto-generated questions in several fields. In addition, “Clicker” could be enhanced by including feedback for every question.

Acknowledgment

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PROBDISTID: A WEB-BASED TOOL FOR IDENTIFYING AND PARAMETER ESTIMATION OF PROBABILITY DISTRIBUTIONS

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ABSTRACT:

Accurately identifying the appropriate probability distribution and the corresponding distribution parameters for input data is essential in a wide range of disciplines, as it can lead to better understanding, modeling, and prediction of the phenomenon under study. In this paper is presented ProbDistID, a versatile R-based web application that simplifies identifying probability distributions and their parameters for user-selected scenarios. Applicable to different fields addressing probability distribution identification, our tool employs the Levenberg-Marquardt Nonlinear Least-Squares Algorithm to fit input data to chosen distribution models. Users can select suitable probability distributions, define expected parameter value ranges, generate random data for testing or import datasets in batch files, and customize data preprocessing to optimize fitting. The web application displays the fitting results in a tabular format, featuring various model selection methods, allowing users to make informed decisions about the appropriate probability distribution. The presented approach, which requires no a priori knowledge of input data and is suitable for real-time probability distribution recognition, provides a comprehensive solution for data-driven decision-making across numerous applications, making it a valuable resource for data mining tasks. We validate the utility and effectiveness of our application through a case study in the wireless communication fading scenario, showcasing its ability to deliver accurate and reliable results.

Keywords: data mining, nonlinear regression, probability distribution recognition, model selection, curve fitting

1. INTRODUCTION

Statistical models are fundamental in various scientific and engineering disciplines [1] to understand, model, and predict complex phenomena. Accurate selection of an appropriate probability distribution and estimation of its parameters is crucial for making informed decisions and improving prediction accuracy [2].

Probability distributions play a significant role in diverse fields, such as wireless fading, wind power, hydrology, and medical studies [3]–[7]. One of the challenges faced in

selecting appropriate probability distributions and their parameters is the lack of a unified approach that can be applied across different disciplines. Existing methods or tools are often limited to specific fields or require extensive user expertise in the subject matter. Moreover, some methods may not be suitable for large datasets, timely analysis, or for those that lack prior knowledge of the data being studied. These limitations call for the development of a versatile and user-friendly tool to simplify the process of identifying probability distributions and estimating their parameters.

This paper presents ProbDistID, a novel R-based web application for identifying probability distributions and their parameters for user-selected scenarios [8]. Building upon our previous work [8], this paper introduces an enhanced version of our approach, including a user-friendly GUI interface, additional probability distributions, and more model selection criteria. A case study demonstrates the effectiveness and utility of our tool in the identification of statistical models for fading in wireless systems.

This paper is organized as follows: Section 2 describes the capabilities and features of ProbDistID, including its interface and functionalities; Section 3 presents a case study in the wireless communication fading scenario to demonstrate the effectiveness and utility of the tool; and finally, Section 4 concludes the paper with a summary of our findings and suggestions for future work.

2. SOFTWARE CAPABILITIES AND FEATURES

ProbDistID offers a comprehensive solution for distribution fitting, enabling users to identify appropriate probability distributions and estimate their parameters with ease. The web-based tool is designed to be versatile and user-friendly, suitable for users from various disciplines and levels of expertise.

Regression analysis, particularly nonlinear regression (NR), is a powerful approach for analyzing various types of data due to its simplicity, flexibility, and ease of interpretation [9]. ProbDistID employs the Levenberg-Marquardt Nonlinear Least-Squares Algorithm [10], [11] for identifying the best-fitting probability distribution and estimating its parameters. This iterative optimization technique minimizes the sum of the squared residuals between the observed data and the fitted model, providing accurate parameter estimates. A major change in comparison to our previous work [8] is that signal generation is now implemented in R, the same language as the rest of the application. This improvement allows for a more coherent and efficient development process by avoiding the unnecessary mixing of different programming languages or software platforms, which can introduce compatibility issues and increase complexity.

The tool offers users the capability to generate random data for testing purposes, import datasets in batch files, and preprocess data for optimal fitting, all within the R environment. Data preprocessing options include data transformation, normalization, and outlier removal. These features ensure that the input data is properly prepared for the fitting process, enhancing the accuracy and reliability of the results, while maintaining consistency and efficiency throughout the entire application.

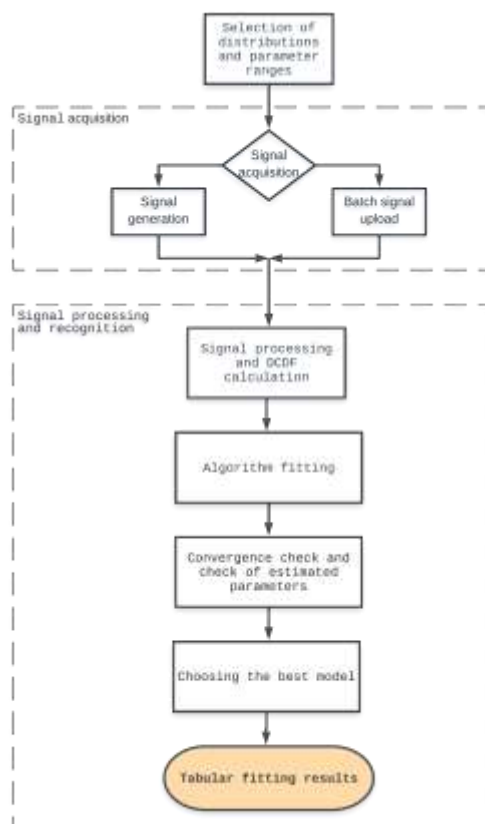


Fig. 1. Algorithm diagram

ProbDistID features an intuitive interface with graphical representations, allowing users to visualize the fitting process and monitor the progress. The system displays the fitting results in a tabular format, featuring various model selection and goodness-of-fit tests: Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) [12], and MAE (mean absolute error), RMSE (root mean squared error), R-squared and adjusted R-squared [13]. These metrics help users compare the performance of different distributions and make informed decisions about the appropriate probability distribution for their data. ProbDistID currently supports 14 probability distributions: Beta, Exponential, Gamma, General Extreme Value (GEV), Gumbel, Logistic, Lognormal, Nakagami-m, Normal, Poisson, Rayleigh, Rician, Uniform, and Weibull. These distributions were selected because they are commonly found in various disciplines, and they encompass a wide range of applications. It is important to note that the application is still in its beta phase, and as

work continues, more distributions will be included to further enhance its versatility and utility.

2.1. The interface of ProbDistID

This section presents a step-by-step guide on how to use ProbDistID, highlighting its graphical user interface (GUI), features, and functionalities. The GUI of ProbDistID is designed to be intuitive and easy to use, streamlining the process of identifying probability distributions and estimating their parameters. The interface is organized into a sidebar for data input and configuration and a main panel consisting of four subpanels for different stages of the process.

In the sidebar, users can upload a dataset or select a distribution and manually enter parameter values. The sidebar also provides inputs and buttons for discrete cumulative density function [8] (DCDF) calculation and a button to initiate the fitting process.

The software enforces certain constraints to prevent users from generating a signal before selecting the distributions and defining their parameters. Additionally, although users can upload a signal before selecting the distributions and parameters, the software requires them to select these options before initiating the fitting process.

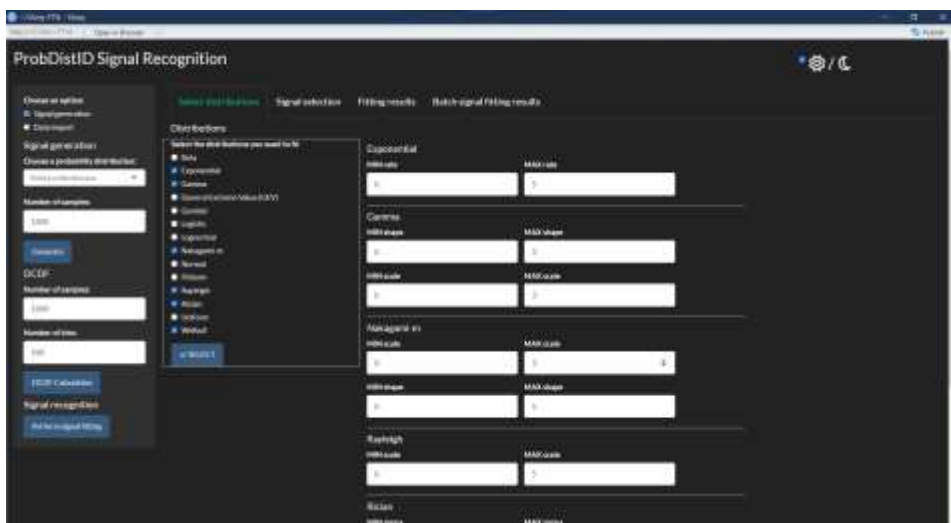


Fig. 2. Distribution and parameter selection window

The main panel features four subpanels. The first panel, "Select Distributions," allows users to choose from 14 probability distributions (Figure 2). The second panel, "Signal Selection," is used for plotting the generated signal in three ways: signal values, probability density function (PDF), or cumulative distribution function (CDF) (Figure 3). Once the DCDF is calculated, its plot is displayed below the signal plot.

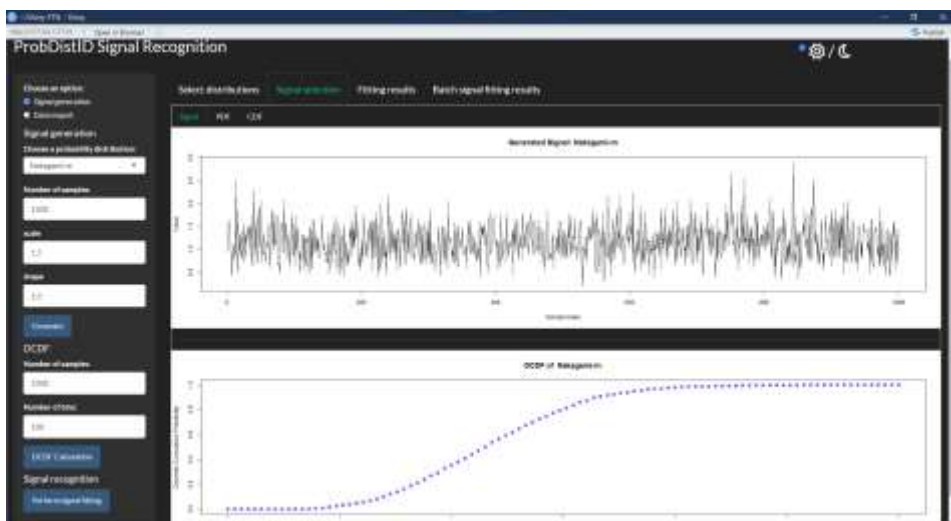


Fig. 3. Distribution plot with signal and DCDF

The third panel, "Fitting Results," displays the results of fitting the generated signal in a tabular format, showing values of model selection and goodness-of-fit tests for each successfully fitted distribution, as well as a second table with the values of the distribution parameters (Figure 4). The fourth panel, "Batch Fitting Results," operates similarly to the third panel but is designed for batch processing.

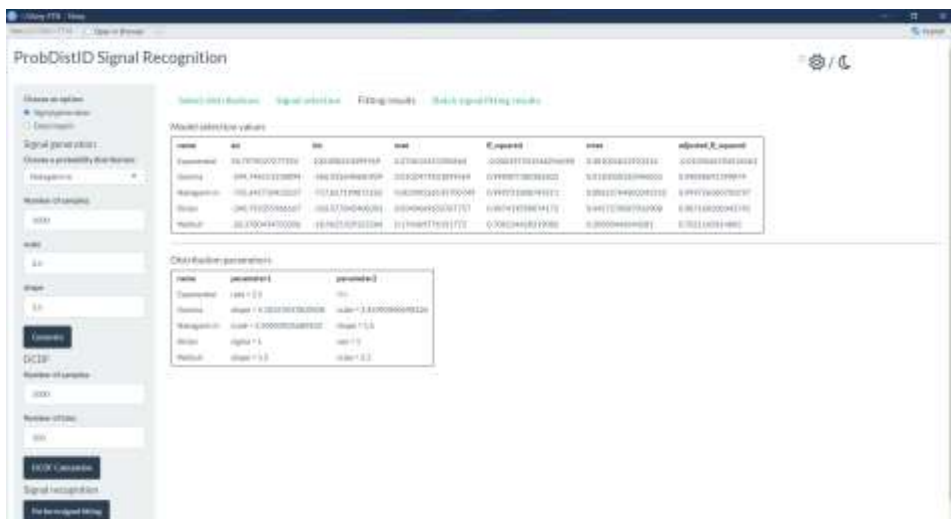


Fig. 4. Fitting results with model selection criteria and estimated parameters

Overall, the user-friendly interface of ProbDistID guides users through the process of identifying probability distributions and estimating their parameters. Its intuitive layout and features, including distribution selection, signal visualization, and fitting results presentation, make it a valuable resource for data-driven decision-making and data mining tasks.

3. CASE STUDY: WIRELESS COMMUNICATION FADING SCENARIO

In this case study, we continue our work from the previous paper [8] and explore the application of ProbDistID to the wireless communication fading scenario, a complex problem that requires accurate distribution identification and parameter estimation. In [8] the proposed approach was validated on a large set of 38,400 randomly generated signals with five different probability distributions usually employed to model wireless fading, namely Gamma, Rayleigh, Rician, Nakagami-m, and Weibull.

In this case study, we varied parameters in accordance with the reference value ranges given in [14]. We used these parameter ranges:

- for the Gamma distribution, five values of parameter c from 1 to 3 in increments of 0.5;
- for the Nakagami-m distribution, six values of parameter m starting with 0.5 and from 1 to 5 in increments of 1;
- for the Rice distribution, six values of parameter K from 0 to 5 in increments of 1;
- and for the Weibull distribution, six values of parameter c from 0.5 to 3 in increments of 0.5.

We omitted the Rayleigh distribution from this study since the results for Rayleigh are thoroughly presented in our previous paper. We have fixed the scale value at 2, as we proved in our previous work that it does not affect the recognition results.[8]. We generated 100 signals for each parameter combination, and the combined recognition plots are shown in Figure 5.

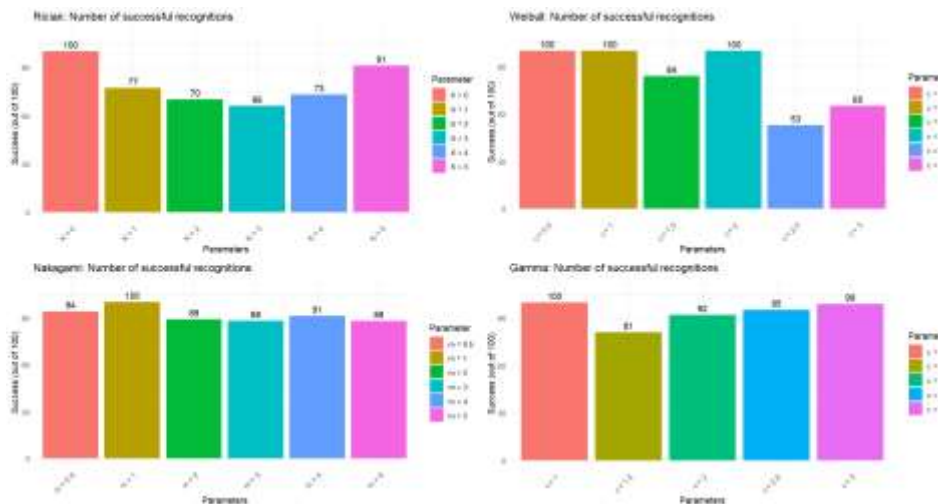


Fig. 5. Recognition results

The case study involves a realistic simulation setup with user-generated and then imported datasets, showcasing the flexibility and effectiveness of ProbDistID. ProbDistID successfully identifies appropriate distributions and estimates their parameters in the case study, demonstrating its practical utility and reliability.

5. CONCLUSION AND FUTURE WORK

ProbDistID offers a comprehensive, user-friendly, and versatile solution for probability distribution identification and parameter estimation, applicable to a wide range of disciplines. Our primary contributions include the development of a web-based tool that streamlines the process of selecting appropriate probability distributions and estimating their parameters, as well as the successful application of this tool in a wireless communication fading case study. The robust performance of ProbDistID highlights its value in data-driven decision-making and data mining tasks across various domains.

Future enhancements to the software may include the addition of more distribution models, improved recognition methods, and expanded preprocessing options to accommodate diverse application scenarios and data types. Future work may involve refining the tool's performance, expanding its range of supported distributions, and exploring new applications in different domains. ProbDistID has the potential to serve as a valuable resource in various fields where accurate probability distribution identification and parameter estimation are critical for modeling, prediction, and decision-making purposes.

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REŠAVANJE PROBLEMA LINEARNOG PROGRAMIRANJA PRIMENOM SOFTVERA WINQSB

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SAŽETAK:

Linearno programiranje je posebna matematička metoda koja se koristi u operacionim istraživanjima i predstavlja osnovu za rešavanje mnogih problema sadržanih u matematičkom programiranju. Uz pomoć različitih softverskih paketa ova metoda se raširila skoro u sve segmente života i poslovanja, a posebno kada je u pitanju optimizacija proizvodnje. Vodeći se time, u radu je prikazan matematički model linearnog programiranja koji služi za optimizaciju proizvodnje sa aspekta maksimalnog korišćenja proizvodnih potencijala uz respektovanje tržišnih ograničenja. Za rešavanje konkretnog problema korišćen je softver WinQSB. WinQSB je softverski paket koji je veoma intuitivan za upotrebu i ne zahteva poznavanje programskih jezika i pisanje komplikovanih programskih kodova. Pored toga, u sebi sadrži module za skoro sve istraživačke probleme iz oblasti operacionih istraživanja i poslovnog odlučivanja.

Ključne reči: linearno programiranje, optimizacija, proizvodni potencijali, WinQSB

1. UVOD

Za uspešno poslovanje, opstanak i razvoj poslovno-proizvodnog sistema od strateškog je značaja pitanje proizvodnog programa. Želja menadžera je da očekivano-željeno stanje bude i optimalno. Međutim, željama uvek stoje na putu ograničenja koja treba uzeti u obzir prilikom primene metoda i tehnika optimizacije. Operaciona istraživanja u praksi zahtevaju timski rad i rešavanje problema u više faza. Faze rešavanja problema operacionog istraživanja su, [1]:

1. Definisanje realnog problema i prikupljanje relevantnih podataka;
2. Formulisanje odgovarajućeg matematičkog modela;
3. Rešavanje modela koristeći softversku podršku;
4. Testiranje modela i njegova dorada po potrebi;
5. Priprema za primenu modela;
6. Implementacija.

Cilj je definisati matematički model koji omogućava pronalaženje optimalnih rešenja na različitim nivoima upravljanja i sa različitih aspekata. Prema [2] najveći izazov predstavlja

optimizacija sveobuhvatnog planiranja proizvodnje kao i nedostatak opšteg optimuma. Za planiranje proizvodnje najčešće se primenjuju sledeće metode: LP (*linear programming*), NLP (*nonlinear programming*), and MILP (*mixed integer linear programming*), [3]. Pri izboru metode optimizacije potrebno je voditi se sledećim principima: postavljeni zadatak treba da zadovolji matematička i formalna ograničenja korišćene metode, a korišćena metoda treba da obezbedi pouzdano dolaženje do tačnih rešenja za što kraće vreme i uz što manje napora i troškova, [4]. Linearno programiranje (LP) je jedna od najkorišćenijih metoda operacijskog istraživanja a naziv je dobila zato što model obuhvata uglavnom linearne funkcije.

Prema [5] linearno programiranje je dokazana metoda koja rešava veliki skup problema koji značajno smanjuju troškove i povećavaju dobit u ekonomiji ili uopšte vrše optimizaciju tražeći optimalno rešenje, bilo to minimum ili maksimum.

Postoje različiti programski jezici i softverski paketi koji rešavaju problem primenom metoda linearnog programiranja: QSB, WinQSB, Lindo, Lingo, Excel, Visual Math, Gurobi, GAMS, Mathematica, MATLAB, IpSolveAPI, CPLEX, Xprey – MP, Mosek, AIMMS, Ortec softver, SAS/OR, JDA i drugi. Na pitanje koji je najbolji softver za linearno programiranje ne postoji jednostavan odgovor. Pri odabiru treba imati u vidu jednostavnost korišćenja kao i dodatne izlazne podatke (analize) koje softver podržava.

U radu je prikazan matematički model linearnog programiranja koji služi za optimizaciju proizvodnje sa aspekta maksimalnog korišćenja proizvodnih potencijala uz respektovanje tržišnih ograničenja. Za rešavanje konkretnog problema korišćen je softver WinQSB.

2. MATEMATIČKI MODEL

Problem linearnog programiranja karakterišu, kao što i samo ime kaže, linearne funkcije nepoznatih. Model se sastoji od linearne funkcije cilja određenih promenljivih i ograničenja koja predstavljaju jednakosti i/ili nejednakosti ovih promenljivih, [6]. Formulacija standardnog problema LP glasi, [1,6]: naći ono nenegativno rešenje (x_1, x_2, \dots, x_n) , $(x_i \geq 0, i = 1, 2, \dots, n)$ sistema linearnih jednačina/nejednačina (ograničenja), relacija (1), za koje funkcija cilja, relacija (2), dostiže optimalnu (maksimalnu ili minimalnu) vrednost.

$$a_{11}x_1 + a_{12}x_2 + \dots + a_{1n}x_n \begin{cases} \leq \\ = \\ \geq \end{cases} b_1$$

$$a_{21}x_1 + a_{22}x_2 + \dots + a_{2n}x_n \begin{cases} \leq \\ = \\ \geq \end{cases} b_2$$

...

$$a_{m1}x_1 + a_{m2}x_2 + \dots + a_{mn}x_n \begin{cases} \leq \\ = \\ \geq \end{cases} b_m$$

(1)

$$F = F(x_1, x_2, \dots, x_n) = c_1x_1 + c_2x_2 + \dots + c_nx_n$$

(2)

U cilju definisanja matematičkog modela, za optimizaciju proizvodnje sa aspekta maksimalnog korišćenja proizvodnih potencijala, utvrđeni su normativi mašinskog vremena (a_{ij}), za sve aktuelne proizvode ($x_j, j = \overline{1,20}$), po komponentnim kapacitetima ($M_i, i = \overline{1,8}$) na nivou jedne radne jedinice. Pored ograničenja raspoloživih mašinskih kapaciteta ($b_i, i = \overline{1,6}$) u matematičkom modelu prisutna su i ograničenja koja definišu apsorpcionu moć tržišta ($b_i, i = \overline{7,26}$). U tabeli 1 nalaze se svi potrebni podaci za definisanje matematičkog modela.

Tabela 1. Parametri a_{ij} , b_i i c_j u matematičkom modelu

X_i	$a_{ij} (\cdot 10^{-5})$						c_j ($\cdot 10^{-5}$)	$b_i,$ $i = \overline{7,26}$
	$M1$	$M2$	$M3$	$M4$	$M5$	$M6$		
X_1	0	536	0	0	0	0	536	≥ 50000
X_2	1154	0	0	0	0	0	1154	≥ 50000
X_3	1154	0	0	0	0	0	1154	≥ 50000
X_4	0	0	0	0	556	0	556	≤ 800000
X_5	0	750	0	0	0	0	750	≥ 80000
X_6	0	2500	0	0	1250	5000	8750	≥ 50000
X_7	0	469	0	0	0	0	469	≥ 60000
X_8	0	0	910	0	0	0	910	≥ 30000
X_9	0	750	0	0	0	0	750	≥ 40000
X_{10}	0	1744	0	0	872	3488	6104	≥ 50000
X_{11}	0	469	0	0	0	0	469	≥ 20000
X_{12}	0	3750	0	0	0	0	3750	≥ 65000
X_{13}	0	0	0	750	0	0	750	≤ 800000
X_{14}	0	0	5357	0	0	0	5357	≥ 50000
X_{15}	0	0	0	375	0	0	375	≥ 50000
X_{16}	577	0	0	0	0	0	577	≤ 50000
X_{17}	7500	0	0	0	0	0	7500	≥ 75000
X_{18}	1154	0	0	0	0	0	1154	≥ 25000
X_{19}	0	0	0	0	3750	13236	16986	≤ 50000
X_{20}	0	1875	0	0	0	1875	3750	≤ 50000
$b_i,$ $i = \overline{1,6}$	9011	23572	5052	12461	10138	4522	64756	

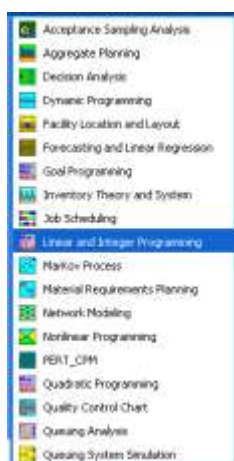
3. SOFTVER WINQSB ZA REŠAVANJE PROBLEMA LP

Softver WinQSB razvio je profesor Yih-Long Chang sa Tehnološkog instituta iz Džordžije i predstavlja Windows verziju softverskog paketa QSB (*Quantitative Systems for Business*) koji je prvi put predstavljen 1986. godine, [7]. Danas je dostupna druga

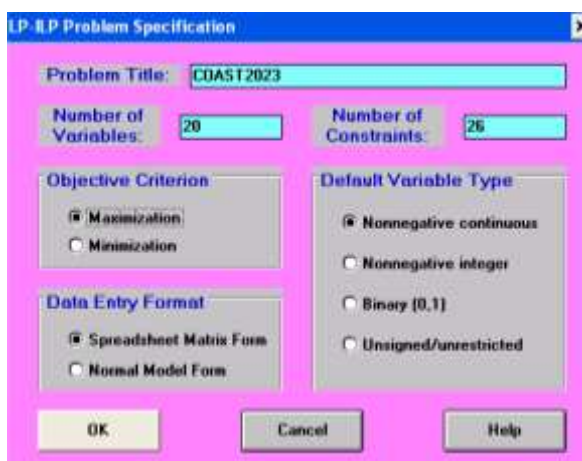
verzija WinQSB-a, [8]. WinQSB je interaktivni sistem za podršku odlučivanju koji nudi niz moćnih alata koji pomažu menadžerima da reše probleme i donose uspešne poslovne odluke iz područja operacionih istraživanja, poslovnog odlučivanja i sl. Jedna od opcija podrške je modul za rešavanje problema linearnog programiranja (*Linear and Integer Programming*) koji je detaljno objašnjen u ovom radu. Pored ovog modula u literaturi se mogu sresti moduli za rešavanje problema: alokacije (*Network Modeling-Assignment Problem*) [9]; primenom tehnika mrežnog planiranja (PERT/CPM) [10, 11]; planiranja potrebnih materijala (*Material Requirements Planning*) [7]; primenom teorije Markovljevih lanaca (*Markov Process*) [12] i mnogi drugi.

Rešavanje problema LP pomoću softverskog paketa WinQSB vrši se u nekoliko koraka:

1. Korak: Nakon odabranog modula za rešavanje problema LP, slika 1a, potrebno je definisati novi problem (*File → New problem*).
2. Korak: U okviru za dijalog, slika 1b, potrebno je definisati sledeće podatke: naziv problema; ukupan broj nepoznatih; ukupan broj ograničenja; optimum funkcije cilja (max ili min); tip nepoznatih i format unosa podataka.
3. Korak: Uneti ulazne podatke, tj. formirati model LP, slika 2. U ovom radu koriste se podaci iz tabele 1.
4. Korak: Rešiti problem (*Solve and Analyze*).



a)



b)

Slika 1. Izbor modula za rešavanje problema LP i definisanje osnovnih podataka

Variable	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	Function	R.H.S.
Maximize	0.00000	0.01154	0.01154	0.00556	0.00075	0.00075	0.00400	0.0001	0.00075	0.00184	0.00400	0.01075	0.00075	0.00357	0.00075	0.00577	0.00075	0.00184	0.00000	0.00075		3611
S1	0.00075	0.01154	0.01154		0.00075	0.00075	0.00400		0.00075	0.00184	0.00400	0.01075		0.00357		0.00577	0.00075	0.00184		0.00075		23572
S2								0.0001														3052
S3																						17481
S4																						01138
S5																						4522
S6																						50000
S7																						50000
S8																						000000
S9																						00000
S10																						50000
S11																						50000
S12																						50000
S13																						50000
S14																						50000
S15																						50000
S16																						50000
S17																						50000
S18																						50000
S19																						50000
S20																						50000
S21																						50000
S22																						50000
S23																						50000
S24																						50000
S25																						50000
S26																						50000

Slika 2. Unos ulaznih podataka modela

Nakon formiranja modela LP pristupa se rešavanju problema, klikom na Solve and Analyze. Iz padajućeg menija može se odabrati više opcija, u zavisnosti na koji način želimo da se problem reši i prikaže na ekranu. Prva opcija Solve the Problem rešava problem bez prikaza iteracija na ekranu. Opcija Solve and Display Steps rešava problem po koracima tj. iteracijama i prikazuje svaku iteraciju na ekranu. Poslednja opcija (Graphic Method) odnosi se na rešavanje problema grafičkom metodom.

Kada je problem uspešno rešen pristupa se pregledu i tumačenju rezultata. Softver automatski prikazuje kombinovani izveštaj (*Results* → *Combined Report*), slika 3, međutim, mogu se odabrati i drugi prikazi rezultata odabirom odgovarajućih opcija (*Solution Summary*, *Constraint Summary*, slike 4 i 5) ili se prikazati analiza osetljivosti za koeficijente u funkciji cilja (c_j) ili analiza osetljivosti koeficijenata b_i , slike 6 i 7.

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Decision Variable	Solution Value	Total Cost as Profit (€)	Total Contribution	Residual Cost	Basic Status	Allowable Max (€)	Allowable Min (€)	
1	X1	50,000,000.00	0.0004	280,000.00	0	basic	M	0.0004
2	X2	50,000,000.00	0.0115	527,000.00	0	basic	M	0.0115
3	X3	50,000,000.00	0.0115	527,000.00	0	basic	M	0.0115
4	X4	600,000,000.00	0.0050	4,440,000.00	0	basic	B	M
5	X5	60,000,000.00	0.0075	680,000.00	0	basic	M	0.0075
6	X6	50,000,000.00	0.0075	4,375,000.00	0	basic	M	0.0075
7	X7	60,000,000.00	0.0047	281,000.00	0	basic	M	0.0047
8	X8	30,000,000.00	0.0031	273,000.00	0	basic	M	0.0031
9	X9	40,000,000.00	0.0075	280,000.00	0	basic	M	0.0075
10	X10	50,000,000.00	0.0110	3,052,000.00	0	basic	M	0.0072
11	X11	20,000,000.00	0.0047	93,000.00	0	basic	M	0.0047
12	X12	5,303,440,000.00	0.0375	19,306,000.00	0	basic	B	M
13	X13	600,000,000.00	0.0075	6,000,000.00	0	basic	B	M
14	X14	30,710,000.00	0.0530	4,778,000.00	0	basic	B	M
15	X15	1,722,810,000.00	0.0037	6,463,000.00	0	basic	B	0.0017
16	X16	0	0.0050	0	0	at bound	M	0.0050
17	X17	980,911,000.00	0.0750	7,568,000.00	0	basic	B	M
18	X18	20,000,000.00	0.0115	280,500.00	0	basic	M	0.0115
19	X19	2,380,330.00	0.1030	286,762.4	0	basic	B	M
20	X20	0	0.0375	0	0.0053	at bound	M	0.0428
Objective Function		(Max) Z =	60,205,760.00	(Ratio)	Allowable	Subtotal	Constraint	
Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Max (€)	Allowable Min (€)	
1	b1	≤	9,011,000.00	0	1.0000	7,067,500.00	M	
2	b2	≤	23,512,000.00	0	1.0000	6,162,000.00	M	
3	b3	≤	9,052,000.00	0	1.0000	2,781,500.00	M	
4	b4	≤	12,401,000.00	0	1.0000	6,167,500.00	M	
5	b5	≤	9,507,762.4	0	0.0027	762.4	M	
6	b6	≤	4,522,000.00	0	1.0033	4,744,000.00	10,082,000.00	
7	b7	≤	50,000,000.00	0	0	3,004,150,000.00		
8	b8	≤	50,000,000.00	0	0	210,614,200.00		
9	b9	≤	50,000,000.00	0	0	210,614,200.00		

Slika 3. Deo rezultata matematičkog modela LP, kombinovani izveštaj

Dec. No.	Decision Variable	Solution Value	Total Cost as Profit (€)	Total Contribution	Residual Cost	Basic Status
1	X1	50,000,000.00	0.0004	280,000.00	0	basic
2	X2	50,000,000.00	0.0115	527,000.00	0	basic
3	X3	50,000,000.00	0.0115	527,000.00	0	basic
4	X4	600,000,000.00	0.0050	4,440,000.00	0	basic
5	X5	60,000,000.00	0.0075	680,000.00	0	basic
6	X6	50,000,000.00	0.0075	4,375,000.00	0	basic
7	X7	60,000,000.00	0.0047	281,000.00	0	basic
8	X8	30,000,000.00	0.0031	273,000.00	0	basic
9	X9	40,000,000.00	0.0075	280,000.00	0	basic
10	X10	50,000,000.00	0.0110	3,052,000.00	0	basic
11	X11	20,000,000.00	0.0047	93,000.00	0	basic
12	X12	5,303,440,000.00	0.0375	19,306,000.00	0	basic
13	X13	600,000,000.00	0.0075	6,000,000.00	0	basic
14	X14	30,710,000.00	0.0530	4,778,000.00	0	basic
15	X15	1,722,810,000.00	0.0037	6,463,000.00	0	basic
16	X16	0	0.0050	0	0	at bound
17	X17	980,911,000.00	0.0750	7,568,000.00	0	basic
18	X18	20,000,000.00	0.0115	280,500.00	0	basic
19	X19	2,380,330.00	0.1030	286,762.4	0	basic
20	X20	0	0.0375	0	0.0053	at bound
Objective Function		(Max) Z =	60,205,760.00	(Ratio)	Allowable	Constraint

Slika 4. Rezultati LP izborom opcije
Solution Summary

Decision Variable	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price
1	b1	≤	9,011,000.00	0	1.0000
2	b2	≤	23,512,000.00	0	1.0000
3	b3	≤	9,052,000.00	0	1.0000
4	b4	≤	12,401,000.00	0	1.0000
5	b5	≤	9,507,762.4	0	0.0027
6	b6	≤	4,522,000.00	0	1.0033
7	b7	≤	50,000,000.00	0	0
8	b8	≤	50,000,000.00	0	0
9	b9	≤	50,000,000.00	0	0
10	b10	≤	50,000,000.00	0	0.0000
11	b11	≤	50,000,000.00	0	0
12	b12	≤	50,000,000.00	0	0.0017
13	b13	≤	50,000,000.00	0	0
14	b14	≤	20,000,000.00	0	0
15	b15	≤	40,000,000.00	0	0
16	b16	≤	50,000,000.00	0	0.0012
17	b17	≤	20,000,000.00	0	0
18	b18	≤	500,000,000.00	0	0.0000
19	b19	≤	500,000,000.00	0	0
20	b20	≤	20,210,000.00	0	0
21	b21	≤	7,072,970.000.00	0	0.0000
22	b22	≤	0	0	0.0000
23	b23	≤	180,911,000.00	0	0.0000
24	b24	≤	20,000,000.00	0	0
25	b25	≤	2,380,330.00	0	0.0000
26	b26	≤	0	0	0.0000
Objective Function		(Max) Z =	60,205,760.00		

Slika 5. Rezultati LP izborom opcije
Constraint Summary

04-30-2023 14:27:30	Decision Variable	Solution Value	Reduced Cost	Unit Cost or Profit Cj	Allowable Min. Cj	Allowable Max. Cj
1	X1	50.000.0000	0	0.0054	M	0.0054
2	X2	50.000.0000	0	0.0115	M	0.0115
3	X3	50.000.0000	0	0.0115	M	0.0115
4	X4	800.000.0000	0	0.0056	0	M
5	X5	80.000.0000	0	0.0075	M	0.0075
6	X6	50.000.0000	0	0.0075	M	0.0052
7	X7	80.000.0000	0	0.0047	M	0.0047
8	X8	30.000.0000	0	0.0091	M	0.0091
9	X9	40.000.0000	0	0.0075	M	0.0075
10	X10	50.000.0000	0	0.0618	M	0.0622
11	X11	20.000.0000	0	0.0047	M	0.0047
12	X12	530.848.0000	0	0.0375	0.0375	M
13	X13	000.000.0000	0	0.0075	0.0075	M
14	X14	89.216.3800	0	0.0536	0.0536	M
15	X15	1.722.933.0000	0	0.0037	0	0.0037
16	X16	0	0	0.0058	M	0.0058
17	X17	100.013.3000	0	0.0750	0.0750	M
18	X18	25.000.0000	0	0.0115	M	0.0115
19	X19	2.100.3320	0	0.1093	0.1054	M
20	X20	0	-0.0053	0.0375	M	0.0428

Slika 6. Analiza osetljivosti parametara c_j

04-30-2023 14:28:58	Constraint Side	Direction	Unit RHS	Right Hand Side	Allowable Min. RHS	Allowable Max. RHS
1	b1	=	1.0000	5.911.0000	2.362.0000	M
2	b2	=	1.0000	23.572.0000	6.102.0000	M
3	b3	=	1.0000	5.052.0000	2.393.0000	M
4	b4	=	1.0000	12.461.0000	6.187.0000	M
5	b5	=	0	10.130.0000	5.587.7620	M
6	b6	=	1.0000	4.522.0000	4.244.0000	10.002.0000
7	b7	=	0	50.000.0000	0	3.301.130.0000
8	b8	=	0	50.000.0000	0	210.414.2000
9	b9	=	0	50.000.0000	0	210.414.2000
10	b10	=	0.0050	800.000.0000	0	1.610.300.0000
11	b11	=	0	80.000.0000	0	2.401.200.0000
12	b12	=	0.0017	50.000.0000	0	10.500.0000
13	b13	=	0	60.000.0000	0	3.704.700.0000
14	b14	=	0	30.000.0000	0	260.824.0000
15	b15	=	0	40.000.0000	0	2.301.200.0000
16	b16	=	0.0012	50.000.0000	0	57.370.1000
17	b17	=	0	20.000.0000	0	3.744.700.0000
18	b18	=	0	10.000.0000	M	530.848.0000
19	b19	=	0	000.000.0000	0	1.630.467.0000
20	b20	=	0	50.000.0000	M	89.216.3800
21	b21	=	0	50.000.0000	M	1.722.933.0000
22	b22	=	0	50.000.0000	0	M
23	b23	=	0	75.000.0000	M	100.013.3000
24	b24	=	0	25.000.0000	0	191.414.2000
25	b25	=	0	50.000.0000	2.100.3320	M
26	b26	=	0	50.000.0000	0	M

Slika 7. Analiza osetljivosti parametara b_i

4. ZAKLJUČAK

Program omogućava dobijanje sledećih rešenja: vrednost realnih promenljivih (*Solution Value*), vrednosti neiskorišćenih potencijala tj. kapacitivnu analizu (*Slack or Surplus*), analizu osetljivosti koeficijenata u funkciji cilja, c_j (*Allowable min c_j i Allowable max c_j*), analizu osetljivosti koeficijenata b_i (*Allowable min RHS i Allowable max RHS*) i vrednost funkcije cilja za dobijena rešenja.

U ovom primeru optimalni proizvodni program angažuje 60205,76 mč/god što predstavlja 92,97% od raspoloživog potencijala mašina koji iznosi 64756 mč/god. Na nivou mašina stepen korišćenja kapaciteta iznosi 100% izuzev za mašinu M5 koji iznosi 55,11%, što je odličan rezultat. Međutim, potrebno je analizirati vrednosti realnih promenljivih u smislu da li su ograničenja tržišta dobro postavljena. Na primer, za proizvod X_{15} optimalna količina iznosi 1.722.933 komada a u ograničenju je stavljeno da je potrebno više ili jednako od 50.000 komada. Nameće se pitanje da li će moći da se proda sva količina. Nasuprot tome, za proizvode X_{16} i X_{22} optimalno rešenje je 0 komada a u modelu je postavljeno da je potrebno manje ili jednako od 50.000 komada. Ukoliko imamo naručene količine ovih proizvoda, obavezno treba postaviti dodatna ograničenja.

Na konkretnom primeru moglo se videti kako jednostavno, uz pomoć softverskog paketa WinQSB, može se rešiti problem linearnog programiranja, gde se maksimizira korišćenje proizvodnih potencijala. Da bi linearno programiranje bilo uspešno mora se dobro modelovati sistem tj. moraju se sva ograničenja predvideti i uvrstiti u model kao i sve varijable odlučivanja.

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SOLVING THE LINEAR PROGRAMMING PROBLEM USING SOFTWARE WINQSB

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ABSTRACT:

Linear programming is a special mathematical method used in operational research and is the basis for solving many problems contained in mathematical programming. With the help of various software packages this method has spread to almost all segments of life and business, especially when it comes to production optimization. Based on this, the paper presents a mathematical model of linear programming that serves to optimize production from the aspect of maximum use of production potential while respecting market restrictions. WinQSB software was used to solve the specific problem. WinQSB is a software package that is very intuitive to use and does not require knowledge of programming languages and writing complicated programming codes. In addition, it contains modules for almost all research problems in the field of operational research and business decision making.

Keywords: *linear programming, optimization, production potentials, WinQSB*

IMPLEMENTATION OF AN ADAPTIVE CONTENT-BASED IMAGE RETRIEVAL SYSTEM FOR SEARCHING IMAGES BASED ON COLOR HISTOGRAMS

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ABSTRACT:

The Internet today represents an unlimited database. Quick search and extraction of the desired content is a priority for all users. In addition to textual content, users are increasingly searching for other multimedia content (image, video, animation, sound). That is why it is necessary to develop algorithms for fast search of multimedia content based on attributes such as image size, resolution, primary color, type, etc.

In this paper is presented an adaptive content-based image retrieval system for searching multimedia content. A system is implemented in the Python programming language using the color histogram method and the CV library. The Euclidean distance was used to compare the similarities between the photos that were previously indexed. The implementation of the search engine is used for the recommendation system of clothing combinations based on colors, where it is possible to search for similar clothing that has a color match with the image from the query. To test the system, a corpus of photos consisting of 2055 photos of wardrobes, with different colors and types, is used.

Keywords: *image retrieval, python, CV library, clothing recommendations, color histograms*

1. INTRODUCTION

Searching for multimedia content is a very attractive topic today. An unimaginable amount of information is generated on the Internet on a daily basis, the most common of which are texts, images, videos, audio recordings, etc.

With the advent of the Internet, and later its development, there was a need to process the content that is exchanged daily on the Internet. When processing such content, a frequent activity is searching for multimedia content. User requirements are such that it is necessary to provide data quickly and easily.

Among the search for multimedia content, the search for images is represented in many cases. As an application, it is reflected in medicine, industry, marketing and many spheres of everyday life.

There are a lot of works dealing with this topic, and some of them will be listed below. Article [1] presented an overview of the some of available literature on content-based image retrieval in the medical domain. The large number of research publications in the field of content-based medical image retrieval especially in that years shows that it was very active and that it is starting to get more attention, which turned out to be true. Content-based visual information retrieval definitely has a large potential in the medical domain.

In paper [2] was presented a comparative analysis of Content based Image Retrieval. In paper was told that the development of multimedia technology made the rapid increasing usage of large image database become possible. To carry out its management and retrieval, Content-Based Image Retrieval (CBIR) is an effective method.

In paper [3] is presented the content based image retrieval, using features like texture and color. The texture and color features are extracted through wavelet transformation and color histogram and the combination of these features is robust to scaling and translation of objects in an image.

This paper will deal with image search, specifically image search based on color histograms. The goal of the work and implementation is not to introduce a new method for image search, but to use a well-known photo search method that can be useful in searching for similar wardrobes by color, and can also be adaptive for other problems.

2. COLOR HISTOGRAMS

The term histogram in statistics is a graphical display of tabular values. A histogram is a graphical version of a table that shows what proportion of cases belong to each of a number of specific categories. Categories are usually specified as non-overlapping intervals of some variable. The categories on the histogram are actually columns and they must be neighbors. A histogram is actually a bar graph, which has the values of the independent variable on the X axis, and the values of the dependent variable on the Y axis. The axis labels should be linearly arranged in ascending order. [4]

The graph is constructed by first dividing the X axis into intervals, and by applying the values of all categories to it. Then the number of data matching that category is plotted as a horizontal line above the corresponding interval, this is why a bar graph is obtained.

One of the very important applications of histograms is in digital photography, and therefore in computing in the areas of photo processing [5-6]. A histogram of an image is

defined as a graph that has all shades of color or intensity of brightness on the horizontal axis, and the number of pixels that are those shades on the vertical axis.

It was mentioned that the histogram on the horizontal axis has all shades of color or brightness intensities, namely there are two types of histograms, one based on colors and the other on intensity.

Color-based histograms are created by counting pixels that have the same values for each of the color components, if the RGB model is used, a histogram will be created for each color component, red, green, and blue. The maximum number of shades per color component is 256, since eight bits are used for each color. In research and systems that use color histograms, very often a reduced number of color components is used, namely pixel values are grouped into intervals. The choice of the number of color components is very important and is closely dependent on the corpus of images at one's disposal. This choice will be discussed later.

Intensity-based histograms transform an image into a histogram by calculating the light intensity for each pixel.

3. MODELS FOR REPRESENTING COLORS IN COMPUTING

A color model is a specification of a 3D color coordinate system. The goal of a color model is to provide a convenient specification of colors within a color scale. There are multiple color models such as: RGB, CMY, CMYK, HSV, YIK, HLS, and others. RGB and HSV color models will be explained in more detail.

3.1. RGB Model

RGB is a model with three primary colors: red (R), green (G) and blue (B). Other colors are obtained by mixing these colors in different proportions. This color model is based on human perception, since there are three receptors in the human eye.

The RGB model is most often represented as a cube, which is shown in Figure 1.

3.2. HSV Model

In addition to the RGB model being fairly easy to understand, this model does not mimic the way humans experience color. The HSV model is a color space that maps pixel intensity to a cylinder. The components of this model are hue (H - hue), saturation (S - saturation), color intensity (V - value).

Hue is the color of a part of the color model, expressed as a number from 0 to 360 degrees. Table 1 shows the colors and degrees [7].

Table 1. Colors in the Hue space

<i>Color</i>	<i>Value in degrees</i>
Red	0 – 60
Yellow	60 – 120
Green	120 – 180
Cyan	180 – 240
Blue	240 – 300
Purple red	300 – 360

Saturation is the amount of gray color, it is presented in percentage.

Color intensity is also represented as a percentage, 0% represents black and 100% represents white.

The HSV color model is represented by a cylinder or cup. Figure 2 shows the cylinder of the HSV model.

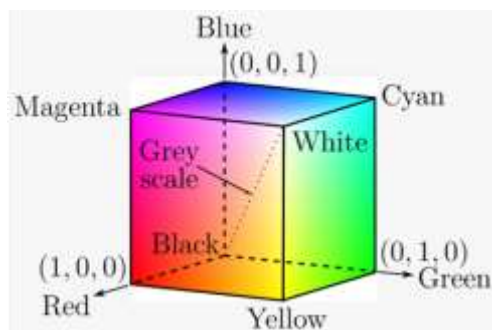


Fig. 1. RGB color model

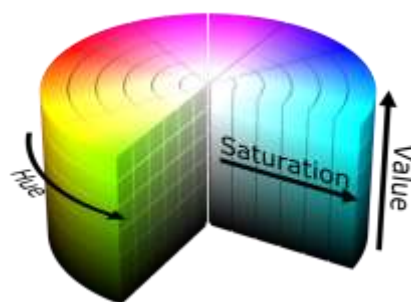


Fig. 2. HSV color model

4. IMAGE RETRIEVAL

In recent years, the number of photographs taken has grown exponentially [8]. This increase in the number of images is reflected in the development of high-quality cameras and more and more excellent cameras on mobile phones. Along with this development of devices, a great development is also taking place in computer networks which are becoming faster and more affordable. Every day, more than a million pictures are posted

on social networks such as Facebook, Twitter, Instagram... The pictures circulating on the Internet are of the most varied content. Works of art, travel pictures, satellite, medical, experimental pictures are just some examples of such photos.

Searching for relevant images is a challenge for computer science researchers today [9]. At the beginning, research related to photo search focused on image descriptions and metadata. These search methods gave fairly accurate results, but they also had a lot of problems. Namely, considering the amount of photos, it has become too laborious and expensive to assign metadata to each image, also considering the huge market and the huge number of languages, such solutions have ceased to be popular.

For the last two decades, most research has been based on content-based photo searches. Systems that implement content-based image search methods are called CBIR (Content Based Image Retrieval) systems.

4.1. CBIR Systems

The goal of such systems is to observe the content of the image from the population of colors, textures and shapes. Using various algorithms, the content of the image is represented by numerical values, most often arrays of values, which are often called feature vectors. Obtaining image feature vectors can be more easily understood if viewed as indexing text documents. Corpus of images are also indexed in such systems using certain algorithms, which are often called image descriptors, and when the corpus is searched for a certain image, a feature vector is also created for it, which is then compared with already indexed images, and the most similar ones are searched for. This procedure is quite convenient because the similarity search operation is reduced to operations on numerical values.

Figure 3 shows the feature vector creation procedure. At the very beginning of this process, we have a photo as input. A descriptor is applied to the image, an algorithm that will actually study and classify the content of the photo, and the output from the descriptor is a list of image characteristics, i.e. a feature vector.

As mentioned, using feature vectors is very convenient because you can easily compare photos later using operations on numerical values. The feature vectors can then be compared using distance metrics or similarity functions to assess how similar the images are. Figure 4 shows the process of comparing two images. The distance metric or similarity function takes two feature vectors as input, and then as output calculates the similarity between the photos whose vectors are passed.

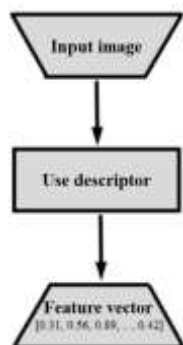


Fig. 3. Feature vector creation procedure

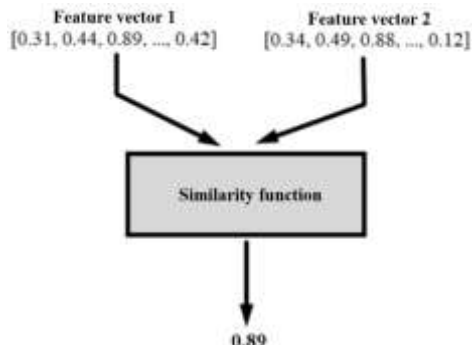


Fig. 4. The procedure of comparing two images

In the paper, the color histogram method will be used as an image descriptor.

4.2. Steps of building a CBIR system

The process of building a CBIR system can be generalized into four unique phases. Each of the stages may require different details and ways of implementation, but the purpose of each step in different content-based image retrieval systems is the same [10].

The first phase is the phase of defining image descriptors, where it is decided about the parts of the images that will be studied, the algorithms that will be used to create feature vectors, the shape of the areas of the image that are being considered, and the like. The indexing phase continues. It is responsible for applying descriptors to each image in the dataset and storing their vectors. There are many different possibilities for storing feature vectors, for example they can be stored in CSV files, relational and non-relational databases, caching databases, etc. The third phase is dedicated to defining distance metrics or similarity functions that will be in charge of comparing images. There are many such metrics, we should mention some of the most famous such as Euclidean, cosine, minkowski distance, etc. Finally, the last phase is the search phase where the search for similar images actually takes place. In this phase, the user specifies a query image from which a feature vector is generated that is compared to the stored feature vectors using the distance metric, after which the relevant results for the user can be displayed.

5. IMPLEMENTATION

The implementation represents an example of a system for image retrieval based on content, following the phases and architecture described in the previous chapter. The wardrobe-search application is implemented in the Python programming language, which is highly suitable for implementing such systems. Python provides a plethora of useful libraries that can quickly and easily yield satisfactory results. The primary library used in this work is the OpenCV library. The OpenCV library is open-source and is employed for problems related to computer vision, containing functionalities for working with images [11].

5.1. Architecture of application

The organization of the system is divided into two parts, the main and the auxiliary. The main part contains the files *index.py* responsible for indexing photos and *search.py* for searching. In the auxiliary part, there are Python classes that implement functionalities for creating feature vectors and searching, namely the *ColorDescriptor* and *Searcher* classes.

5.2. Images corpus

The corpus of photographs [12] is located in the "db" folder, containing 2055 photographs featuring various types and colors of clothing. The idea of the search engine is to display similar clothing to the user based on a query image. Figure 6 illustrates a part of the image corpus.

5.3. Photo descriptor and indexing

As mentioned, the *ColorDescriptor* class contains functionality for creating a feature vector. The feature vector is created for an image based on a color histogram using the HSV color model of the image. This model is chosen because it is closer to human perception of colors, as humans can perceive not only colors, but also different shades of the same color. The region of interest for describing images in the im-search system is the central ellipse with a height and width of 75% of the image. The ellipse is chosen because the most important information about clothing color in all images of the dataset is located in the center. Figure 5 illustrates the central ellipse. The selection of the image region to be considered makes this system adaptive depending on the images used for indexing and later searching.

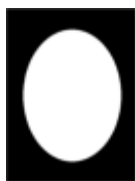


Fig. 5. The procedure of comparing two images

The next important factor used in the system is the number of intervals to which the histogram is divided, known in English literature as bins. The choice of bins is crucial in such color histogram-based systems, as the precision of the final results depends on the number of bins. It is necessary to carefully select this number because if it is too large, images that look quite similar will be classified as completely different, while if it is too small, completely different images may be considered similar [13]. The best practice when choosing the number of intervals in this case was an iterative process. By using this experimental method and investing a little more time, the optimal number of bins can be found. For the project purposes, the following values from Table 2 are used. It is important to emphasize that the number of intervals depends on the specific project and it is possible that it may be different in other systems that use color histograms to describe images.

Table 2. Values for the number of bins

<i>HSV space</i>	<i>Number of bins</i>
Hue	8
Saturation	12
Value	3

The following important parts of the implementation in the ColorDescriptor class will be mentioned below. The key method is *describe_image*, which is tasked with returning the features for the given image via the parameters. In this method, the color model (HSV - in line 10) and the space that will be observed are selected. Finally, the histogram function is called, whose task is to calculate the histogram using a function from the OpenCV library and normalize the values of the feature vector.

The script *index.py* is intended for indexing images and its purpose is to load images from the corpus sequentially and call the *describe_image* method for each of them. The result of this method is a set of feature vectors which are stored in a CSV file.

5.5. Searching

The search logic is implemented in the script *search.py*. It creates an instance of the ColorDescriptor class with the bin values specified in table 2. In the further execution of the script, the query image is loaded, its feature vector is created and searched, and both the query image and the search results are displayed. The central logic for searching is implemented in the Searcher class, which performs image comparison using the Euclidean distance metric [14]. The class also includes sorting of results by relevance. The described logic is executed in the *search_indexes* function.

6. RESULTS

Chapter 6 is devoted to presenting the results of the system for several questionable photographs. Figures 6, 7, 8 and 9 show the query photo on the left and the top 10 relevant results on the right.



Fig. 6. Results

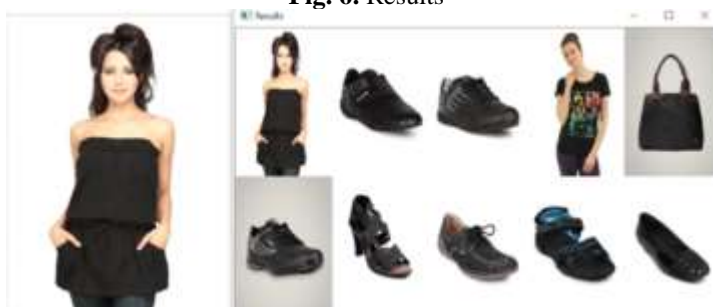


Fig. 7. Results



Fig. 8. Results



Fig. 9. Results

7. CONCLUSION

Color histograms are a powerful tool in CBIR (Content-Based Image Retrieval) systems, especially for specific groups of photographs.

It is crucial to make a decision about the portion of images that will be considered when planning a system. This can be done statically by inspecting the image corpus and identifying the important parts of the images, just as demonstrated in the paper. Alternatively, it is possible to dynamically determine the area of the images to be considered using various algorithms that analyze each image in detail. It is also crucial to choose the number of bins in the histogram, as the correct choice of this number can greatly contribute to the final results.

In the paper, the storage of indexes in CSV files is implemented, however, this is also a challenge when designing the system. Namely, in commercial applications that use an image search system, hashing databases are often used, which can improve system performance.

On the final results, it can be clearly seen that image search using color histogram with carefully selected parameters gives quite good and expected results. Such a solution can be very useful, for example, for applications in which it is necessary to search for similar products that have important characteristics in the form of color. Also, this kind of solution with small changes can be useful for systems in which landscape search is performed, in which there are many colors and intensities, etc. Finally, the results of the image search system based on the color histogram can be combined with various other methods, which together can be very good solutions in many other situations.

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MODEL AUTA NA DALJINSKO UPRAVLJANJE BAZIRAN NA ARDUINO PLATFORMI

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SAŽETAK:

U radu je realiziran model automobila na daljinsko upravljanje baziran na Arduino platformi. U ovom sustavu koristi se Arduino UNO s ATmega328P mikrokontrolerom za upravljanje senzorima i ostalim komponentama od kojih se sastoji automobil. Pogon automobila je baziran na upravljačkoj ploči motora TB6612FNG. Na automobil se spajaju različiti senzori koji će omogućiti mnoštvo funkcija, kao što su praćenje linije koja je nacrtana na podu, izbjegavanje prepreka pomoću RGB senzora i senzora za izbjegavanje prepreka, praćenje svjetlosti te praćenje pokreta rukom. Podnica automobila je izrađena od šperploče debljine 5 mm na koju će biti pričvršćene sve komponente. Poklopac automobila, odnosno karoserija je modelirana na računalu te nakon toga isprintana pomoću 3D printera. Automobil za kretanje koristi 4 kotača od plastike i gume te se svaki kotač spaja na svoj zaseban motor. Automobilu Bluetooth senzor, koji je spojen na upravljačku ploču motora, omogućuje povezivanje i komunikaciju Arduina s pametnim telefonom. Nakon paljenja sklopa potrebno je upaliti aplikaciju na pametnom uređaju i povezati se pomoću Bluetootha. U sučelju aplikacije možemo odabrati hoćemo li samo upravljati automobilom ili možemo odabrati neku od funkcija kao što su praćenje linija, praćenje svjetlosti, praćenje pokreta ili izbjegavanje prepreka. U aplikaciji također možemo odabrati funkciju koja nam omogućuje upravljanje putem daljinskog upravljača. Ako odaberemo manualni način upravljanja, pomoću tipki u aplikaciji upravljamo automobilom te također možemo mijenjati brzinu kojom će se automobil kretati. U slučaju odabira automatskog upravljanja, odnosno opcije da se automobil kreće sam, automobil počinje koristiti ultrazvučni senzor za detekciju prepreka.

Ključne riječi: *Arduino UNO, upravljačka ploča TB6612, ultrazvučni senzor, senzor za praćenje linija, 3D printer*

1. UVOD

Cilj rada je izrada automobila na daljinsko upravljanje baziranog na Arduino platformi. Koristeći se pri tome Arduino UNO pločom i različitim senzorima koji će biti pričvršćeni na drvenu podnicu te će se na to zalijepiti plastična konstrukcija u obliku automobila. Komponente su kupljene putem internet trgovine, dok je podnica napravljena od šperploče. Konstrukcija automobila modelirana je i isprintana pomoću 3D printera. Nakon nabavke dijelova, komponente se pričvršćuju na drvenu podnicu te spajaju s Arduino UNO pločicom. Zatim slijedi programiranje te testiranje funkcija. Na samom kraju plastična konstrukcija se postavlja na drvenu podnicu kako bi projekt imao dizajn automobila.

2. ARDUINO UNO

Arduino UNO je jedna od najboljih i najpoznatijih razvojnih ploča za početak rada s Arduino platformom i za izradu prvog projekta radi jednostavnosti, ali i mnoštva mogućnosti koje pruža. Arduino UNO je ploča s mikrokontrolerom baziranog na ATmega328P. Na ploči se nalazi ukupno 14 pinova. Od tih 14 pinova, njih 6 se može koristiti kao izlaz, a drugih 6 se može koristiti kao analogni ulaz. Ploča ima procesor takta frekvencije 16 MHz. Za povezivanje s računalom Arduino UNO ploča ima USB konekciju i ona je jedna od prvih ploča koja nam nudi tu mogućnost. Za napajanje se nude mogućnosti napajanja pomoću baterija i napajanja pomoću AC/DC adaptera. Na Arduino UNO ploči također se nalazi i gumb za resetiranje s kojim možemo resetirati cijelu ploču ukoliko je to potrebno.



Slika 1. Arduino UNO ploča
Izvor: Autori

2.1. Upravljačka ploča TB6612FNG

Na ovom projektu kao pogonski čip motora koristi se TB6612FNG koji se spaja na Arduino UNO ploču. TB6612FNG je proizvod koji proizvodi *Toshiba Semiconductor Corporation*. Upravljačka ploča TB6612FNG je *H-Bridge* motorni kontroler koji

omogućuje upravljanje smjerom vrtnje, te u isto vrijeme može pokretati 2 motora. Ploča nudi 4 načina upravljanja motorom – naprijed, nazad, kočenje i zaustavljanje. Ploča u sebi ima ugrađeni toplinski krug za isključivanje, kondenzatore za filtriranje na oba dovodna voda i zaštitu od povratnog napajanja na napajanju motora.



Slika 2. Upravljačka ploča TB6612FNG
Izvor: Autori

2.2 HC – SR04 Ultrazvučni senzor

Za utvrđivanje udaljenosti se koristi HC-SR04 ultrazvučni senzor. On određuje udaljenost od objekta ispred sebe primanjem visokofrekventnih zvučnih valova, kao što to rade i šišmiši. Kao što možemo vidjeti na slici 3., na njemu se nalaze dva objekta koja nalikuju očima – jedan objekt je odašiljač, a drugi objekt je primatelj. Ovaj senzor se koristi u puno projekata za pomoć pri utvrđivanju udaljenosti i otkrivanju prepreka.



Slika 3. HC-SR04 senzor
Izvor: Autori

2.3 SG90 servo motor

Servo motor se koristi kako bi se ultrazvučni senzor iz prethodnog poglavlja mogao okretati da bi bolje odredio gdje se nalaze prepreke. Njegov raspon kuta rotacije je od 0 stupnjeva do 180 stupnjeva. Koristi se SG90 servo motor koji se sastoji od kućišta, ploče za strujni krug, motora bez jezgre, senzora položaja i zupčanika. On radi tako da prima signal od prijmnika te nakon toga proizvodi signal s periodom od 20 ms i širine 1,5 ms. Nakon toga uspoređuje istosmjerni prednapon s naponom potencijometra i dobiva izlaznu razliku napona.



Slika 4. SG90 servo motor
Izvor: Autori

2.4 Bluetooth JDY-16

Za komunikaciju između Arduina i drugog pametnog uređaja, u ovom slučaju pametnog telefona, koristi se Bluetooth dodatak (engl. *shield*) modela JDY-16. Prijenosni modul JDY-16, temelji se na protokolu standarda 4.2 koji je kompatibilan s Bluetoothom. U sebi ima ugrađenu PCB (engl. *Printed Circuit Board*) antenu. JDY-16 Bluetooth može ostvariti prijenos podataka ne samo između senzora i pametnog uređaja, nego i između senzora i drugog senzora što znači da može ostvariti komunikaciju dva Arduino uređaja. Spajanje na Bluetooth uređaj vrlo je jednostavno – potrebno je spojiti uređaj na upravljačku ploču, na pametnom uređaju odabrati Bluetooth JDY-16 te ih povezati.



Slika 5. JDY-16 Bluetooth senzor
Izvor: Autori

2.5 Infracrveni senzor za izbjegavanje prepreka

Infracrveni senzor za detekciju prepreka na sebi ima par infracrvenih dioda za odašiljanje i primanje kako bi obavio svoj posao. Kad senzor naiđe na neki objekt ili na prepreku odašiljač emitira infracrvene zrake određene frekvencije. Infracrvene zrake se zatim reflektiraju natrag gdje ih prima dioda za primanje. Kad se to dogodi na senzoru će početi svijetliti indikator, odnosno zeleno LED (engl. *Light Emitting Diode*) svijetlo. Nakon što strujni krug obradi tu informaciju, terminal signala će početi emitirati digitalni signal. Na uređaju postoji potencijometar gdje možemo podešavati udaljenost detekcije. Za izradu ovog projekta koristila su se dva takva senzora, jedan na lijevoj i jedan na desnoj strani za bolju i tačniju detekciju prepreke.

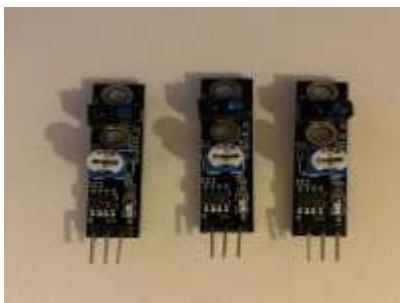


Slika 6. Infracrveni senzor za izbjegavanje prepreka
Izvor: Autori

2.6 Senzor za praćenje linija

Jedna od mogućnosti koju ima automobil iz ovog projekta je praćenje nacrtane linije. Za to se koriste 3 senzora za praćenje linija (lijevi, srednji i desni). Senzor za praćenje linija je zapravo infracrveni senzor. Komponenta koja je korištena u izradi ovog rada je infracrvena dioda TCRT5000. Princip rada senzora čini korištenje različite refleksije

infracrvenog svjetla u odnosu na boju, zatim pretvaranje snage reflektiranog signala u trenutni signal. U ovom slučaju riječ je o crnoj boji. Kad senzor primijeti crnu boju na signalni pin senzora izlazi HIGH (1), a status na LED svjetlu je isključen. Kad senzor primijeti bijelu boju događa se suprotno, na signalni pin senzora izlazi LOW (0), a status na LED svjetlu je uključen.



Slika 7. Senzori za praćenje linija
Izvor: Autori

2.7 Fotoelektrični senzor

Fotoelektrični senzor radi tako da kad prepozna svjetlo automobil ga automatski počne pratiti. Zbog toga su korištena dva senzora, jedan s lijeve i jedan s desne strane. Kad lijevi senzor prepozna da je jače svjetlo s njegove strane početak će se kretati u lijevo. Isto tako, kad desni senzor prepozna svjetlo početak će se kretati u desno. Fotoelektrični senzor je poluvodički rezistor izrađen fotoelektričnim efektom. Vrlo je osjetljiv na ambijentalno svjetlo, pa mu se vrijednost otpora mijenja s obzirom na intenzitet svjetla. Kad se intenzitet svjetla poveća, otpor se smanjuje i izlazni napon se smanjuje. U slučaju u kojem se intenzitet svjetla smanji, otpor se povećava, a izlazni napon raste.

2.8 TT 130 Motor

TT 130 Motor je istosmjerni motor koji se koristi za pokretanje kotača na automobilu na daljinsko upravljanje. Koriste se 4 takva motora, što znači da svaki kotač ima svoj zasebni motor. Na upravljačkoj ploči sučelje se sastoji od ulaza A1, A2, B1 i B2. Motori spojeni na sučelje A1 i A2 imaju istu brzinu i isti smjer. Isto tako, motori spojeni na B1 i B2 imaju istu brzinu i isti smjer. D2 ulazno-izlazni port kontrolira smjer portova A, dok D4 ulazno-

izlazni port kontrolira brzinu portova A. D4 ulazno-izlazni port kontrolira smjer portova B, a D6 ulazno-izlazni port kontrolira brzinu portova B.

2.9. KONSTRUKCIJA

Za konstrukciju automobila koristi se drvo i plastika. Podnica automobila napravljena od šperploče dimenzija 500x500x5 mm. Podnica je naknadno izrezana po mjeri u potreban oblik automobila pomoću ubodne pile. Nakon što je ploča izrezana na potreban oblik, na njoj su se prvo izbušile potrebne rupe za pričvršćivanje komponenata te je obojana u crnu boju. Drugi dio konstrukcije je modeliran u program *Prusa Slicer*. Nakon toga je isprintan pomoću 3D printera modela Prusa i3 MK3S+ u dva dijela. Isprintan je u dva dijela jer printer nije bio dovoljno velik da bi isprintao sve u cjelini. Nakon što je bilo gotovo i podnožje i konstrukcija automobila, obje komponente su spojene s čvrstim ljepilom koje se koristi u industrijskoj proizvodnji za lijepljenje plastike.



Slika 8. Auto u cjelini

Izvor: Autori

3. ZAKLJUČAK

Tijekom izrade ovog rada prikazano je nekoliko od mnoštva mogućnosti koje nam nudi Arduino platforma. Zbog svoje jednostavnosti platforma je idealna za korištenje prilikom izrade projekata kako početnicima tako i iskusnijima. Osim svoje jednostavnosti, kod Arduina se ističe njegova pristupačna cijena. Arduino platforma odlična je za početak učenja ili nadogradnju znanja iz područja elektrotehnike, digitalnih i elektroničkih sklopova, programiranja te robotike. Navedeno je u ovom radu prikazano kroz izradu automobila na daljinsko upravljanje. Za izradu ovog projekta koristili su se senzori za praćenje linija, senzori za izbjegavanje prepreka, fotoelektrični senzor i mnoštvo drugih. Upravljanje automobilom moguće je pomoću pametnog uređaja nakon spajanja s Bluetooth senzorom ili daljinskim uređajem koji se spaja s infracrvenim senzorom na

upravljačkoj ploči. Za ovaj automobil postoji mogućnost nadogradnje, poput dodavanja web kamere koja bi nam omogućila da na zaslonu pametnog uređaja gledamo kuda se automobil kreće kad ga vozač ne može vidjeti. Također, jedna od nadogradnji bila bi stavljanje dvije LED žarulje s prednje strane što bi nam omogućilo lakšu vožnju po mraku. Arduino platforma je idealna zbog toga što korisnicima uvijek nudi mogućnost nadogradnje projekata.

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GENETIC ALGORITHMS AS ARTIFICIAL INTELLIGENCE SUPPORT TO SUSTAINABLE OPTIMIZATIONS OF COMPLEX SYSTEMS

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ABSTRACT:

The main goal of this paper was to find an optimal nature inspired model, which will simulate on the most adequate way all the conditions and restrictions, requirements and conflicting interests of one energy system. The main goal of the optimization of one energy system is to find an optimal operation mode at the present stage, and to research possible future optimal installation from the aspect of cost and sustainability, considering technical and economical criteria, as well as emission and other environmental criteria. Different scenarios of introducing renewable power plant in a whole energy system of one country are developed. Evolutionary multiple objective genetic algorithms are applied. The results of such artificial intelligence model show the maximal economy, technical and environmental effects of introducing higher capacities of renewable resources in a system.

Keywords: genetic algorithm, artificial intelligence, nature inspired optimization, sustainability, environment.

1. INTRODUCTION AND BACKGROUND

Production of energy is one of the most demanding industries, relating to numerous conditions and restrictions, requirements and conflicting interests [1]. Since the electricity system is composed of a different type of power plants [2], different possible installation, different operation modalities, different production capacities [3], from one side and bad, or less bad environmental impact, from the other side, one can say that the energy system of one country is the most representative example of one complex system.

Electricity system of one country is a complex system with the task to ensure production of electricity being equal to consumption in every moment [4]. Otherwise the system is broken. Different types of power plans are involved: big [5] and small hydro power plants

(HPP), thermal power plant on coal [6], gas (TPP) [7], solar power plants (SPP) [8], wind power plants (WPP) [9], and nuclear power plants (NPP) [10]. Each of them has a specific mode of operation.

All of them, producing electricity, are a complex system which requires adequate simulation model, in order to present as more as possible realistic correlation in between the elements of the system (particular power plant). The goal is to maximize production to the level of consumption, to minimize cost of the production, to minimize environmental pollution, to allow sustainability and to minimize greenhouse gas emission.

The main motivation was to search the answers in the nature and to define optimization model finding inspiration in the nature. One can define criteria for selection of optimal result copying the nature law. Bad solutions, wrong combinations, weak results can't be accepted as the weak individual in nature can't survive.

2. RESEARCH QUESTIONS

The main goal of this research is to find adequate optimization model which will simulate the electricity system of one country, analyzing production and consumption, and give as the answers to the research questions:

- What is the optimal combination of power plants in order to cover consumption in every moment?
- What will be the optimal operation system of each particular existing power plant?
- What will be the optimal operation system of each particular power plant, possible to be constructed as a new energy source to be involved in the system?
- How the sustainability can be presented within the requirements?
- How greenhouse gas emission can be calculated and numerically presented and involved in a system?
- How environmental pollution can be quantified and numerically involved in a system?
- What will be the most adequate nature inspired optimization model for simulation and optimization of one electricity system?

3. METHODOLOGY

Optimal electricity system operation may be defined by evolutionary multiple objective genetic algorithm GANetXL [11], as a decision-support system generator. The input data are defined and organized within an Excel add-in that provides easy access to evolutionary multi objective optimization algorithms. Basically, GANetXL is developed for solving of problems in water engineering practice, with the goal to close the gap between the

achievements in optimization technology and the successful use of decision support system in practice. This paper develop application of GANetXL to complex energy system, as it is electricity system of one country, composed by different energy plants from one side and consumption requirements defined by the 24-hour daily diagram of load.

Methodology is based on different developed scenarios of introducing renewable power plant in a whole electricity system of one country and searching the optimal combination. Simulation of the system operation is done for three possible installations of renewable solar power plant (SPP), with different degree of installation. Aldo renewable power plant could be solar, or wind, or small hydro power plant, or other renewable resource, depending of the country, region, or location of local community available natural potential, the solar power plant introducing in a system is performed in this research, through case study.

4. RESULTS AND DISCUSSION

The central problem analyzed is this research of innovative possibilities of integration of RES (renewable energy sources) technologies, with the task to increase economic and energy benefits, and at the same time improve environmental quality and reduce greenhouse gas emissions, in project society which has to be sustainable. The aim of this research was to research which degree of integration of RES, is giving maximum synergistic positive effects for the local community and for the entire community, harmonizing the conflicting interests. Solar power plant integration in to the power system of Serbia was selected as a case study. Changing in total costs (10^3 €) of electricity production of the power system after solar power plant integration with different level of instalation in MW is presented in Figure 1. Total emissions of CO₂ (equivalent tons) from the whole power system after solar power plant integration with different level of instalation in MW are presented in Figure 2.

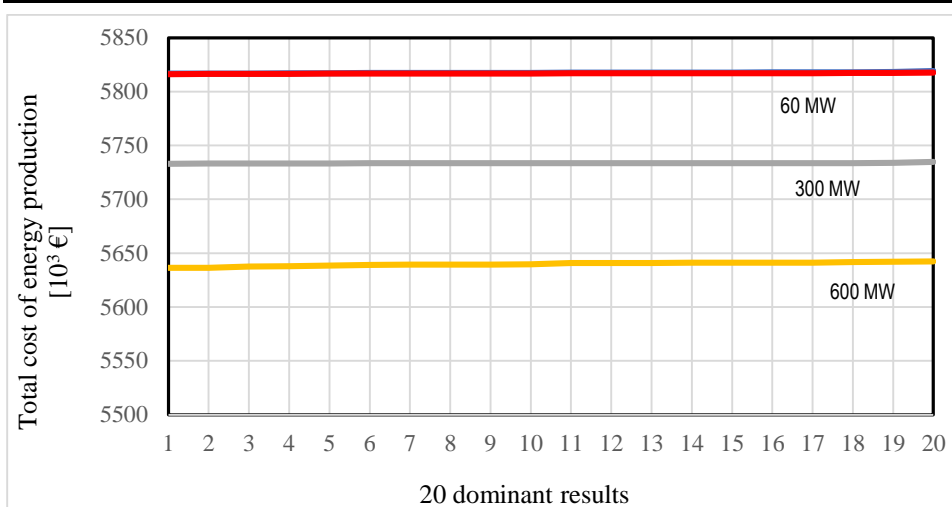


Fig. 1 Total costs of electricity production of the power system after solar power plant integration with different level of instalation in MW

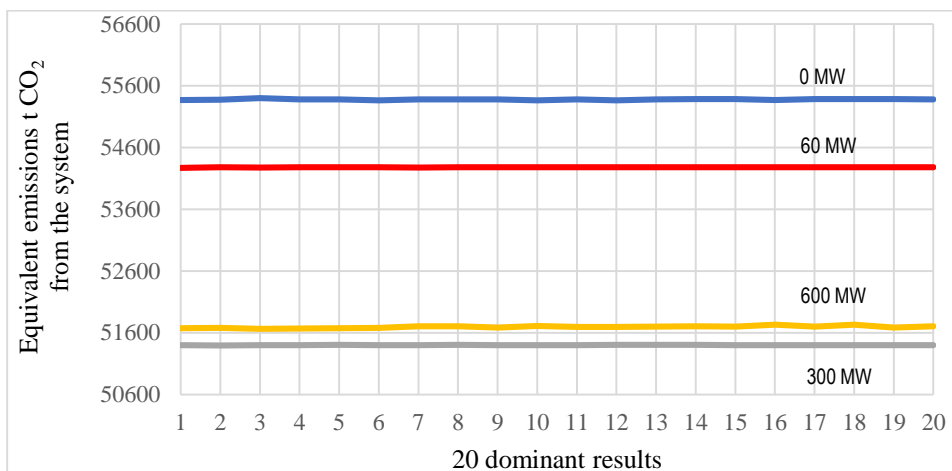


Fig. 2 Total emissions of CO₂ (equivalent tons) from the power system after solar power plant integration with different level of instalation in MW

The solution obtained suggests that higher installation of renewable power plant provides bigger benefits for whole system, as well for local community, regarding cost, environment, sustainability and decrease in CO₂ emissions. Counting the limitation of coal

reserves and New EU Energy Policy 2050 requirements relating to the emission reductions, the results and conclusion on justification of investment in solar energy implementation are even more on the side of feasibility.

Further research can be in analyzing both decentralized renewable energy options vs. centralized energy generation, their advantages and disadvantages, and also on similar studies at regional, country or local levels. Also, social and institutional components of sustainability can be a very important area to further develop in future research of nature inspired optimization models.

5. CONCLUSION

The subject of this research was the development and interdisciplinary research of various models for integration of renewable energy sources (RES), with the aim of contribution to the achievement of energy strategies until 2050. in accordance with the criteria of environmental management and sustainable development. The interdisciplinary approach analyzes, integrates and harmonizes researches in the field of strategic management, resource management, circular economy, energy, environmental management and sustainable development into a coherent integrity, by physical and mathematical statistical simulation models.

The aim of the research is realized by the development of a the nature-inspired optimization model of multidimensional genetic algorithms holistically within the real power system.

The results achieved by the development of holistic interdisciplinary models for integration of RES can be support to decision makers and all stakeholders, on the long path to the realization strategic goal of decarbonizing society. The results of this research can help in making more adequate management decisions and in the development of strategic studies and projects.

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APPLICATION OF NEURAL NETWORK MODEL IN PEDIATRIC HEMODIALYSIS FOR OVERHYDRATION PREDICTION: A CASE STUDY OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE

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ABSTRACT:

This research presents a comprehensive review of the utilization of artificial intelligence (AI) in the healthcare domain. It explores various applications of AI in healthcare and includes a specific case study focusing on the application of AI in hemodialysis for children. The case study examines the hemodialysis procedure and emphasizes the importance of using artificial neural networks to obtain accurate information regarding overhydration. Furthermore, the research provides an overview of the database model, artificial neural network architecture, and the necessary equipment required for conducting research in this field.

The use of AI in healthcare has revolutionized patient care and medical decision-making processes. AI technologies, such as machine learning algorithms and neural networks, have demonstrated significant potential in diagnosing diseases, predicting patient outcomes, and optimizing treatment plans. In the context of hemodialysis for children, the application of AI can play a crucial role in improving treatment efficacy and patient safety. With the utilization of artificial neural networks, healthcare professionals can obtain precise information about overhydration, enabling them to adjust dialysis parameters and mitigate potential risks.

The research showcases the significant potential of AI in healthcare, specifically in the field of hemodialysis for children. The case study exemplifies how AI technologies can enhance the accuracy and effectiveness of medical procedures, ultimately leading to improved patient outcomes and quality of care.

Keywords: artificial intelligence, healthcare, artificial neural networks

1. INTRODUCTION

Artificial intelligence is being utilized across a wide range of fields in human creativity. In a broader sense, artificial intelligence refers to the ability of an artificially created entity to perform tasks that are typically associated with human thinking. This type of intelligence has the potential to revolutionize many areas, particularly those that focus on

user experience. It is believed that artificial intelligence technology has the ability to surpass human reasoning and predict outcomes that the human brain cannot.

In the medical field, artificial intelligence is seen as the future of treatment. It promises to improve treatment outcomes, especially in life-and-death situations. However, improvements are still necessary in the area of AI-based healthcare, particularly with regards to data security, fear of machine malfunction, and lack of human supervision. Despite these concerns, there is a lot of potential in this field, and the government, technology companies, and medical experts are investing in AI-based solutions.

Artificial intelligence is also important in medicine for preventing and diagnosing various diseases, as well as monitoring the effects of therapy. Research has shown that artificial intelligence will soon replace medical staff in many activities, as the results obtained using AI are more accurate. Applications have been developed that make it easier for patients to adhere to therapy, improving the overall effect of treatment. In the pharmaceutical industry, AI is utilized for designing new drugs, which shortens preclinical tests that are lengthy and costly. However, care must be taken to ensure the validity of the data used to develop algorithms, as it can have a significant impact on the results.

Data protection is a crucial aspect of AI in healthcare, as the possibility of publishing patient data is a major ethical concern. Additionally, computers and artificial intelligence are already causing job loss in various industries worldwide, and this trend is likely to continue.

The purpose of this article is to provide an overview of the applications of artificial intelligence in healthcare, as well as to present a use case related to pediatric hemodialysis.

2. ARTIFICIAL INTELLIGENCE IN HEALTHCARE

Artificial intelligence (AI) is a trending topic, and many experts are conducting research where AI techniques and methods are implemented in different fields of science. The constant development of AI has significantly improved many spheres of human life. One of the substantial areas within which AI has made a turning point in development is the field of healthcare. The healthcare sector is providing a vast amount of data such as electronic health records and medical images and thus making AI implementation possible [1, 2]. The applications of AI techniques to medical imaging can be divided into three relevant tasks: [3]

- Detection,
- Segmentation, and
- Classification.

Detection and classification tasks are usually carried out using convolutional neural networks (CNNs) and one of their main research questions in healthcare is related to disease diagnosis [3-5]. AI's most significant role is the computer-aided diagnosis (CAD) which provides clinical decision support to doctors when establishing a diagnosis of a particular disease or in determining the stage or certain diagnostic category and treatment of the disease [3, 4, 6]. Some of the healthcare subfields that yield immense potential for automation or CAD are:

- Rheumatology,
- Mammography,
- Dermatology,
- Microscopy,
- Oncology, etc.

With an increasing number of laboratories that are collecting digital data, the potential of AI in healthcare is rising and aims to create image analysis tools by incorporating clinical, radiologic, and genomic data to help diagnose diseases, predict patient prognoses, or derive novel insights into disease biology, in addition to those that can be achieved by traditional methods [7, 8]. CNN-based software can be applied to different medical image data such as MRI images, cell smear images, X-rays, and CT scans.

Applying CNNs to wrist MRI images can successfully perform image analysis aimed to help detect and assess rheumatoid manifestations [5].

CAD systems based on AI are being utilized worldwide in mammography to provide help in detecting suspicious lesions using X-ray breast images [4]. Multiple studies confirmed an improved detection rate of breast cancer cases when using CAD software powered by AI [9, 10]. AI-based algorithms have shown promising results in the quantitative assessment of parenchymal density, detection, and diagnosis of breast cancer, and prediction of breast cancer risk [11].

Dermatology is a branch of medicine that relies on morphological features, and diagnoses are commonly based on visual pattern recognition which makes it suitable for applying AI image recognition [12]. Most AI applications in dermatology focus on differentiating between benign and malignant skin lesions [13], and developing CNNs that are able to recognize skin cancer, especially melanoma [12-16]. The study [17] analyzed the results of 132 papers and combined their results to determine the difference between the diagnosis established by dermatologists and the CAD system and came to the conclusion that the performance of the CAD system is equivalent to that of experts. Other AI implementations in dermatology are related to the detection of psoriasis, atopic dermatitis, onychomycosis, ulcers, inflammatory skin diseases, allergen exposure, dermatopathology, and gene expression profiling [13, 15].

The implementation of AI in microscopy is closely related to image segmentation [18]. Segmentation is the identification of image regions that are part of specific cellular or subcellular structures and often is an essential step in image analysis [19]. This process can be independent of detection and classification, and it can also precede them and thus enable better performance of algorithms. Machine learning has proven efficient at using automated segmentation to reduce diagnostics workload in histopathology [3]. Apart from image segmentation, AI has an important role in tasks such as artificial labeling and restoration of microscopic images [19].

In recent years, AI methods, especially CNNs, have also generated interest in the single-molecule localization microscopy (SMLM) field [19]. Its application is especially important in SMLM reconstruction which produces super-resolution microscopy images. Numerous studies have been conducted on the topic of applying CNN algorithms to blood smear images in order to detect infected cells and distinguish healthy controls from

subjects who have a certain disease. These tasks have resulted in high accuracy for numerous diseases and offer great potential in the application of CAD systems. When applied to blood smear images, there is significant potential for use of AI in solving the following tasks [20, 21]:

- Observation of bacterial smears,
- Parasite diagnostics, and
- Reproductive medicine.

Automation in microbiology laboratories impacts management, workflow, productivity, and quality [22]. One of the bacterial diseases that can be detected using AI methods is bacterial vaginosis [20, 23, 24]. Although additional research is required for clinical application, it is recognized that AI can contribute to better blood smear-based detection of this disease [24]. AI algorithms can also be trained to recognize tuberculosis-related abnormalities on chest X-rays [25-27]. Also, AI-supported pathology may be more sensitive than bacteriological tests for detecting acid-fast bacilli infections such as tuberculosis in samples collected via bronchoscopy [28]. In addition, the domain of application of AI systems showed promising results in the detection of microbial growth in urine samples [22, 29], as well as in many other subfields of microbiology.

When it comes to the application of AI for parasite diagnostics, the largest amount of research is directed towards the detection of malaria-infected cells [6, 20, 30-32]. Malaria is a disease that, despite being present for over a century, still claims a significant number of lives every year, and introducing machine learning approaches to this field can be beneficial in disease prevention, detection, and therapy [6].

Crossing the potential of AI and optical microscopy opens up possibilities for innovative approaches in the analysis and improvement of reproductive medicine. AI-based technology demonstrated an ability for improved sperm and oocyte assessment and selection, including quantitative measurement of sperm concentration, motility, and seminal pH, as well as the predictive ability for evaluation of human embryo viability using images captured by optical light microscopy [21, 33, 34].

One of the significant and promising applications of AI systems in the healthcare domain is improving the accuracy of detection and classification of cancer in the early stages of its development, and characterization and monitoring of different types of cancer [35, 36] such as breast cancer [9-11] or skin cancer [12-16]. Common research tasks include the detection and diagnosis of cancer, subtype classification, optimization of cancer treatment, and identification of new therapeutic targets [37]. AI approach offers a facilitative identification of the best treatment for a patient suffering from cancer, which includes drug discovery and development and how these drugs are clinically validated and ultimately administered at the point of care [38].

AI has recently been explored in biomarker discovery for specific diseases such as inflammation, migraine, and cancer, and it provided encouraging results [39, 40]. Recognition of key biomarkers and their critical values may have diagnostic, prognostic, or predictive purposes, and AI can provide support for biomarker evaluation [41].

The application of AI in healthcare opens up great opportunities in personalized medicine and providing individual therapy for patients [35, 41]. Certain diseases which involve

patient-related factors such as cancer or kidney diseases require specialized therapy and clinical care which includes observing the individual conditions of patients, providing personalized treatments, and monitoring individual responses to the treatment [35, 42, 43]. AI introduces powerful tools for processing large amounts of medical data that is constantly being collected and thus can significantly help in diagnosing diseases, determining treatments and proper medical care for patients, as well as in discovering hidden information in the data that brings new knowledge and helps in answering many important medical questions [1]. In addition, AI technology can have a significant impact on poor regions due to the ability to send medical data to modern laboratories for diagnosis and treatment, thereby achieving socioeconomic benefits and reducing the gap in the level of development of healthcare among different regions [36].

Although the application of AI-based systems is a significant topic in numerous research and their potential in healthcare has been demonstrated, their implementation in real systems is present in a very small percentage [44]. Based on the current stage of AI development in healthcare, it is assumed that in the coming period, medical experts will not be replaced by AI systems, but that hybrid solutions will be implemented where these systems will assist doctors in interpreting data, providing diagnoses, and personalized treatments [2, 5].

3. CASE STUDY OF CHILDREN HEMODIALYSIS

It is important to achieve a good fluid balance in children with kidney failure who are undergoing hemodialysis (HD) in order to prevent hypo- and hyper-hydration and long-term cardiovascular complications. HD removes excess fluid from the body of a patient whose kidney function is reduced or completely absent, usually achieved by ultrafiltration. However, there are no typical rules for this process and many clinical doctors use their long-term experience and personal perception to evaluate the complete HD process.

In recent years, non-invasive and less expensive methods such as bioelectrical impedance (BI), body mass index (BMI), and blood pressure (BP) have been used together with physiological parameters like hematocrit to provide a predictive assessment for experimental and clinical HD situations. This case study aims to establish a unique method and rule for each patient using a mathematical approach to assess fluid balance during HD in children. The results obtained from this study can be used for the development of a system that will automatically monitor and control the HD process, including a prior assessment of the duration and amount of liquid to be removed.

Using artificial intelligence, machine learning, and fuzzy logic, the system will create connections and relations between the measured physiological parameters. These connections will enable the system to make predictions and decisions at certain moments during the HD process. The complete HD treatment will be fully customizable to individual patients and can be remotely controlled by clinical experts. This system will provide real-time, continuous, multiparametric monitoring of patients, enabling early detection of abnormalities and trend analysis of patient status. The system will guarantee the accuracy of measures and treatments, personalized feedback, and advice for patients.

The system described in the case study aims to improve the monitoring and control of HD treatment in children with kidney failure. The system consists of two parts - a smart watch worn by the patient and an apparatus for HD treatment. The smart watch measures physiological parameters such as bioimpedance, blood pressure, and body weight index, and uses built-in algorithms to assess when the child patient needs to be referred for HD treatment. The smart watch also has a connection to the clinic where HD is performed, so that the clinic can have information in advance about the current condition of the child patient and be ready to accept him or her for treatment.

The apparatus for HD treatment has data about the child patient through the history of HD treatment and current data, allowing for immediate evaluation of the amount of fluid that needs to be removed and the duration of the treatment. The system can detect more than 8 blood parameters in real-time and uses embedded software and remote-controlled applications for multi-sensor data fusion. Additionally, the system utilizes energy-optimized control of IoT-based devices and integrated components.

Overall, the system aims to provide real-time, continuous, and multiparametric monitoring of patients, enabling early detection of abnormalities and trend analysis of patient status. By using artificial intelligence, machine learning, and fuzzy logic, the system can make predictions and decisions during the HD process. The goal is to provide personalized feedback and advice for patients, as well as guarantee the accuracy of measures and treatments.

Based on the examination of the real system at the University Children's Clinic in Tiršova, certain prerequisites have been established for the development of the database. These include a method of data collection, which involves pre-defined procedures and time intervals for measuring data. The database is expected to contain detailed data on each relevant parameter for the dialysis process. Additionally, in order to obtain a comprehensive picture of a dialysis patient's health status, data on periodic tests and analyses that are routinely performed, such as blood count results and heart ultrasounds, need to be integrated with the data generated during the dialysis process.

Regarding the frequency of data generation, it was determined that monitoring the data during the entire dialysis process, rather than just before and after, would provide real benefits for improving the process. The bioimpedance measurement process takes no more than 5 minutes, and it was determined that a total of 6 measurements should be taken during the entire dialysis process (which lasts a minimum of 3 hours). This will significantly contribute to the accuracy of the dialysis flow monitoring process.

It is essential to ensure the security and privacy of patients' data while developing the database for the dialysis process. The defined protocol on the use of bioimpedance measuring devices, storage, and transmission of data, and data protection controls are critical aspects to consider.

To ensure data integrity, it is recommended to create a unique mapping for each patient and determine a memory card to be used for all measurements of that patient. Additionally, a method of data transfer and storage should be defined to prevent any changes to generated data that may occur before transfer to the database.

The system elements necessary for the collection and monitoring of the dialysis process include the creation of a database model, a service for periodic transfer of data from memory cards and medical information systems, and data protection controls. By implementing these system elements and the defined protocol, the database can be developed to accurately record and monitor the dialysis process while ensuring the privacy and security of patients' data.

The preliminary model of the database is presented in the Fig. 1, which will be additionally modified after the creation of the service for the periodic transfer of data from the medical information system on findings and routine analyses.

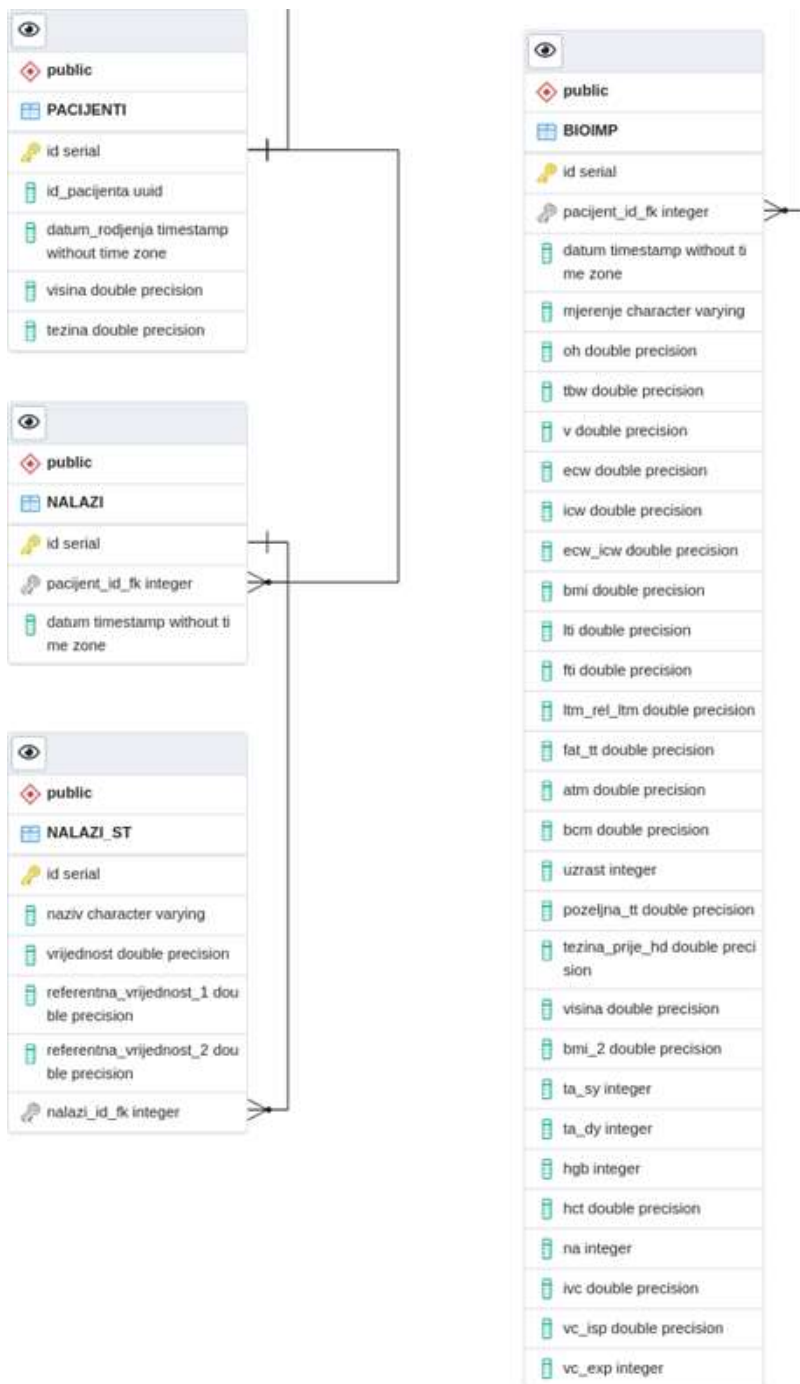


Fig. 1. Database model

Data were measured for nine patients, for each patient an average of five measurements. Each measurement represents a separate file.

The following is a display of relevant parameters:

OH [L] Weight [kg], NH Weight [kg], BP sys [mmHg], BP dia [mmHg], BMI [kg/m²], LTI [kg/m²], FTI [kg/m²], V urea [L], TBW [L], ECW [L], ICW [L], LTM [kg], Fat [kg], ATM [kg], BCM [kg], Height [cm], Z kHz [Ohm]

The following is a description of the meaning of the most significant parameters.

Fluid status:

Measured overhydration (OH)

Pre dialysis relative overhydration [OH/ECW Pre](OH ref class)

Pre-dialysis/Intracellular fluid [ECW/ICW] (EcwIcwRatioRefClass)

Liquid volumes:

Extracellular fluid (ECW)

Intracellular fluid (ICW)

Total Body Fluid (TBW)

V urea according to BCM

Lean tissue index (LTI) (LtiRefClass)

Fat tissue index (FTI) (FtiRefClass)

3.1 Review of research support equipment

The work team from the Faculty of Technical Sciences from Čačak, together with the representatives of the University Children's Clinic in Tiršova, analyzed the necessary equipment for procurement by the end of the current year. The characteristics and performance of the device for measuring bioimpedance, as well as the Raspberry Pi and Arduino development systems, are defined.

The method of bioimpedance measurement is shown in Fig. 2.



Fig. 2. Bioimpedance measurement

The team has carefully considered the smart watch options and found a suitable device that can measure blood pressure and pulse. The Huawei Smart Watch Pro seems like a good choice since it has the necessary features and connectivity. It's important to ensure that the device is reliable and accurate in its measurements, so it's recommended to conduct some validation testing before incorporating it into the system. Additionally, it's essential to take into consideration the privacy and security aspects of the smart watch's connectivity to the internet, to prevent any potential data breaches or unauthorized access to sensitive patient information.

Figure 3 presents bioimpedance measurement in real environment.



Fig. 3. Bioimpedance measurement in real environment

3.2 Developing, Experimenting, and Evaluation Model

A Multilayer Perceptron (MLP) was created and trained with a backpropagation algorithm. Input parameters are: date, measurement, OH (L), TBV (L), V (L), ECV (L), ICV (L), ECV / ICV (L), BMI (kg / m²), LTI (kg) / m², FTI (kg / m²), LTM / rel LTM (kg), fat / tt (kg), ATM (kg), BCM (kg), age [months], weight before HD [kg], height (cm), tp [m²], BMI [kg / m²], TA SI (mmHG), while the output parameter is ideal weight [kg] . Testing was done using two approaches: cross-validation and splitting the data 70-30 (70% for training and 30% for testing). To evaluate the accuracy, the following measures were used: RMSE and MAE.

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (\text{prediction}_i - \text{actual}_i)^2} \quad (1)$$

$$MAE = (1/n) * \sum |y_i - x_i| \quad (2)$$

The neural network model is shown in Fig. 4.

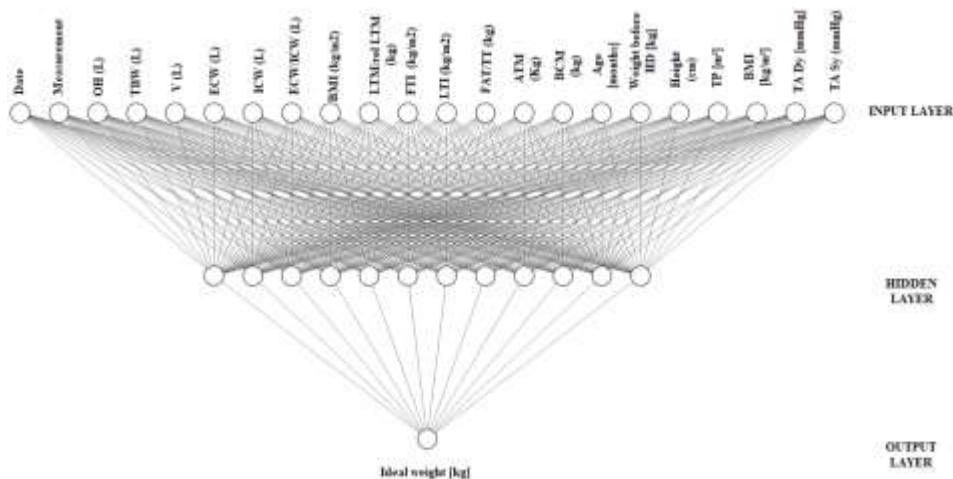


Fig. 4. Artificial neural network model

Based on the measured data, a separate neural network is created for each patient, and the output from the network is OH (Fig.5).

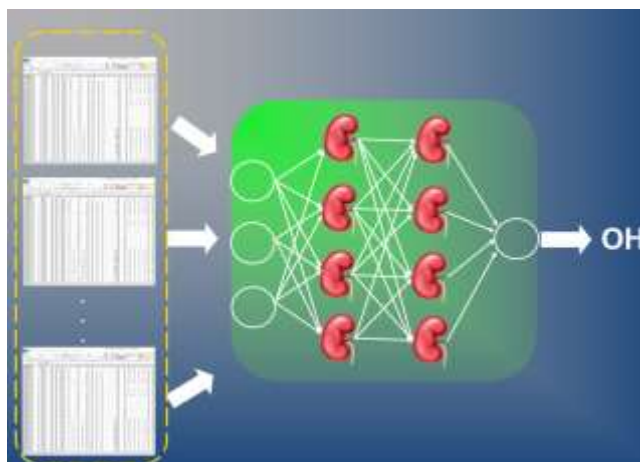


Fig. 5. Illustration of the application of the artificial neural network for the case study

The verification process was conducted as follows: Doctors from the University Children's Clinic prepared the patient for the dialysis process. The first measurement was taken before dialysis, then after the start of dialysis, as well as every 15 minutes. The total duration of dialysis is at least four hours. The measurement of parameters was performed using the previously acquired equipment and data transfer cards to computers. After each

measurement, the data was transferred to computers and entered into the machine learning model that was previously trained, personalized, and prepared for the specific patient. The model predicts the value of hypervolemia (OH) based on input parameters. The model's results were compared with the actual results, and thus the accuracy of the algorithm was tested and verified. Table 1 shows a comparative display of the actual results and the algorithm results for the first 10 measurements.

Table 1. Comparative results: algorithm and expected

Id	Algorithm results – OH (L)	Expected results – OH (L)
1.	1.9	2
2.	1.8	1.8
3.	1.4	1.4
4.	1	1.1
5.	0.9	1
6.	0.7	0.8
7.	0.5	0.5
8.	0.3	0.4
9.	0.1	0.1
10.	-0.1	0

4. CONCLUSION

Based on the findings presented in this study, several conclusions can be drawn. Firstly, it is evident that the use of artificial intelligence in healthcare presents significant potential for the future, given the current possibilities and advancements in this field. Secondly, the application of artificial intelligence in the hemodialysis process for children has proven to be successful in terms of providing more comfortable access and timely information. This has the potential to significantly improve the quality of care for these patients. Lastly, future work should focus on implementing the proposed solution in the wider application of artificial intelligence for hemodialysis of children, as well as exploring other innovative solutions in this area to further improve patient outcomes. Overall, the results of this study provide promising insights into the potential of artificial intelligence to improve healthcare outcomes and patient care.

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BIOLOGIJA, FIZIKA, HEMIJA, MATEMATIKA
BIOLOGY, PHYSICS, CHEMISTRY, MATHEMATICS

SYNTHESIS, CHARACTERIZATION AND KINETIC STUDIES OF NEW MONONUCLEAR RUTHENIUM(II) POLYPYRIDYL COMPLEXES

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ABSTRACT:

We have prepared a series of new monofunctional Ru(II) terpyridine complexes with general formula $mer-[Ru(L_3)(N-N)Cl]Cl$, where L_3 is 2,2':6',2''-terpyridine (tpy) or 4'-(4-chlorophenyl)-2,2':6',2''-terpyridine (Cl-Ph-tpy), while N-N is o-benzoquinonediimine (o-bqdi), 2,3-naphthoquinone diimine (nqdi), 4,4'-dimethyl-2,2'-bipyridine (dmbpy) or 2,2'-bipyridine-4,4'-dicarboxylic acid (dcbpy). The complexes were characterized by elemental analysis and by various spectroscopic techniques, such as IR, UV-Vis, ¹H and ¹³C NMR, and ESI-MS. The synthesis of the chloride salts of complexes **1** – **7** was performed by reacting the neutral Ru(III) precursors $mer-[Ru(tpy)Cl_3]$ or $mer-[Ru(Cl-Ph-tpy)Cl_3]$ with the respective aromatic chelating ligand under the reflux. Ru(II) complexes with quinone diimine ligands o-benzoquinonediimine (o-bqdi, **1** and **2**) or 2,3-naphthoquinone diimine (nqdi, **5**) were prepared as a product of the reaction of the corresponding Ru(III) precursor with the redox-active ligands o-phenylenediamine (o-pda) or 2,3-diaminonaphthalene (dan) upon their oxidation to an imine species. The kinetic results showed that the ligand substitution reactions of new Ru(II)-polypyridyl complexes with biomolecules (guanine derivative guanosine-5'-monophosphate, and sulfur-containing amino acids L-cysteine and L-methionine) were affected by different substituents and aromaticity of meridional tridentate and bidentate spectator ligands as well as by the nature of the entering nucleophile. The reactivity of the complexes increases in the order: $Ru(dmbpy) < Ru(dcbpy) < Ru(nqdi) < Ru(o-bqdi)$.

Keywords: quinone diimines, ruthenium(II), terpyridine, mechanism

1. INTRODUCTION

In the search for nonplatinum antitumor drugs with a different spectrum of activity and fewer side effects than those of cisplatin and its analogues, ruthenium compounds appear to be the front runners, especially after the introduction of two ruthenium(III) complexes,

namely, [indH]trans-[RuCl₄(ind)₂] (ind = indazole, KP1019) and [imH]trans-[RuCl₄(dmsO-S)(im)] (im = imidazole, NAMI-A), into clinical trials [1,2]. The major goal in the discovery of new metallodrugs is to develop and implement innovative therapies with increased effectiveness and tolerability. Scientists are still working on the development of new transition metal ion complexes in cancer therapy associated with lower side effects, drug resistance and higher biocompatibility than the compounds used so far.

Although polypyridyl-based ruthenium(II) complexes are known, the information on their biological application is still insufficient and requires further extensive research. It appears that both *fac* and *mer* ruthenium(II) complexes of the general formula [Ru(L₃)(N-N)X]⁺ (where L₃ is a tridentate ligand) are capable of making monofunctional adducts with DNA and of inducing cytotoxicity in cancer cells *in vitro*. However, despite some promising results, the solubility problems of terpyridine derivatives reduced the interest in the class of *mer* compounds, and they have been much less explored for anticancer activity compared to those with facial geometry. It is therefore of interest in this context to obtain more insight at the molecular level on ruthenium complexes with the *mer* geometry.

Over the last few years, we have reported several scientific publications and described in detail a structure-activity relationship and correlation between the reactivity and *in vitro* cytotoxicity of polypyridyl ruthenium(II) complexes with general formula *mer*-[Ru(L₃)(N-N)Cl][Y]. The coordination sphere of these complexes contains a tridentate chelate, such as 2,2':6',2''-terpyridine, tpy, 4'-chloro-2,2':6',2''-terpyridine, Cl-tpy or 4'-(4-chlorophenyl)-2,2':6',2''-terpyridine, Cl-Ph-tpy, a bidentate ligand with various electronic and steric properties and a chlorido ligand. In the previous studies we have used the following bidentate spectator ligands: ethylenediamine (en), 1,2-diaminocyclohexane (dach), 2,2'-bipyridine (bpy), and 1,10-phenanthroline (phen), *o*-phenylenediamine (*o*-pda) and picoline (pic) [3]. We have demonstrated that polypyridyl ligands with different substituents on the tpy moiety affected on the reactivity and biological activity of complexes. Additionally, we have also described that the bidentate chelating ligands with different electronic and steric properties affected on the rate of the ligand substitution reactions as well as on the anticancer activity of these Ru(II) complexes. Overall, we have demonstrated that the modulation of the aromatic surface area considerably influences on the chemistry and reactivity of Ru(II)-terpyridine complexes.

Here, building on the experience gained with ruthenium(II) terpyridine complexes, we investigated a series of new Ru(II)-tpy complexes with general formula *mer*-[Ru(L₃)(N-N)Cl]Cl, where L₃ is tpy or Cl-Ph-tpy, N-N is *o*-benzoquinonediimine (*o*-bqdi), 2,3-naphthoquinonediimine (nqdi), 4,4'-dimethyl-2,2'-bipyridine (dmbpy) or 2,2'-bipyridine-4,4'-dicarboxylic acid (dcbpy). We have studied the substitution reactions of newly synthesized Ru-tpy complexes **1** – **7** with guanine derivative 5'-GMP and sulfur-containing amino acids L-Cys and L-Met. These reactions were investigated under the *pseudo*-first-order conditions as a function of the nucleophile concentration and temperature using UV-Vis spectroscopy. The structures of the newly synthesized Ru-tpy/Cl-Ph-tpy complexes are presented in Fig. 1.

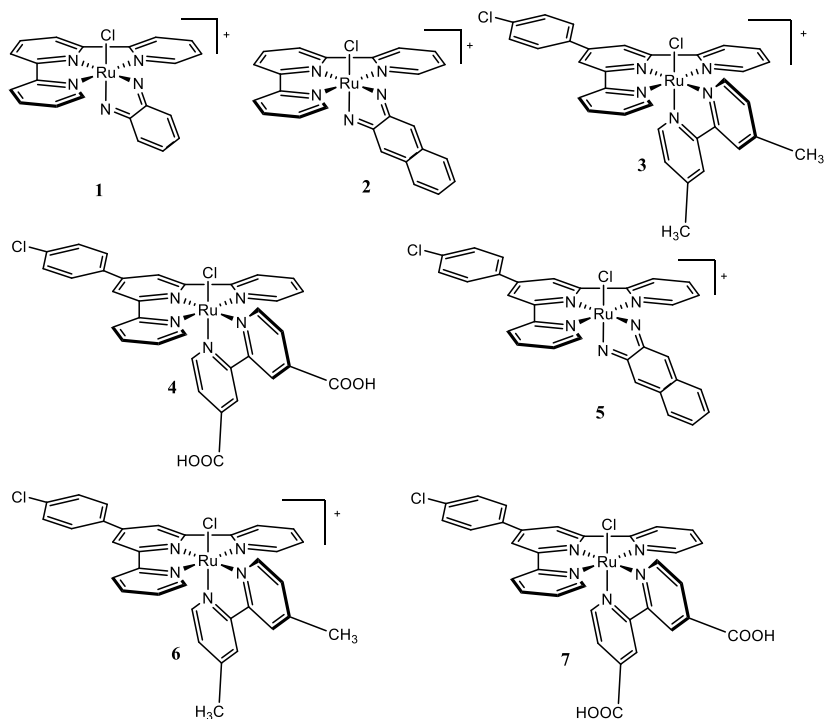
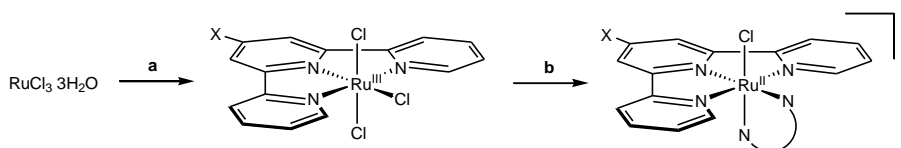


Fig. 1. Structures of the Ru(II) polypyridyl complexes **1** – **7**.

2. Synthesis and characterization of Ru(II) terpyridine complexes

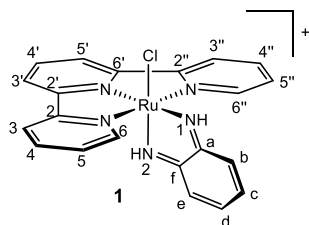
We have prepared a series of new monofunctional Ru(II) terpyridine complexes with general formula $mer-[Ru(L_3)(N-N)Cl]Cl$, where L_3 is 2,2':6',2''-terpyridine (tpy) or 4'-(4-chlorophenyl)-2,2':6',2''-terpyridine (Cl-Ph-tpy), while $N-N$ is *o*-benzoquinonediimine (*o*-bqdi), 2,3-naphthoquinone diimine (nqdi), 4,4'-dimethyl-2,2'-bipyridine (dmbpy) or 2,2'-bipyridine-4,4'-dicarboxylic acid (dcbpy). The procedure for the synthesis of complexes is described in Scheme 1, while the schematic structure of complexes is presented in Figure 1. The synthesis of the chloride salts of complexes **1** – **7** was performed by reacting the neutral Ru(III) precursors $mer-[Ru(tpy)Cl_3]$ or $mer-[Ru(Cl-Ph-tpy)Cl_3]$ with the respective aromatic chelating ligand under the reflux. All complexes were obtained in moderate yields (%) as air- and moisture-stable solids. Ru(II) complexes with quinone diimine ligands *o*-benzoquinonediimine (*o*-bqdi, **1** and **2**) or 2,3-naphthoquinone diimine (nqdi, **5**) were prepared as a product of the reaction of the corresponding Ru(III) precursor with the redox-active ligands *o*-phenylenediamine (*o*-pda) or 2,3-diaminonaphthalene (dan) upon their oxidation to an imine species. The complexes were characterized by

elemental analysis and by various spectroscopic techniques, such as IR, UV-Vis, ¹H and ¹³C NMR, and ESI-MS.

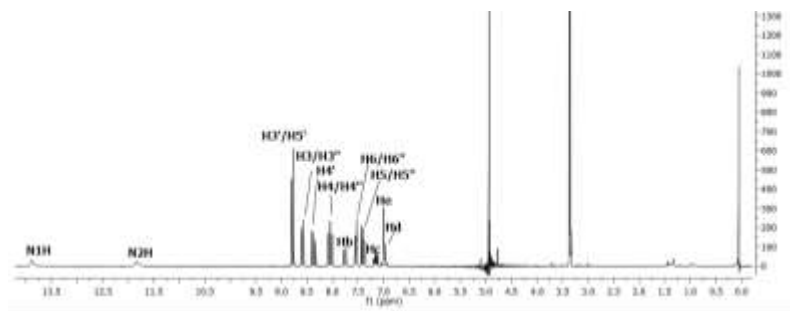


Scheme 1 Synthetic pathway for the preparation of complexes **1–7**. Reagents and conditions: (a) tpy or Cl-Ph-tpy, EtOH, reflux; (b) *N-N* (1.2 eq.; *N-N* = *o*-bqdi, nqdi, dmbpy, dcbpy), EtOH/H₂O (3:1), Et₃N (3.0 eq.), LiCl (10.0 eq.), reflux.

The ¹H NMR spectra of monofunctional Ru(II)-tpy complexes (**1–7**) display the typical resonances of tpy and Cl-Ph-tpy ligands, as well as signals for the corresponding *N-N* bidentate aromatic ligands (Fig. 2). The ¹H NMR spectra of complexes **1**, **2** and **5** with *o*-bqdi or nqdi bidentate chelating ligands showed the protons of the half of *o*-bqdi or nqdi ligands. The NH protons of the chelating ligands are evident as two singlets quite far apart from one another. These two peaks, integrating for 1 H each, resonate at considerably high frequencies, typical for imine protons, confirming the nature of the chelating ligands (i.e. diimine). A similar effect was observed for the previously studied [Ru(Cl-Ph-tpy)(*o*-bqdi)Cl]Cl complex and other complexes reported in the literature [4]. As expected, the ¹³C NMR spectrum of **1**, **2** and **5**, either in CD₃OD or DMSO-*d*⁶, exhibits the resonances for the symmetric tpy or Cl-Ph-tpy ligands, and the resonances for the inequivalent carbon atoms of *o*-bqdi or nqdi. ¹H NMR spectra of complexes **3**, **4**, **6** and **7** with substituted bpy ligands showed that the most downfield shifted doublet, typical for a pyridine H6 located *cis* to a coordinated chloride, corresponds to the H6 of the equatorial pyridine moiety of bpy ligand (*viz.*, CaH). The ¹³C NMR spectra of **3**, **4**, **6** and **7**, either in CD₃OD or DMSO-*d*⁶, exhibit the resonances for the symmetric tpy or Cl-Ph-tpy ligands and the resonances for the inequivalent carbon atoms of dmbpy or dcbpy.



A)



B)

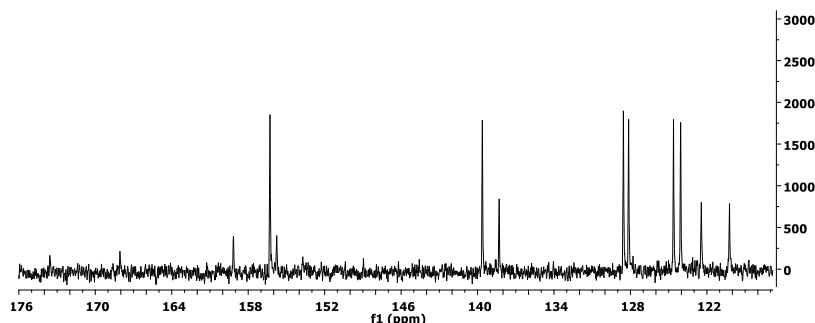


Fig. 2. A) ^1H and B) ^{13}C NMR spectrum of $[\text{Ru}(\text{tpy})(o\text{-bqdi})\text{Cl}]\text{Cl}$ (**1**) in CD_3OD at 298 K.

2.1. Kinetic studies of Ru(II) tpy complexes with biomolecules

The substitution behavior of Ru(II) chloride complexes is of great importance in terms of their biological activity and application. In the present work, we extended our research to the 4,4'-substituted bipyridine ligands (dmbpy and dc bpy) and the quinone diimine ligand 2,3-naphthoquinonediimine (nqdi). For comparison, we also studied the kinetic behavior of complex **1**, which contains *o*-benzoquinonediimine (*o*-bqdi). The kinetics of the substitution reactions with nucleophiles guanosine-5'-monophosphate (5'-GMP), L-cysteine (L-Cys) and L-methionine (L-Met) (Fig. 3) were investigated using the electronic absorption spectroscopy in the visible range by following the change of the absorbance at selected wavelengths, corresponding to the maximum change in the absorption, as a function of time.

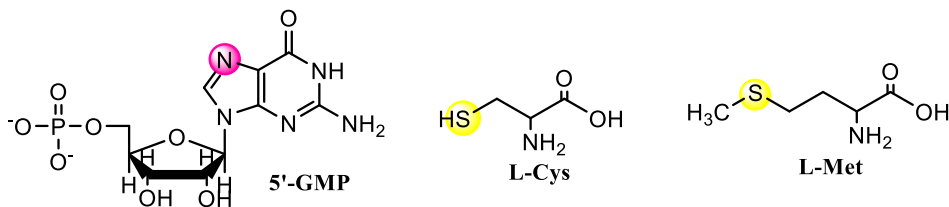
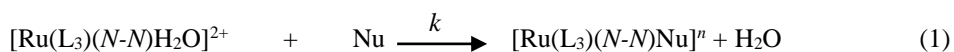


Fig. 3. Structures of the nucleophiles guanosine-5'-monophosphate (5'-GMP), L-cysteine (L-Cys) and L-methionine (L-Met).

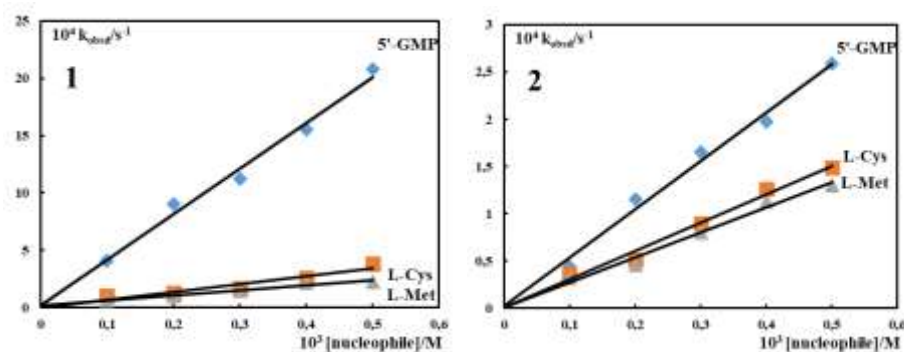
The substitution reactions of Ru(II) complexes with biomolecules could be represented by eq. (1):



where (L_3) = tpy, Cl-Ph-tpy; $\text{N}-\text{N}$ = *o*-bqdi, nqdi, dmbpy, dc bpy; Nu = 5'-GMP, L-Cys or L-Met.

The substitution reactions were followed as a function of the entering nucleophile concentration for all studied complexes. Plots of k_{obsd} vs entering nucleophile concentration are linear with zero intercepts within the error limits for complexes **1** – **7** (Fig. 4). Considering this, the rate constant k can be calculated from the slope of the observed line, according to the eq (2).

$$k_{\text{obsd}} = k[\text{Nu}] \quad (2)$$



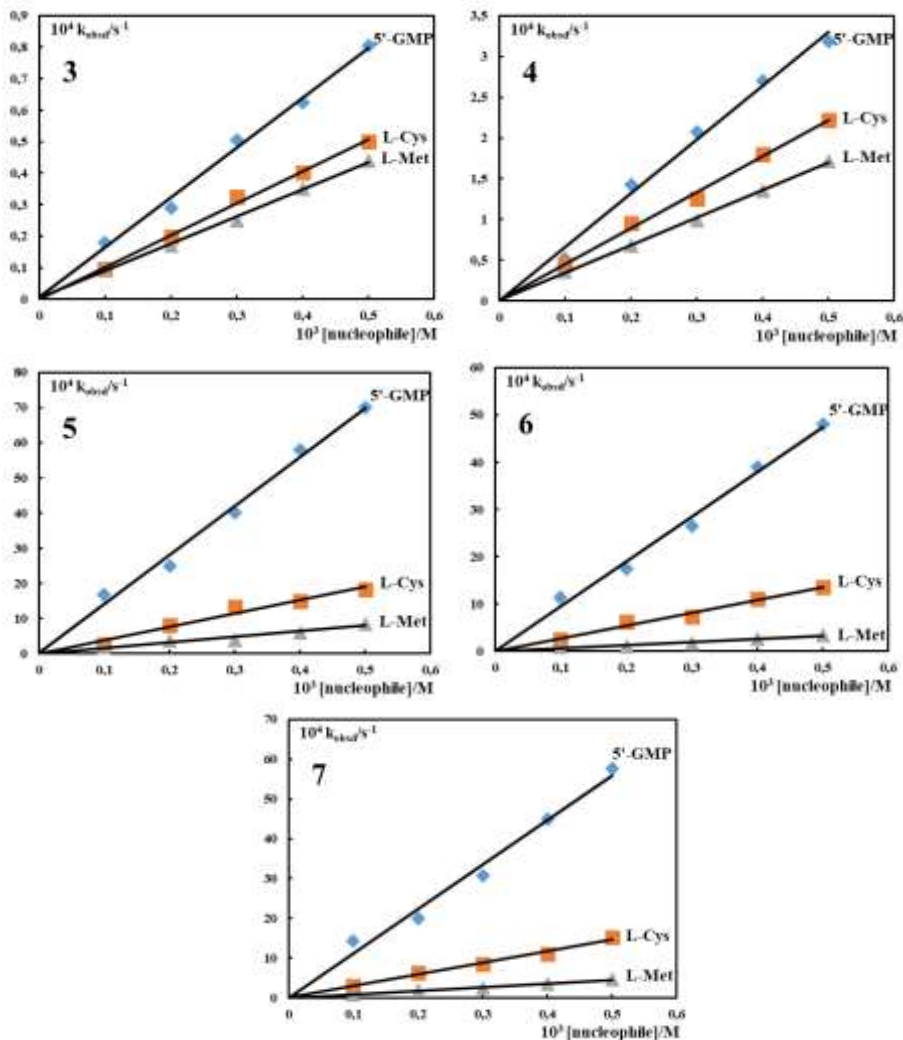


Fig. 4. *Pseudo*-first order rate constants, k_{obsd} , as a function of the nucleophile concentration and temperature for the substitution reaction of complexes **1** – **7** with 5'-GMP, L-Cys and L-Met.

The calculated values of rate constant k are summarized in Table 1. Kinetic measurements were carried out at three different temperatures for the substitution reactions of complex **1** with the selected nucleophiles to enable the calculation of the entropy of activation and enthalpy of activation, Table 1. The activation parameters (ΔH^\ddagger and ΔS^\ddagger) obtained from

the Eyring plots for the reactions of complex **1** with 5'-GMP, L-Cys and L-Met are: $\Delta H^\ddagger = 56 \pm 2$, 51 ± 4 , 41 ± 2 [kJmol⁻¹]; $\Delta S^\ddagger = -71 \pm 6$, -98 ± 13 , -133 ± 6 [JK⁻¹mol⁻¹], respectively. The negative values found for the entropies of activation support an associative ligand substitution mechanism, most probably of the associative interchange (I_a) type typical for the substitution reactions of Ru(II) complexes [5,6].

The reactivity of the tpy and Cl-Ph-tpy complexes decreased in order **5** > **7** > **6** > **1** > **2** > **4** > **3**. The introduction of the chlorophenyl fragment on the 4'-position of tpy has a strong electron-withdrawing effect on the tpy ligand and, consequently, on the metal center. This causes the higher reactivity of chlorophenyl-tpy complexes **5–7** compared to tpy complexes **1–4**. Moreover, the addition of electron-donating groups on the aromatic spectator ligand (bpy) usually increases electron density on the ligand, which is then forwarded to the metal ion by inductive effects. Consequently, the metal ion becomes less electrophilic, leading to a reduced rate of substitution with incoming nucleophiles due to the decreased π -back bonding. Therefore, this results in higher reactivity of dcbpy complexes **4** and **7** compared to dmbpy complexes **3** and **6**.

It is known that the substitution reactions of octahedral Ru(II) complexes depend highly on the nature of the entering nucleophile. As such, the nucleophilicity of the nucleophiles selected for this study depends on both their electronic and steric properties. For all studied complexes, the substitution reaction occurs most rapidly when the nucleophile is 5'-GMP. Based on the borderline hard-soft acidic properties of ruthenium, it was expected for ruthenium complexes to show a higher affinity for nitrogen-bonding nucleophiles, which poses the borderline hard-soft properties, as well. A slightly higher reactivity of L-Cys than L-Met can be noted due to the presence of a voluminous methyl group, which is directly linked to the binding sulfur atom in the molecule of thioether.

Table 1 Rate constants for the substitution reactions between complexes **1–7** and nucleophiles 5'-GMP, L-Cys and L-Met

Complex	t [°C]	k [M ⁻¹ s ⁻¹]		
		<i>L-Met</i>	<i>L-Cys</i>	<i>5'-GMP</i>
1 (<i>o</i> -bqdi)	15	0.14 ± 0.01	0.15 ± 0.01	0.70 ± 0.01
	25	0.35 ± 0.03	0.43 ± 0.03	1.5 ± 0.0
	37	0.51 ± 0.03	0.69 ± 0.06	3.9 ± 0.2
2 (nqdi)	37	0.26 ± 0.02	0.30 ± 0.02	0.51 ± 0.03
3 (dmbpy)	37	0.09 ± 0.01	0.11 ± 0.01	0.16 ± 0.01
4 (dcbpy)	37	0.34 ± 0.01	0.44 ± 0.02	0.66 ± 0.08
5 (nqdi)	37	1.6 ± 0.1	3.8 ± 0.4	14.0 ± 0.9
6 (dmbpy)	37	0.64 ± 0.08	2.7 ± 0.2	9.5 ± 0.6
7 (dcbpy)	37	0.91 ± 0.06	2.9 ± 0.2	11.2 ± 0.9

3. CONCLUSION

Here we described the synthesis and characterization of seven new Ru(II)-tpy/Cl-Ph-tpy complexes, with general formula *mer*-[Ru(L₃)(*N-N*)Cl]Cl, where L₃ is tpy or Cl-Ph-tpy, *N-N* is *o*-benzoquinonediimine (*o*-bqdi), 2,3-naphthoquinonediimine (nqdi), 4,4'-dimethyl-2,2'-bipyridine (dmbpy) or 2,2'-bipyridine-4,4'-dicarboxylic acid (dcbpy). The study of the kinetics of the substitution reactions of complexes **1–7** with nitrogen- (5'-GMP) and sulfur-donor nucleophiles (L-Cys and L-Met) showed higher reactivity of chlorophenyl-tpy complexes **5–7** compared to tpy complexes **1–4** due to the electronic effects. Additionally, the selection of the substituents on bipyridine spectator ligand affects on the reactivity of studied Ru(II) complexes as well. Furthermore, complexes **1 – 7** showed higher reactivity toward nitrogen-donor compared to sulphur-donor nucleophiles. The observed order of reactivity is: 5'-GMP >> L-Cys > L-Met.

4. LITERATURE

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¹H NMR STUDY OF THE REACTIONS BETWEEN DINUCLEAR PLATINUM(II) COMPLEXES AND GUANOSINE-5'-MONOPHOSPHATE

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ABSTRACT:

Platinum-based drugs, as classical chemotherapeutic agents, have ability to form intrastrand covalent adducts with DNA by binding of Pt to the N7 atoms of two adjacent guanine bases. A novel class of promising antitumor agents with potential clinical significance represent polynuclear platinum complexes. In present investigation, dinuclear $\{[Pt(L)(Cl)]_2(\mu\text{-pz})\}Cl_2$ complexes (L is bidentately coordinated ethylenediamine (en), 1,3-propylethylenediamine (1,3-pd), and 2,2-dimethyl-1,3-propylethylenediamine (2,2-diMe-1,3-pd), pz is the bridging ligand pyrazine (1,4-diazine)) were synthesized and their structure was confirmed based on the results of elemental microanalysis and NMR spectroscopy (¹H and ¹³C). The reactions between guanosine-5'-monophosphate (5'-GMP) as biologically relevant ligand and synthesized dinuclear Pt(II) complexes were studied by ¹H NMR spectroscopy. It was found that in the reactions of the $\{[Pt(L)Cl]_2(\mu\text{-pz})\}^{2+}$ complexes with the nucleotide guanosine-5'-monophosphate (5'-GMP) in a 1:1 molar ratio (pH = 7.40 in 50 mM phosphate buffer) only one complex, $\{[Pt(L)(5'\text{-GMP-N7})](\mu\text{-pz})[Pt(L)Cl]\}^+$, was formed in the solution after 24 hours of reaction time. The rate of the coordination reaction of 5'-GMP, through the N7 nitrogen atom of guanine, for the investigated dinuclear $\{[Pt(L)(Cl)]_2(\mu\text{-pz})\}Cl_2$ complexes depends on the nature of the bidentately coordinated diamine ligand L. The second-order rate constants (*k*₂) were determined, showing that as the steric effect of ligand L increases in the series en > 1,3-pd > 2,2-diMe-1,3-pd, the values of the constants *k*₂ decrease. According to this, *k*₂ values indicate that $\{[Pt(en)(Cl)]_2(\mu\text{-pz})\}Cl_2$ complex shows the best binding ability for 5'-GMP.

Keywords: dinuclear platinum(II) complexes, guanosine-5'-monophosphate, ¹H NMR spectroscopy

1. INTRODUCTION

The development of platinum-based compounds as drugs for cancer chemotherapy began with an incidental observation by Rosenberg. It was found that cisplatin (originally called Peyrone's chloride), first synthesized by Michele Peyrone in 1844, inhibited cell proliferation [1,2]. Nowadays, three mononuclear platinum(II) complexes (cisplatin, carboplatin, and oxaliplatin) are approved worldwide for human cancer treatment. These complexes are able to form intrastrand covalent adducts with DNA after binding of Pt(II) to the N7 atoms of two adjacent guanine bases [3,4]. Apart from anticancer activity, many negative side effects, such as nephrotoxicity, ototoxicity, cardiotoxicity, neurotoxicity, vomiting and resistance, are observed during treatment with these platinum(II) agents. Therefore, researchers are developing new classes of platinum complexes with improved antitumor properties [5,6]. Polynuclear platinum(II) complexes belong to a new generation of antitumor platinum containing drugs, and some of them are in the stage of preclinical trials [7–9]. Some multinuclear platinum(II) complexes contain flexible aliphatic diamine ligands as bridging ligands, and therefore they react much faster with DNA compared to cisplatin because they achieve a different type of coordination for DNA [9]. Dinuclear platinum(II) complexes containing inflexible molecules such as azines as bridging ligands have also been synthesized [10]. These complexes have different DNA binding mechanisms than mononuclear clinically used drugs. They have been found to reduce the possibility of deformation of the helical DNA structure after coordination with nucleic bases in DNA, and therefore may have pronounced biological activity.

In this study, the influence of the bidentate coordinated diamine ligand in dinuclear platinum(II) complexes of the type $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ (L is bidentate coordinated ethylenediamine (en), 1,3-propylenediamine (1,3-pd) and 2,2-dimethyl-1,3-propylenediamine (2,2-diMe-1,3pd), pz is a bridging pyrazine ligand) in reaction with the nucleotide guanosine-5'-monophosphate (5'-GMP) were studied. All reactions were studied by ^1H NMR spectroscopy with equimolar amounts of the dinuclear platinum(II) complexes and 5'-GMP at 25 °C in 50 mM phosphate buffer (pH = 7.40) in D_2O as solvent.

2. MATERIALS AND METHODS

2.1. Materials and methods

Chemicals and reagents D_2O , DNO_3 , NaOD, ethylenediamine (en), 1,3-propylenediamine (1,3-pd), 2,2-dimethyl-1,3-propylenediamine, pyrazine (pz), nucleotide guanosine-5'-monophosphate (5'-GMP) and $\text{K}_2[\text{PtCl}_4]$ were purchased from Aldrich Chemical Co (Merck). Mononuclear platinum(II) complexes, $[\text{Pt}(\text{L})\text{Cl}_2]$ (where L is bidentately coordinated en, 1,3-pd and 2,2-diMe-1,3-pd) were synthesized by a modified procedure previously described in literature [11]. The purity and structure of the complexes were

checked using the results of elemental microanalysis and NMR (^1H and ^{13}C) spectroscopy. All the other chemicals were of the highest purity commercially available and used without further purification. Elemental analysis for carbon, hydrogen and nitrogen were performed by the Microanalytical Laboratory, Faculty of Chemistry, University of Belgrade. All pH measurements were made at room temperature. The pH meter (S220 Seven Compact, pH/Ion, Mettler Toledo) was calibrated with a buffer solution of pH 4.00 and 7.00. The results were not corrected for the deuterium isotope effect. The UV-Vis spectra were recorded on a Shimadzu double-beam spectrophotometer equipped with thermostated 1.00 cm quartz Suprasil cells, after dissolving the corresponding platinum(II) complexes in water, over the wavelength range of 200–600 nm. The concentrations of the platinum(II) complexes was $5 \cdot 10^{-5}$ M. The NMR (^1H and ^{13}C) spectra were acquired on a Varian Gemini 2000 (^1H at 200 MHz, ^{13}C at 50 MHz) at 25 °C in D_2O with TSP (sodium 3-(trimethylsilyl)propionate) as an internal reference.

2.2. Preparation of $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complexes

The dinuclear platinum(II) complex of the type $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ was obtained from the corresponding mononuclear complexes $[\text{Pt}(\text{L})\text{Cl}_2]$ by a modified procedure previously described in the literature [12–15]. In the suspension of the $[\text{Pt}(\text{L})\text{Cl}_2]$ complex ($3.38 \cdot 10^{-4}$ mol) in 10 cm^3 of dimethylformamide, 0.0553 g ($3.25 \cdot 10^{-4}$ mol) of AgNO_3 dissolved in 5 cm^3 of dimethylformamide was added. The reaction mixture was stirred overnight at room temperature in the dark. The precipitated AgCl was separated by filtration, and the pale yellow solution of the $[\text{Pt}(\text{L})(\text{dmf})\text{Cl}]^+$ complex in dimethylformamide was used as a starting material for the synthesis of dinuclear $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complexes. The solution obtained by dissolving 0.0133 g ($1.66 \cdot 10^{-4}$ mol) of pyrazine (pz) in 5 cm^3 of dimethylformamide was slowly added dropwise into the solution containing the $[\text{Pt}(\text{L})(\text{dmf})\text{Cl}]^+$ complex. The mixture was stirred at room temperature in the dark for about 12 hours. Dimethylformamide was then evaporated on a rotary vacuum evaporator, and the dry residue washed several times with ether. After evaporating the ether, residue was dissolved in small volume of 0.5 mol/dm^3 aqueous solution of LiCl . The resulting solution was left in the refrigerator overnight. Obtained light yellow crystals of the dinuclear platinum(II) complexes were separated by filtration, washed with methanol, then ether and dried in air. Depending on the type of diamine ligand (L), the yield of the dinuclear platinum(II) complex was 30–40%. The purity and structure of the complex were checked using the results of elemental microanalysis, and UV-Vis and NMR (^1H and ^{13}C) spectroscopy.

Calculated for $\{[\text{Pt}(\text{en})\text{Cl}]_2(\mu\text{-pz})\}\text{Cl}_2 = \text{C}_8\text{H}_{20}\text{N}_6\text{Cl}_4\text{Pt}_2$ (Mr = 732.25): C, 13.12; H, 2.75; N, 11.48. Found: C, 13.16; H, 2.98; N, 11.19%. ^1H NMR (D_2O , 200 MHz); δ (ppm) 2.68–2.79 (*m*, CH_2 en), 9.03 (*s*, CH pz); ^{13}C NMR δ (D_2O , 200 MHz); (ppm) 52; 153. UV-Vis (H_2O , λ_{max} , nm): 283 ($\epsilon = 7.26 \cdot 10^3 \text{ M}^{-1}\text{cm}^{-1}$).

Calculated for $\{[\text{Pt}(1,3\text{-pd})\text{Cl}]_2(\mu\text{-pz})\}\text{Cl}_2 = \text{C}_{10}\text{H}_{24}\text{N}_6\text{Cl}_4\text{Pt}_2$ (Mr = 760.31): C, 15.80; H, 3.18; N, 11.05. Found: C, 15.90; H, 3.24; N, 10.87%. ^1H NMR (D_2O , 200 MHz); $\delta(\text{ppm})$ 1.79-1.95 (*m*, CH_2 1,3-pd), 2.66-2.87 (*m*, CH_2 1,3-pd), 9.02 (*s*, CH pz); ^{13}C NMR (50 MHz, D_2O); $\delta = 30$; 45; 46; 154. UV-Vis (H_2O , λ_{max} , nm): 288 ($\epsilon = 8.34 \cdot 10^3 \text{ M}^{-1}\text{cm}^{-1}$).

Calculated for $\{[\text{Pt}(2,2\text{-diMe-1,3-pd})\text{Cl}]_2(\mu\text{-pz})\}\text{Cl}_2 \cdot 2\text{LiCl} \cdot 10\text{H}_2\text{O} = \text{C}_{14}\text{H}_{52}\text{Cl}_6\text{Li}_2\text{N}_6\text{O}_{10}\text{Pt}_2$ (Mr = 1081.35): C, 15.55; H, 4.85; N, 7.77. Found: C, 16.04; H, 4.72; N, 8.17%. ^1H NMR (D_2O , 200 MHz); $\delta(\text{ppm})$ 1.01 (*s*, CH_3 2,2-diMe-1,3-pd), 2.38 and 2.49 (*2s*, CH_2 2,2-diMe-1,3-pd), 9.05 (*s*, CH pz); ^{13}C NMR (50 MHz, D_2O); $\delta = 26$; 36; 54; 55; 154. UV-Vis (H_2O , λ_{max} , nm): 285 ($\epsilon = 7.58 \cdot 10^3 \text{ M}^{-1}\text{cm}^{-1}$).

2.3. ^1H NMR measurements

Reactions between dinuclear $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complexes and guanosine-5'-monophosphate were monitored using ^1H NMR spectroscopy. All reactions were carried out with equimolar amounts of the dinuclear platinum(II) complexes and guanosine-5'-monophosphate at 25°C in 50 mM phosphate buffer (pH = 7.40) in D_2O as solvent. The initial concentration of the guanosine-5'-monophosphate and platinum(II) complex solution was 40 mM. The values of the rate constants (k_2) are obtained from the slope of the line when the expression $x/a_0(a_0-x)$ from the equation for the second-order reaction:

$$k_2 t = \frac{x}{a_0(a_0 - x)}$$

is considered as a function of time (t). In this equation, a_0 is the initial concentration of guanosine-5'-monophosphate and x is the concentration of the corresponding $\{[\text{Pt}(\text{L})(5'\text{-GMP-N7})](\mu\text{-pz})[\text{Pt}(\text{L})\text{Cl}]\}^+$ complex at time t . The concentration of the Pt(II)-5'-GMP complex was determined based on the decrease in the intensity of doublet at 5.92 ppm corresponding to the C' ^1H ribose protons of uncoordinated 5'-GMP and the increase in the doublet intensity at 5.98 ppm originating from the C' ^1H of ribose protons after monodentate coordination of 5'-GMP via the N7 nitrogen atom to the Pt(II) ion in the $\{[\text{Pt}(\text{L})(5'\text{-GMP-N7})](\mu\text{-pz})[\text{Pt}(\text{L})\text{Cl}]\}^+$ complex. Experimental results were processed using computer programs Microsoft Excel and OriginPro 8.

3. RESULTS AND DISCUSSION

In this work, the reactions of bidentate $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complexes (L is bidentate coordinated ethylenediamine (en), 1,3-propylenediamine (1,3-pd) and 2,2-dimethyl-1,3-propylenediamine (2,2-diMe-1,3pd), pz is a bridging pyrazine ligand) with guanosine 5'-monophosphate (5'-GMP) were studied by ^1H NMR spectroscopy. All reactions were carried out at a molar ratio of 1:1 between the corresponding platinum(II) complex and guanosine 5'-monophosphate in 50 mM phosphate buffer at a pH of 7.4 in D_2O as solvent and at a temperature of 25 °C. The structural formulae of the investigated dinuclear platinum(II) complexes $\{[\text{Pt}(\text{en})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$, $\{[\text{Pt}(1,3\text{-pd})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ and $\{[\text{Pt}(2,2\text{-$

diMe-1,3-pd)Cl]₂(μ-pz)}²⁺ as well as the guanosine 5'-monophosphate are shown in Fig. 1. The chelated five- or six-membered diamine ligand as well as the bridging pyrazine ligands in the {[Pt(L)Cl]₂(μ-pz)}²⁺ complex are a stable part of the molecule and remain coordinated with the Pt(II)-ion during the reactions with guanosine-5'-monophosphate for 24 hours.

Reactions of {[Pt(L)Cl]₂(μ-pz)}²⁺ complexes with guanosine-5'-monophosphate

Considering the potential antitumor activity of dinuclear platinum(II) complexes containing rigid diazines as a bridging ligand, this paper compared the reaction rate of dinuclear {[Pt(L)Cl]₂(μ-pz)}²⁺ complexes, which differ in the size of the diamine ring, with the 5'-GMP nucleotide.

When an equimolar amount of the {[Pt(L)Cl]₂(μ-pz)}²⁺ complex was mixed with the guanosine-5'-monophosphate nucleotide, under the previously described experimental conditions, only one {[Pt(L)(5'-GMP-N7)](μ-pz)[Pt(L)Cl]}⁺ complex could be detected after 24 hours of the reaction (Fig. 2). The formation of the {[Pt(L)(5'-GMP-N7)](μ-pz)[Pt(L)Cl]}⁺ complex was monitored using ¹H NMR spectroscopy. The singlet at 8.20 ppm originating from the C8H proton of uncoordinated 5'-GMP decreases during time, while the intensity of the singlet at 8.96 ppm, from the C8H proton of coordinated 5'-GMP for the Pt(II) ion increases.

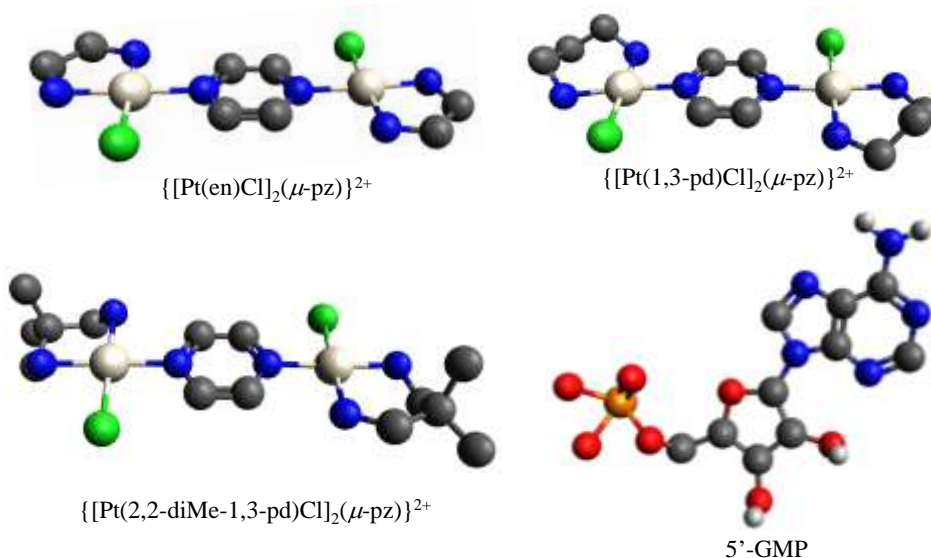


Fig. 1. Structural formulas of the studied dinuclear complexes of platinum(II) and guanosine-5'-monophosphate

However, the rate of the substitution reaction of the chlorido ligand in the $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complex with the *N*7 nitrogen atom of guanosine-5'-monophosphate cannot be monitored based on the change in signal intensity from C8H hydrogen atom, because the signal for the coordinated nucleotide overlaps with the signal originating from four equivalent protons of the coordinated pyrazine bridging ligand (9.02-9.05 ppm). In addition to the change in the intensity of the singlet from the C8H proton, after the coordination of 5'-GMP to the Pt(II) ion, doublet originating from the hydrogen atom (C1'H) of the ribose sugar at 5.92 ppm ($J = 4.6$ Hz) shifts to the 5.98 ppm ($J = 4.6$ Hz). Fig. 3 shows part of the ^1H NMR spectrum for the reaction of $\{[\text{Pt}(\text{en})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complex with 5'-GMP over time.

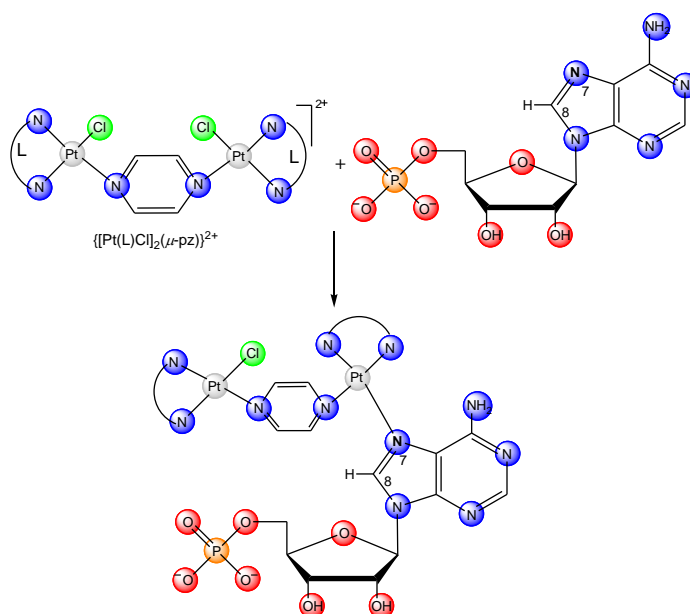


Fig. 2. Schematic presentation for the reactions of dinuclear $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complexes with guanosine-5'-monophosphate in 50 mM phosphate buffer, pH = 7.40, and temperature of 25 °C

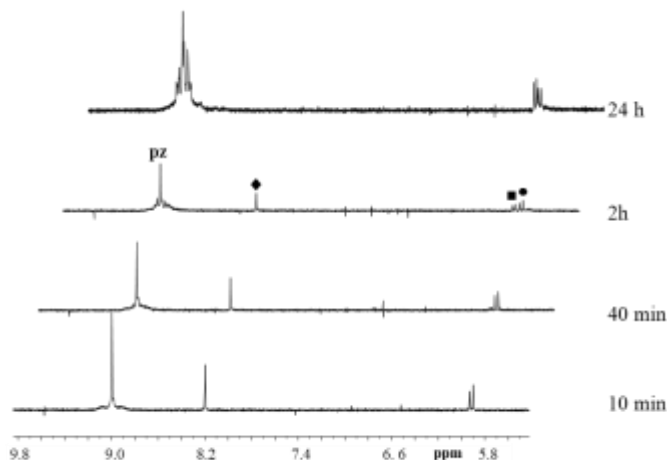


Fig. 3. Parts of the ^1H NMR spectrum for the reaction of $\{[\text{Pt}(\text{en})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ with 5'-GMP in a 1:1 molar ratio, as a function of time in 50 mM phosphate buffer ($\text{pH} = 7.40$) in D_2O as a solvent. (♦) C8H protons of uncoordinated 5'-GMP, (●) C1'H protons of ribose of uncoordinated 5'-GMP, (■) C1'H protons of ribose in $\{[\text{Pt}(\text{L})(5'\text{-GMP-N7})](\mu\text{-pz})[\text{Pt}(\text{L})\text{Cl}]\}^+$ complex

As it can be seen from Fig. 3, after 24 hours of reaction time there is no free 5'-GMP in the solution and the entire amount of mononucleotide is coordinated to the Pt(II) ion. The tested dinuclear complexes of platinum(II) during the reaction with 5'-GMP in a 1:1 molar ratio are stable, and after 24 hours in the aromatic region only the singlet from the protons of the coordinated pyrazine bridging ligand was detected.

Based on the change of the doublet from the C1'H proton of ribose in 5'-GMP, it was found that after 40 minutes of reaction time about 20% of 5'-GMP is coordinated to $\{[\text{Pt}(\text{en})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complex, while in the same time in the reaction of 5'-GMP with $[\text{Pt}(2,2\text{-diMe-1,3-pd})\text{Cl}]_2(\mu\text{-pz})^{2+}$ about 10% of nucleotides are coordinated. After 3 hours of reaction time about 65% of 5'-GMP is coordinated for the $\{[\text{Pt}(\text{en})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$, containing a five-membered ethylenediamine ring, while $\{[\text{Pt}(1,3\text{-pd})\text{Cl}]_2(\mu\text{-pz})\}^{4+}$ or $\{[\text{Pt}(2,2\text{-diMe-1,3-pd})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ coordinates about 40% of mononucleotide (Fig. 4). Based on this, it can be concluded that the reaction rate of dinuclear $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complexes with 5'-GMP is affected by the size of the diamine ring, while influence of substituents on the C-atoms of the diamine ring is negligible.

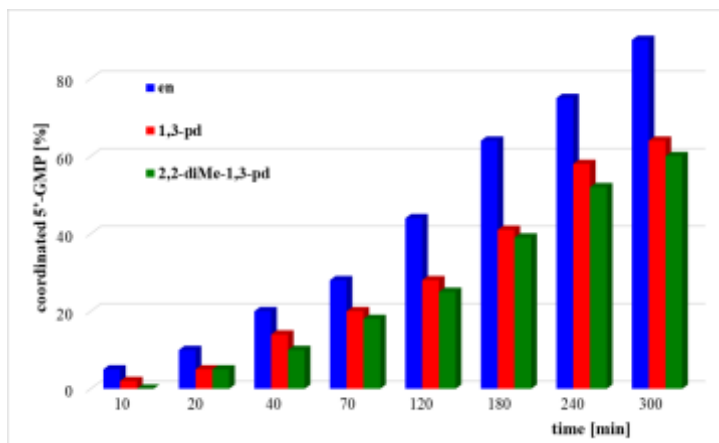


Fig. 4. Time dependence of the coordination reaction of guanosine-5'-monophosphate for $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complexes

The difference in the reaction rate of nucleotide and the studied dinuclear $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complexes depends solely on the coordination rate of the N7 nitrogen atom from guanine for the corresponding Pt(II) complex. The mononucleotide coordination reaction for dinuclear platinum(II) complexes was observed as a second-order reaction (Table 1). As it can be seen from Table 1, the values of the rate constant (k_2) decrease with the increase of the steric effect of the diamine ligand in dinuclear platinum(II) complexes. Our results showed that the rate of the coordination reaction of 5'-GMP via the N7 nitrogen atom of guanine for the $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complex depends on the steric effect of the diamine and decreases in the order: $\text{en} > 1,3\text{-pd} > 2,2\text{-diMe-}1,3\text{-pd}$. Therefore, the rate of coordination of nucleotides for $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complex can be affected by modifying the structure of dinuclear $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complex, i.e. by introducing a sterically large diamine ligand L, and therefore on the potential antitumor activity of dinuclear platinum(II) complexes.

Table 1. Rate constants for the reactions of $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$ complex with 5'-GMP, at pH = 7.4 and 25 °C in D₂O as solvent

Complex	$k_2, 10^2 k_2 / \text{M}^{-1} \text{s}^{-1}$
$\{[\text{Pt}(\text{en})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$	(1,07 ± 0,04)
$\{[\text{Pt}(1,3\text{-pd})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$	(0,63 ± 0,03)
$\{[\text{Pt}(2,2\text{-diMe-}1,3\text{-pd})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$	(0,47 ± 0,02)

3. CONCLUSION

Reactions of dinuclear platinum(II) complexes with aromatic N-heterocyclic bridging ligands, $\{[\text{Pt}(\text{L})\text{Cl}]_2(\mu\text{-pz})\}^{2+}$, with 5'-GMP have been investigated by ^1H NMR spectroscopy. It was found that only one complex, $\{[\text{Pt}(\text{L})(5'\text{-GMP-N7})](\mu\text{-pz})[\text{Pt}(\text{L})\text{Cl}]\}^+$, was formed in the solution after 24 hours of reaction time. Numeric value of calculated second-order rate constants (k_2) for $\{[\text{Pt}(\text{en})(\text{Cl})]_2(\mu\text{-pz})\}^{2+}$ complex is approximately two times higher than for $\{[\text{Pt}(2,2\text{-diMe-1,3-pd})(\text{Cl})]_2(\mu\text{-pz})\}^{2+}$ indicating that $\{[\text{Pt}(\text{en})(\text{Cl})]_2(\mu\text{-pz})\}^{2+}$ complex shows the best binding ability for 5'-GMP. That points out that the rate of the coordination reaction of 5'-GMP, through the N7 nitrogen atom of guanine, for the investigated complexes depends on the nature of the bidentately coordinated diamine ligand L. The second-order rate constants (k_2) show that as the steric effect of ligand L increases in the series $\text{en} > 1,3\text{-pd} > 2,2\text{-diMe-1,3-pd}$, the values of the constants k_2 decrease.

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RADIOACTIVITY MEASUREMENTS OF FISH SAMPLES FROM SERBIAN MARKETS

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ABSTRACT:

*Concentrations of naturally occurring radionuclides (^{226}Ra , ^{232}Th , and ^{40}K), as well as anthropogenic radionuclides (^{137}Cs), in a total of 10 fish samples (freshwater species *Oncorhynchus mykiss* and *Cyprinus carpio*, and marine species *Merluccius merluccius* and *Scomber scombrus*) were purchased on Serbian markets have been measured to better understand background radiation levels in daily food diet. This investigation verified that the main source of radiation exposure from the fish intake is ^{40}K . In this study, none of the fish samples examined had any ^{134}Cs at measurable levels. An average ^{137}Cs level was below 20 Bq.kg^{-1} . The resulting radiation dose for people from fish consumption would be a very small fraction of the annual dose from exposure to natural background radiation. According to the findings, fish from Serbian markets do not present a radiological health risk.*

Keywords: fish samples, gamma spectrometry, radioactivity concentrations

1. INTRODUCTION

Both natural and artificial radionuclides can be found in aquatic environments. The natural radionuclides are either primordial or cosmogenic in origin, and they are present in water due to their solubility, as well as their deposition from land and the atmosphere. These radionuclides can also be exchanged and removed from the aquatic environment through the removal of particulate matter. Among the radionuclides present in the aquatic environment, ^{40}K is the most abundant, followed by ^{238}U . On the other hand, ^{232}Th and its series members are not found in substantial amounts in sediments due to the fact that they are practically insoluble in water and tend to be absorbed into the particulate matter of

cosmogenic radionuclides. Plants and animals in the aquatic environment accumulate radionuclide to a concentration greater than of the ambient [1].

Radioactivity measurements of fish samples have been an important area of research for several decades. Due to the potential dangers of exposure to radioactive substances, it is crucial to monitor the radioactivity levels in the aquatic environment, particularly in fish which are a major source of food for humans. Several studies have shown that fish can accumulate and retain radionuclides in their tissues, which can be harmful to both human and aquatic life [2,3].

In recent years, there has been an increasing interest in the measurement of radioactivity in fish samples, especially in the aftermath of nuclear accidents such as the Chernobyl and Fukushima disasters. The need for accurate and reliable methods for measuring radioactivity in fish samples has never been greater. There are several methods for radioactivity measurements, including gamma-ray spectrometry, liquid scintillation counting, and alpha spectrometry, which have been widely used in the measurement of radioactivity in fish samples [4].

Serbia is a developing country which has adopted legislation setting maximum levels of contaminants in food [5,6]. However, food safety control is still a matter of great concern, particularly regarding imported food products [7]. Therefore, analyses of contaminant content in fishery products are one of the most important activities when controlling food safety [7,8].

Four fish species of great importance in the diet of the Serbian population are two imported marine species, hake (*Merluccius merluccius*) and mackerel (*Scomber scombrus*), along with two freshwater ones, common carp *Cyprinus carpio* and rainbow trout *Oncorhynchus mykiss* (dominating with over 90% of total fish production in fish ponds) [9,10].

This study aims to measure the radioactivity levels of fish samples using gamma-ray spectrometry. The results of this study will contribute to understanding the levels of radioactivity in fish samples and the potential risks associated with consuming them. In addition, this study can be an excellent introduction to the development of strategies for monitoring and controlling radioactivity levels in the environment.

2. MATERIALS AND METHODS

2.1. Gamma spectrometry analysis

Gamma spectroscopy is a common technique for assessing radioactivity in the environment and detecting radioactive contamination over large areas of land.

In this study, ten samples of technologically processed (packaged) fish were collected and analyzed. Obtained samples are available on the Serbian markets from three different distributors (Vasović, BioFish, and Tropic Trade). Fish samples were placed in sealed 450 mL Marinelli beakers and stored for over four weeks to prevent the escape of radon gas

(²²²Rn) and avoid any disequilibrium issues between ²²⁶Ra and its short-lived progeny (²¹⁴Pb and ²¹⁴Bi). The activity concentrations of radionuclides such as ²²⁶Ra, ²³²Th, ⁴⁰K, and ¹³⁷Cs were measured using a high-purity germanium (HPGe) detector with an energy resolution of 1.85 keV at 1.33 MeV (⁶⁰Co). The MAESTRO 2 software was used for spectrum analysis.

2. RESULTS AND DISCUSSION

This study presents the results of a gamma spectrometric analysis conducted on ten fish samples from the Serbian markets. Table 1. shows the specific activity of natural radionuclides and ¹³⁷Cs. The first six fish samples are marine species, while the remaining four represent freshwater species.

Table 1. Specific activities of radionuclides in selected fish samples (fish species and distributors).

Sample	²²⁶ Ra (Bq.kg ⁻¹)	²³² Th (Bq.kg ⁻¹)	⁴⁰ K (Bq.kg ⁻¹)	¹³⁷ Cs (Bq.kg ⁻¹)
Hake (Vasović)	3.2 ± 0.2	4.2 ± 0.2	94.1 ± 4.7	4.5 ± 0.2
Hake (BioFish)	2.2 ± 0.1	4.2 ± 0.2	124.4 ± 6.2	5.1 ± 0.3
Hake (Tropic Trade)	2.3 ± 0.1	3.1 ± 0.2	93.1 ± 4.7	3.1 ± 0.2
Mackerel (Vasović)	8.9 ± 0.4	5.9 ± 0.3	105.9 ± 5.3	2.9 ± 0.1
Mackerel (BioFish)	5.4 ± 0.3	7.4 ± 0.4	97.5 ± 4.9	7.5 ± 0.4
Mackerel (Tropic Trade)	4.3 ± 0.2	7.2 ± 0.4	107.4 ± 5.4	5.4 ± 0.3
Common carp (Vasović)	6.7 ± 0.3	6.3 ± 0.3	86.4 ± 4.3	6.4 ± 0.3
Common carp (BioFish)	7.8 ± 0.4	5.8 ± 0.3	95.8 ± 4.8	2.8 ± 0.1
Rainbow trout (Vasović)	9.0 ± 0.5	11.1 ± 0.6	111.3 ± 5.6	3.3 ± 0.2
Rainbow trout (Tropic Trade)	10.1 ± 0.5	9.8 ± 0.5	159.8 ± 8.0	5.8 ± 0.3
Min	2.1	3.1	86.4	2.8
Max	10.1	11.1	159.8	7.5
Mean	6.0	6.5	107.6	4.7
SD	2.8	2.4	20.3	1.6

The results of this study show that the concentrations of naturally occurring radionuclides (²²⁶Ra, ²³²Th, and ⁴⁰K) and anthropogenic radionuclide (¹³⁷Cs) in the fish samples collected from Serbian markets were generally low. The average activity concentrations of ²²⁶Ra, ²³²Th, ⁴⁰K, and ¹³⁷Cs were found to be 6.0 ± 2.8, 6.5 ± 2.4, 107.6 ± 20.3, and 4.7 ± 1.6 Bq/kg, respectively. These results are consistent with other studies that have reported low levels of radioactivity in fish samples [11, 12].

This study's results show that most of the radiation exposure from fish consumption comes from naturally occurring radionuclides such as ⁴⁰K, rather than from anthropogenic

radionuclides such as ^{137}Cs . The fact that none of the fish samples had detectable levels of ^{134}Cs is a positive finding, as this radionuclide is a byproduct of nuclear power plants and can potentially contaminate the environment and food chain.

It is worth noting that the concentrations of ^{226}Ra and ^{232}Th in the fish samples were relatively low. This could be attributed to the fact that the fish were not affected by nearby industrial activities or geological features that could contribute to higher levels of these radionuclides. These values were well below the recommended limits set by international organizations such as the International Atomic Energy Agency (IAEA) and the European Union (EU).

It is important to note that the measured activity concentrations of radionuclides in fish samples can vary depending on several factors, such as the fish species, the fishing ground's location, and the environmental conditions. Therefore, continued monitoring of radioactivity levels in fish samples from different sources is necessary to ensure the safety of consumers.

This study's findings align with the national and international regulations on food safety and radiation protection. The results can be used by regulatory bodies and health authorities to make informed decisions about food safety and to establish appropriate guidelines and limits for radioactivity levels in food products.

3. CONCLUSION

The study aimed to investigate the radioactivity levels in fish samples purchased from Serbian markets to assess potential radiological health risks associated with fish consumption. The results showed that naturally occurring radionuclides, particularly ^{40}K , were the main contributors to radiation exposure through the fish intake. Anthropogenic radionuclides were below measurable levels in all samples. The average ^{137}Cs level was found to be near the limit of detection, and the radiation dose from consuming fish was found to be negligible compared to the annual dose from natural background radiation. The results of this study provide valuable information on the radioactivity levels in fish sold on Serbian markets and serve as a baseline for future monitoring and assessment of radioactivity in fish and other food products. Overall, the findings suggest that consuming fish from Serbian markets does not pose a significant radiological health risk to the general population.

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BIO-MODIFIKOVANE UREA-FORMALDEHIDNE SMOLE: SADRŽAJ SLOBODNOG I OSLOBODENOG FORMALDEHIDA

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SAŽETAK:

U ovom radu su analizirane urea-formaldehidne (UF) smole modifikovane biomaterijalima. Kao biomaterijali su korišćeni betain (modifikovana amino kiselina koja se sastoji od glicina sa tri metil grupe) i tanin (složeni biomolekuli polifenolne prirode). Određivanje slobodnog FA u modifikovanim UF smolama izvršeno je disulfitnom metodom. Procenat slobodnog FA u betain-modifikovanoj UF smoli je 0,1%, dok je procenat slobodnog FA u smoli modifikovanoj taninom 0,8%. Hidrolitička stabilnost modifikovanih UF smola je određena merenjem koncentracije oslobođene FA u modifikovanim UF smolama, nakon kisele hidrolize. Rezultati pokazuju da je procenat oslobođenog FA u UF smolama modifikovanim betainom 3,6%. Procenat oslobođenog FA u UF smolama modifikovanim taninom je 7,4%.

Ključne riječi: *Betain, Tanin, Urea-formaldehidna smola, Slobodan i oslobođeni formaldehid*

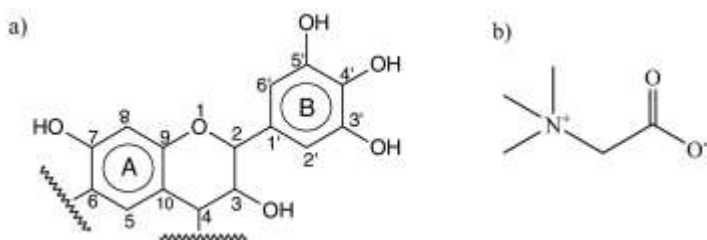
1. UVOD

Urea-formaldehidne (UF) smole (koje se nazivaju i aminoplastima) su visoko umrežene, termoreaktivne smole, nastale kao proizvod reakcije kondenzacije između uree (U) i formaldehida (FA) [1]. UF smole su poznate po svojoj visokoj čvrstoći, krutosti, isplativosti i brzom umrežavanjem. UF smole su među najbrže umrežavajućim smolama na raspolaganju. Na povišenim temperaturama mogu da se umreže za samo dve sekunde [2]. Veliki deo UF smola se koristi u industrija proizvoda od drveta; naročito, služe kao adhezivi za ivericu [2]. UF smole su popularne, kao glavni adheziv za proizvode na bazi drveta, zbog niske cene, lakoće upotrebe u različitim uslovima umrežavanja, raznovrsnosti, niskih temperatura umrežavanja, otpornosti na stvaranje buđi, odličnih

termičkih svojstva, nedostatka boje umreženog proizvoda kao i odlične rastvorljivost (neumrežene) smole u vodi [3]. Glavni nedostatak UF adheziva u poređenju sa drugim termoreaktivnim adhezivima za drvo, kao što su fenol-formaldehidne smole i polimerni diizocijanati je nedostatak otpornosti na vlagu posebno na povišenim temperaturama kada dolazi do emisije FA zbog reverzibilnosti amino-metilenskih veza i njihove hidrolitičke razgradnje.

U cilju daljeg smanjenja sadržaja slobodnog FA, osim niskog molskog odnosa FA/U koji je iznosio 0.8, dodati su, kao biomaterijali, betain (modifikovana amino kiselina koja se sastoji od glicina sa tri metil grupe) i tanin (složeni biomolekul polifenolne prirode).

Tanini i betaini su prirodna organska jedinjenja i kao takvi su pogodni za upotrebu jer potiču iz obnovljivih sirovina. Tanini se dobijaju ekstrakcijom iz drveta, kore, listova i plodova. Na ovaj način dobijeni tanini se koriste u mnogim tradicionalnim industrijama, kao što su proizvodnja kože, medicina, poljoprivreda, kao i u industriji adheziva [4]. Sa hemijske tačke gledišta, tanini su složena organska jedinjenja fenolne strukture, odnosno to su polihidroksifenoli. Prisustvo slobodnih hidroksilnih grupa u strukturi tanina omogućava laku hemijsku modifikaciju, što ih čini pogodnim za upotrebu u industriji adheziva. Tanini su reaktivni zbog prisustva rezorcinola (prsten A) i kateholnih prstenova (prsten označen B) (slika 1a).



Slika 1. Struktura a) tanina i b) betaina.

Betain (trimetil glicin) je široko rasprostranjen u prirodi i može se naći u životinjama, biljkama i mikroorganizmima, a takođe je i sastojak mnogih prehrambenih proizvoda. Zbog svoje biološke aktivnosti, betain se široko koristi u medicini, farmaciji i biologiji. Betaini se obično nalaze u obliku cviter jona i imaju dve formalno naelektrisane grupe koje obično nisu konjugovane (slika 1b). Kvaternarni atom azota je inertan kao centar vodonične veze, dok je karboksilna grupa bazna. U normalnim uslovima, betain kristališe kao hidrat, pošto molekul betaina ima jaku H-akceptorsku funkcionalnu karboksilatnu grupu i nema kiselih H-donora. Može biti i u obliku anhidrida [5].

U ovom radu je izvršeno poređenje dva biomaterijala kao „hvatača“ FA određivanjem sadržaja slobodnog i oslobođenog FA iz UF biokompozita.

2. MATERIJAL I METODE RADA

U eksperimentalnom radu su za sintezu UF smola korišćeni sledeći reagensi i materijali: Urea - $(\text{NH}_2)_2\text{CO}$ (Alkaloid-Skopje, Severna Makedonija), 35% formaldehid - CH_2O (Unis-Goražde, Bosna i Hercegovina); tanin (Merck, New Jersey, USA) i betain (AlfaAesar GmbH&KG, Karlsruhe, Germany) kao prirodna biopunila. Svi ostali reagensi i rastvori korišćeni u analitičkim metodama su bili analitičke čistoće.

Sinteza UF kompozita. Sinteza UF biokompozita sa betainom i taninom (UF/B i UF/T) izvedena je po postupku [6]. Molarni odnos formaldehida i uree (FA/U) u modifikovanoj UF smoli bio je 0,8.

Određivanje slobodnog FA. Procenat slobodnog FA određen je sulfitnom metodom [7], što je detaljnije objašnjeno u našem prethodnom radu [8]. Procenat slobodnog FA je računat iz jednačine (1):

$$FA(\%) = \frac{V \cdot c \cdot E \cdot 100}{1000 \cdot a} \quad (1)$$

gde je V - zapremina HCl (cm^3), c je koncentracija HCl (mol dm^{-3}), E je ekvivalentna masa FA, a a je masa uzorka (g).

Hidrolitička stabilnost. Sintetisani UF biokompoziti su izloženi kiseloj hidrolizi, po postupku opisanom u radu [9]. Posle hidrolize, sulfitnom metodom i primenom jednačine 1 je određen procenat oslobođenog FA, na isti način kao za slobodni formaldehid.

4. REZULTATI I DISKUSIJA

FA je poslednjih godina u žiži interesovanja, jer je kontrola emisije FA u zatvorenim prostorijama bitan faktor u ekološkim i zdravstvenim problemima, u smislu da je opasan po zdravlje i glavni uzročnik iritacije respiratornih organa, dermatoloških problema kao i uzročnik kancera. Formaldehid je čest sastojak vazduha, u tragovima, jer nastaje kao međuprodukt oksidacije metana i drugih lakoisparljivih organskih materija [10]. Dok je njegova koncentracija u otvorenom prostoru vrlo niska – oko 10 ppm, osim sa izrazitim epizodama fotohemijskog smoga, nivo FA u zatvorenim prostorima često je i nekoliko puta veća i u izvesnim slučajevima prelazi 1000 ppm. Najčešći izvori FA u vazduhu zatvorenog prostora su: presovani proizvodi na bazi drveta koji sadrže UF adheziv, za koje je karakteristično da i nakon 5 do 10 godina od ugradnje emituje FA, razni proizvodi od tekstila, kozmetički proizvodi, premazi (boje i lakovi) i neki drugi proizvodi od papira, produkti sagorevanja drveta, prirodnog gasa, cigareta, tepisi i gips-kartonske ploče [11]. Na emisiju slobodnog FA iz lepljenih ploča utiču spoljašnji i unutrašnji faktori. Spoljašnji faktori su: temperatura, relativna vlaga, broj izmene vazduha u prostoriji, da li je ploča površinski obrađena ili ne i još neki. Unutrašnji faktori su: sadržaj vlage ploče (tj. iverice), vrsta veziva, vrsta upotrebljenog katalizatora, način proizvodnje ploče.

Nivo oslobođenog FA je direktno povezan sa neizreagovanim FA u smoli i otpornošću smole na vlagu i tečnosti [12, 13]. Poželjno je da procenat slobodnog FA u samoj smoli bude što manji, jer je poznato da FA ima štetno dejstvo na čoveka, odnosno ceo živi svet. Formaldehid koji se emituje iz UF smola nastaje iz nekoliko izvora: a) neizreagovani

formaldehid iz smole; b) formaldehid koji se oslobađa zbog konverzijom etarskih veza u metilenske veze i c) formaldehid koji se oslobađa usled hidrolitičke degradacije slabih veza u umreženoj smoli. Svi ovi faktori formiraju izvore i generišu procese za dugotrajnu emisiju FA [14]. Smanjenjem sadržaja FA u formulaciji ovakvih smola smanjuje se količina terminalnih $-CH_2OH$ grupa, koje su reaktivnije od metilenskih $-CH_2-$ grupa. S druge strane, niži molarni odnos FA/U omogućava stvaranje kristalnog okvira, koji ometa prodiranje vode u ostatak materijala, čineći reaktivne grupe manje dostupnim za hidrolizu [14]. Kristaliničnost UF smola jako zavisi od molarnog odnosa FA/U i što je on niži to će UF smola imati veći stepen kristaliničnosti. Ovakve UF smole su gotovo linearne strukture, što dovodi do niže sorpcije vode i jačih H-veza između lanaca UF smole i takođe imaju manji sadržaj metilolnih grupa.

U tabeli 1 su dati podaci za sadržaj slobodnog i oslobođenog FA u UF biokompozitima

Tabela 1. Sadržaj slobodnog i oslobođenog FA u UF biokompozitima.

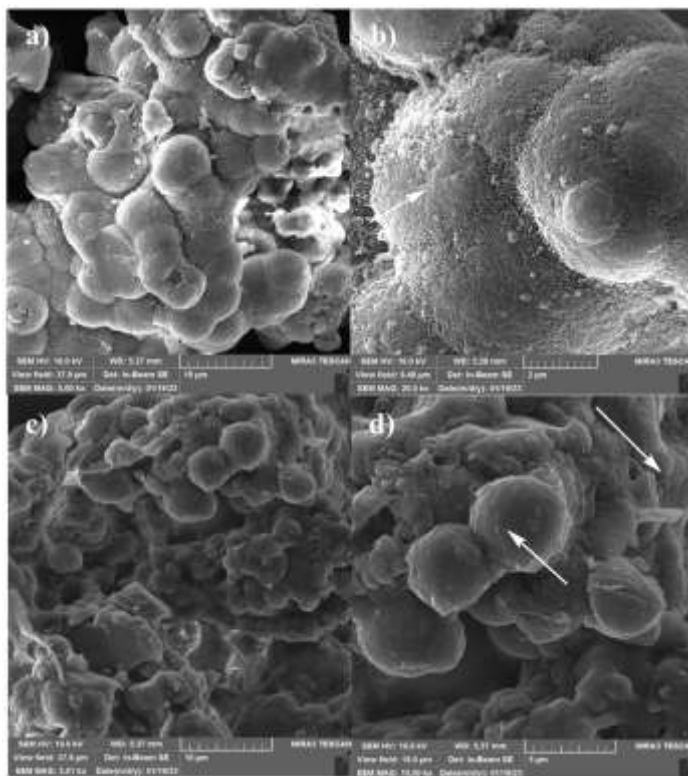
<i>Biokompozit</i>	<i>Slobodni FA (%)</i>	<i>Oslobođeni FA (%)</i>
UF/T	0.8	7.4
UF/B	0.1	3.6

Na osnovu rezultata iz tabele 1, može se videti da UF/T biokompozit ima veći sadržaj i slobodnog i oslobođenog FA u odnosu na UF/B biokompozit, što se ne bi očekivalo na osnovu njihovih struktura (slika 1b). Metilenske veze sa azotom uree su prilično podložne hidrolizi i mogu osloboditi FA usled reverzibilne reakcije metilacije, dok su veze sa fenolnom grupom stabilnije nego sa ureom. Pizzi [15] je pokazao pomoću masene spektroskopije da $-CH_2OH$ grupe UF smole reaguju sa rezorcinol A-prstenovima flavonoidnih jedinica formirajući metilenske mostove. Nizak molarni odnos FA/U tokom sinteze dovodi do formiranja UF smola koje se sastoje od linearnih molekula koji su međusobno povezani vodoničnim vezama, što dovodi do formiranja visoko uređene strukture, odnosno kristalne strukture. Ovakva vrsta strukture sprečava prodiranje tečnosti (vlage) u materijal i na taj način štiti reaktivne delove koji bi bili dostupni za hidrolizu [14, 16] što se slaže sa dobijenim rezultatima.

Slika 2 prikazuje SEM mikrografije modifikovanih UF smola. Na slici 2 se vidi da postoji veliki broj sfernih čestica, od kojih su neke grupisane u aglomerate.

Strelice na slici 2 ukazuju na lameranu strukturu UF/T biokompozita i pločastih formacija u UF/B biokompozitu. Takođe se uočava i linearni raspored u klasterima, koji se smatra izvorom višeg stepena kristalnog domena [17]. Pratt i saradnici [18] su dokazali da jake vodonične veze između molekula UF smole mogu dovesti do nerastvorljivosti, kristalnosti i globularne strukture, posebno kada je molarni odnos FA/U mali. Glavna razlika u morfologiji modifikovane UF/T i UF/B biokompozita je u izgledu površine čestica. Na površini čestice UF/T biokompozita (slika 4a) su pričvršćene mnoge primarne čestice,

tako da površina izgleda neujednačeno. Nasuprot tome, površina UF/B (Slika 4d) biokompozita je glatka i mogu se videti kristali betaina (označeni strelicom) koji su inkapsulirani u UF smoli. Ovakva morfologija verovatno potiče od same prirode biopunila. Treba imati na umu da je betain visoko kristalan a tanin ima amorfni karakter. Kada su sfere uvećane, pojavile su se višeslojne i porozne strukture na površini mikrosfera UF/T biokompozita, (slika 4b) što pogoduje povećanju specifične površine mikrosfera [19]. Slika 4d pokazuje da mikrosfere UF smole modifikovane betainom imaju glatku površinu.



Slika 2. SEM mikrografije modifikovanih UF smola: a) i b) UF/T biokompozit sa različitim uvećanjima na 5000x i 20000x; c) i d) UF/B biokompozit sa različitim uvećanjima na 5000x i 10000x.

5. ZAKLJUČAK

Sintetisana su dva modifikovana UF biokompozita sa bio-punilima: taninom i betainom sa niskim molarnim odnosom FA/U od 0,8. Modifikacija smola je izvršena *in situ* dvostepenom alkalno-kiselinskom reakcijom. Tanin i betain su prirodna organska jedinjenja i kao takvi doprinose „zelenoj“ hemiji i mogu se koristiti kao adsorbenti za zagađujuće supstance, u ovom slučaju za hvatanje FA iz umreženih modifikovanih UF smola. Na osnovu dobijenih eksperimentalnih podataka može se zaključiti sledeće:

1. Betain pokazuje bolja svojstva hvatanja slobodnog FA iz umreženog modifikovanog UF biokompozita u poređenju sa taninom jer je procenat slobodnog FA u UF/B biokompozitu 0,1%, a u UF/T biokompozitu 0,8%. Isto važi i za sadržaj oslobođenog FA nakon kisele hidrolize. U UF/B biokompozitu je utvrđen manji sadržaj oslobođenog FA u količini od 3,6%, dok je u UF/T biokompozitu oko dva puta veći i iznosi 7,4%. Hidrolitički stabilniji je UF/B biokompozit.
2. SEM mikrografije oba UF biokompozita ukazuju na postojanje sfernih čestica koje se međusobno razlikuju po svojoj površini. Morfologija UF/T biokompozita ima višeslojnu i poroznu strukturu, za razliku od morfologije UF/B biokompozita čije mikrosfere imaju glatku površinu i kristale betaina koji su inkapsulirani u UF smoli.

ZAHVALNICA

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BIO-MODIFIED UREA-FORMALDEHYDE RESINS: CONTENTS OF FREE AND LIBERATED FORMALDEHYDE

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ABSTRACT:

In this work, urea-formaldehyde (UF) resins modified with biomaterials are analyzed. In this work, betaine (modified amino acid consisting of glycine with three methyl groups) and tannin (complex biomolecules of polyphenolic nature) were used as biomaterials. Determination of free FA in modified UF resins was performed using the disulfite method. The percentage of free FA in betaine-modified UF resin is 0.1%, while the percentage of free FA in tannin-modified resin is 0.8%. The hydrolytic stability of the modified UF resins was determined by measuring the concentration of liberated FA in the modified UF resins, after acid hydrolysis. The results show that the percentage of liberated FA in UF resins modified with betaine is 3.6%. The percentage of liberated FA in tannin-modified UF resins is 7.4%.

Keywords: Betaine, Tannin, Urea-formaldehyde resin, Free and liberated formaldehyde

O TOTALNOJ INTEGRABILNOSTI

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SAŽETAK: U ovom radu, mi eksplicitno dokazujemo da neophodan i dovoljan uslov, da neka punktualna funkcija f na $[a,b]$, bude generalisano **Riman** integrabilna nad $[a,b]$, je da postoji naboj \mathfrak{S} nad $\mathfrak{I}([a,b])$, takav da diferencijalne forme $\delta\mathfrak{S}$ i δF , gde $F = \langle \mu f \rangle$ i μ je **Lebeg**-ova mera, su u osnovi zbirljivi ekvivalenti na $[a,b]$ i da $\delta\mathfrak{S}$ je totalni diferencijal na $[a,b]$. Uz sve to, \mathfrak{S} mora biti i generalisana apsolutno kontinualna (**ACG_s**) funkcija, na nultom podskupu tačaka E intervala $[a,b]$, u kojima \mathfrak{S} nije diferencijabilna. Pokazaće se da je razlika između totalne i partikularne antiderivativne na $[a,b]$, funkcije f , jednaka sumi funkcije ostataka \mathfrak{R}_{AF} , totalne antiderivativne ΔF funkcije f , na skupu E . Na kraju, sve to je ilustrovano sa par reprezentativnih primera.

Ključne riječi: osnovna zbirljivost, totalna integrabilnost

1. UVOD

U prezentovanom radu, **Definicija 10.** u [6], kojom se definiše generalisani **Riman**-ov integral punktualne funkcije f nad intervalom $[a,b]$ realne prave \mathbf{R} , biće osnova za dalju analizu, u smislu iznalaženja potrebnih i dovoljnih uslova da punktualna funkcija f bude generalisano **Riman** integrabilna nad intervalom $[a,b]$. Pokazaće se da je razlika između totalne i partikularne antiderivativne na $[a,b]$, funkcije f , jednaka sumi funkcije ostatka totalne antiderivativne ΔF , na podskupu tačaka E intervala $[a,b]$, u kojima antiderivativna ΔF nije diferencijabilna.

2. PRELIMINARNI POJMOVI

Za interval $[a,b]$ u \mathbf{R} , neka $\mathfrak{I}([a,b])$ je familija svih kompaktnih podintervala I intervala $[a,b]$ i $\mathbf{P}([a,b])$ je partitivni skup skupa $[a,b]$. Označimo $\mathbf{R}_+ = [0, +\infty)$ i $\mathbf{N} = \{1, 2, 3, 4, 5, \dots\}$. Unutrašnjost, zatvaranje i granica skupa $E \in \mathbf{P}([a,b])$ označavaju se sa $\text{int}.E$, $\text{cl}.E$ i ∂E . Funkcija $\chi_E: \mathbf{R} \rightarrow \{0, 1\}$ je karakteristična funkcija (indikator) skupa E , jednaka **1**, ako je x u skupu E , a **0** ako x nije u skupu E . Za skupovnu funkciju $L: \mathbf{P}([a,b]) \rightarrow \mathbf{R}$ se kaže da je prebrojivo aditivna, ako za svaku najviše prebrojivu familiju $\{E_n\}_{1 \leq n}$, po parovima disjunktih skupova E_n , takvih da $\bigcup_{1 \leq n} E_n \in \mathbf{P}([a,b])$, zadovoljava uslov $L(\bigcup_{1 \leq n} E_n) = \sum_{1 \leq n} L(E_n)$. Svaka prebrojivo aditivna funkcija L je spoljna mera. U teoriji mera, spoljna mera se naziva naboj. Stoga, kada kažemo naboj nad $\mathbf{P}([a,b])$, mi zapravo mislimo na prebrojivo

aditivnu skupovnu funkciju, definisunu na skupu $\mathbf{P}([a,b])$. Pozitivna mera se može smatrati preciznim pojmom "veliĉine" skupa. *Lebeg*-ovu meru u \mathbf{R} oznaĉavamo sa μ , meĊutim, za $I \in \mathbf{I}([a,b])$, ponekad pišemo ili $\Delta x(I)$ ili $|I|$, namesto μ . Nulti skup je skup *Lebeg*-ove mere nula. Za funkciju f nad $[a,b]$ se kaŹe da je nulta funkcija na $[a,b]$, ako je skup $\{x \in [a,b] \mid f(x) \neq 0\}$ nulti skup, **2.4 Definicija** u [1]. Ako je skup $\{x \in [a,b] \mid f(x) \neq 0\}$ prazan skup, onda funkcija f je nulta funkcija na $[a,b]$. Funkciju, saĉinjenju od kombinacija više skupovnih i punktualnih funkcija, povezanih elementarnim algebarskim operacijama, i/ili kompozicijom funkcija, nazivamo skupovno-punktualna funkcija. Na primer, proizvod skupovne i punktualne funkcije $\langle Lf \rangle(E,x)$ oznaĉavamo sa $W(E,x)$. Za realnu punktualnu funkciju $\delta: [a,b] \rightarrow (0,+\infty)$, nazvanu meraĉ, intervalno-punktualni par (I,x) je δ -fina, ako je $I \subset (x-\delta(x), x+\delta(x))$. Prebrojiva particija (podela) intervala $[a,b]$, koju oznaĉavamo sa $P[a,b]$, je najviše prebrojiv skup (familija) intervalno-punktualnih parova $([a_n,b_n],x_n)_{1 \leq n}$, takvih da se podintervali $[a_n,b_n]$ ne preklapaju, $x_n \in (a_n,b_n)$ i uz to $\bigcup_{1 \leq n} [a_n,b_n] = [a,b]$. Taĉke $\{x_n\}_{1 \leq n}$ su tagovi particije $P[a,b]$ [1]. Oĉigledno je da postoji više razliĉitih naĉina izbora poloŹaje tagova x_n u odnosu na podintervale $[a_n,b_n]$. Svaki od ovih izbora vodi ka jednoj od definicija generalisanog *Riman*-ovog integrala. Ako je $E \in \mathbf{P}([a,b])$, onda restrikcija $P[a,b]$ na E je najviše prebrojiv skup intervalno-punktualnih parova $([a_n,b_n],x_n)$, takvih da $x_n \in E$. U simbolima, $P[a,b]|_E = \{([a_n,b_n],x_n) \in P[a,b] \mid x_n \in E\}$. Dalje, neka h je intervalno-punktualna funkcija nad $\mathbf{I}([a,b]) \times [a,b]$ i $E \in \mathbf{P}([a,b])$. U onome što sledi, skup vrednosti i sumu vrednosti h na $P[a,b]|_E \subset P[a,b]$, oznaĉavamo sa $h(P[a,b]|_E)$ i $s(h,P[a,b]|_E)$, tako da $h(P[a,b]|_E) = \{h([a_n,b_n],x_n) \mid ([a_n,b_n],x_n) \in P[a,b]|_E\}$ i $s(h,P[a,b]|_E) = \sum_{([a_n,b_n],x_n) \in P[a,b]|_E} h([a_n,b_n],x_n)$. Jasno, relacija $|h(P[a,b]|_E)| < \varepsilon$ oznaĉava skup relacija $\{|h([a_n,b_n],x_n)| < \varepsilon \mid ([a_n,b_n],x_n) \in P[a,b]|_E\}$. Ako $\rho(x,y)$ je rastojanje dve taĉke x i y u \mathbf{R} , tada $\rho(x,E) := \inf\{\rho(x,y) \mid y \in E\}$ je udaljenost taĉke x od skupa E . Za proizvoljnu punktualnu funkciju f i intervalnu funkciju *Lebeg*-ove mere μ , F je oznaka za intervalno-punktualnu funkciju $\langle \mu f \rangle$.

Definicija 1. Za kompaktni interval $[a,b]$ u \mathbf{R} , neka $E \in \mathbf{P}([a,b])$. Tada, δ -fina particija $P[a,b]$ je potpuno tagovana u $cl.E$, ako i samo ako meraĉ $\delta > 0$ nad $[a,b]$ zadovoljava uslov $\delta(x) \leq \rho(x,\partial cl.E)$, za svako $x \in [a,b] \setminus \partial cl.E$.

U nastavku rada, ako se drugaĉije ne naglasi, a bez gubitka opštosti, skup E je zatvoren skup. Sledi definicija generalisanog *Riman*-ovog integrala punktualne funkcije f , kojom se završava rad [6], a koja je krucijalna definicija, u smislu da je osnova za dalju analizu u prezentovanom radu.

Definicija 2. Za kompaktni interval $[a,b]$ u \mathbf{R} , neka f je punktualna funkcija nad $[a,b]$. Za naboj L nad $\mathbf{I}([a,b])$, takav da njegova diferencijalna forma δL je totalni diferencijal na $[a,b]$, kaŹe se da je partikularna (*vp*) antiderivativna na $\mathbf{I}([a,b])$ punktualne funkcije f , ako i samo ako δL i δF su u osnovi zbirljivi ekvivalenti na $[a,b]$. Ovde, partikularna

integralna vrednost $vp \int_I \delta F(x)$ je generalisani **Riman**-ov integral punktualne funkcije f nad $I \in \mathcal{I}([a, b])$ i

$$vp \int_I \delta F(x) = \sigma_{\delta L}(I) = L(I). \quad (1)$$

3. GLAVNI REZULTATI

Neka naboj ΔF nad $\mathcal{I}([a, b])$, kao pridružena intervalna funkcija punktualnoj funkciji F nad kompaktnim intervalom $[a, b]$, čija diferencijalna forma δF je totalni diferencijal na $[a, b]$ (**Definicija 8.** u [6]), je diferencijabilan na intervalu $[a, b]$, do punktualne funkcije f . Tada, prema modifikovanoj **Saks-Henstok**-ovoj lemi, odnosno **Lemi 2.** u [6], iz uslova da diferencijalne forme δF i δf su u osnovi zbirljivi ekvivalenti na $[a, b]$, sledi da bilo koji podskup tačaka E intervala $[a, b]$, je u osnovi i apsolutno $\langle \delta F - \delta f \rangle$ -zanemarljiv skup.

Dve leme, koje slede, su krucijalne leme u teoriji generalisanih **Riman**-ovih integrala [4].

Lema 1. Za punktualnu funkciju f nad $[a, b]$ u \mathbb{R} , neka $E \subset (a, b)$ je skup tačaka u kojima $f \neq 0$. Skup E je zanemarljiv skup, ako i samo ako je apsolutno δF -zanemarljiv skup.

Dokaz: Neka f je punktualna funkcija nad $[a, b]$, takva da $f \neq 0$ na skupu tačaka $E \subset (a, b)$. Tada, za svako $n^* \in \mathbb{N}$, neka $En^* = \{x \in E \mid n^* - 1 \leq |f| < n^*\}$, a za svako $n \in \mathbb{N}$, neka $En = \{x \in E \mid 1/n \leq |f| < 1/(n-1)\}$. Fiksirajmo n^* i n . Usvajamo da $\varepsilon^* = \varepsilon/(2^{n^*}n^*) > 0$ i $\varepsilon' = \varepsilon/(2^n n) > 0$. Na osnovu **Arhimed**-ove osobine skupa \mathbb{R} , sledi da $E = \bigcup_{n^* \in \mathbb{N}} En^*$, kao i da $E = \bigcup_{n \in \mathbb{N}} En$. Prvo, ako E je zanemarljiv skup, onda i svaki podskup En^* skupa E je zanemarljiv skup, tako da postoji merač $\delta_\varepsilon > 0$ nad $[a, b]$, takav da

$$s(\mu, P[a, b]|_{En^*}) < \frac{\varepsilon}{2^{n^*}n^*} \text{ i } s(|F|, P[a, b]|_E) < \sum_{1 \leq n^*} n^* s(\mu, P[a, b]|_{En^*}) < \sum_{1 \leq n^*} \frac{\varepsilon}{2^{n^*}} < \varepsilon,$$

kadgod $P[a, b]|_{En^*} \subset P[a, b]|_E \subset P[a, b]$ i $P[a, b]$ je prebrojiva δ_ε -fina podela intervala $[a, b]$, potpuno tagovana u E . Stoga, $\sigma_{\delta|F|}(E) = 0$, vidi komentar **Definicije 7.** u [6]. Kao drugo, ako E je apsolutno δF -zanemarljiv skup, onda postoji merač $\delta_\varepsilon > 0$ nad $[a, b]$, takav da

$$s(|F|, P[a, b]|_{En}) < \frac{\varepsilon}{2^n n} \text{ i } s(\mu, P[a, b]|_E) \leq \sum_{1 \leq n} n s(|F|, P[a, b]|_{En}) < \sum_{1 \leq n} \frac{\varepsilon}{2^n} < \varepsilon,$$

kadgod $P[a, b]|_{En} \subset P[a, b]|_E \subset P[a, b]$ i $P[a, b]$ je prebrojiva δ_ε -fina podela intervala $[a, b]$, potpuno tagovana u E . Ovo implicira da $\sigma_{\delta\mu}(E) = 0$.

Lerma 2. . Za punktualnu funkciju f nad $[a, b]$ u \mathbf{R} , neka $[a, b]$ je kompaktni interval u \mathbf{R} i neka $E \subset (a, b)$ je apsolutno (u osnovi) δF -zanemarljiv skup. Za proizvoljni naboj L nad $I([a, b])$, skup E je apsolutno (u osnovi) δL -zanemarljiv skup, ako i samo ako skup E je apsolutno (u osnovi) $\delta(F-L)$ -zanemarljiv skup.

Dokaz **Leme 2.**, na bazi nejednakosti trougla: $\sigma_{\delta(F-L)}([a, b]) \leq \sigma_{\delta F}([a, b]) + \sigma_{\delta L}([a, b])$, odnosno $\sigma_{\delta L}([a, b]) \leq \sigma_{\delta(F-L)}([a, b]) + \sigma_{\delta F}([a, b])$, je trivijalan. Stoga, nije neophodno da u radu bude i eksplicitno naveden.

Poznato je, da neka punktualna funkcija F nad $[a, b]$, je kontinualna funkcija na $[a, b]$, ako i samo ako granična vrednost δF , njoj pridružene intervalne funkcije ΔF nad $I([a, b])$, je nula funkcija na $[a, b]$ [4]. Shodno tome, može se reći da naboj ΔF je kontinualna funkcija na skupu $P([a, b])$, ako njegova diferencijalna forma δF je nula funkcija na intervalu $[a, b]$. Budući da pojam funkcije ostatke $\mathfrak{R}_{(\Delta F-F)}$ nad $[a, b]$, je sinonim za diferencijalnu formu $\langle \delta F - \delta F \rangle$ na $[a, b]$ [6], sa jedne strane, iz nejednakosti trougla, sledi da

$$s\left(\left|\Delta F - \sigma_{\mathfrak{R}_{(\Delta F-F)}}\right|, P[a, b]\right) - s(|F|, P[a, b]) \leq s\left(\left\langle \Delta F - \sigma_{\mathfrak{R}_{(\Delta F-F)}} - F \right\rangle, P[a, b]\right), \quad (2)$$

kadgod $P[a, b]$ je prebrojiva δ_ε -fina podela intervala $[a, b]$. Sa druge strane, ako E je skup tačaka intervala (a, b) , u kojima naboj ΔF nad $I([a, b])$ nije diferencijabilan, tada prema **Definiciji 5.** u [6], ako ΔF i F su derivativni ekvivalenti na $[a, b] \setminus E$, u odnosu na naboj μ , tada funkcija ostatka $\mathfrak{R}_{(\Delta F-F)}$ je nula funkcija na $[a, b] \setminus E$ i skup $[a, b] \setminus E$ je skup regularnih tačaka funkcije $\langle \Delta F - F \rangle$, na kome je zadovoljen uslov: za svako $\varepsilon > 0$ postoji merač $\delta_\varepsilon > 0$ nad $[a, b]$, takav da

$$\begin{aligned} & s(|\Delta F|, P[a, b]_{[a, b] \setminus E}) - s(|F|, P[a, b]_{[a, b] \setminus E}) \leq \\ & \leq s\left(\left\langle \Delta F - F \right\rangle, P[a, b]_{[a, b] \setminus E}\right) < \varepsilon s(\mu, P[a, b]_{[a, b] \setminus E}), \end{aligned} \quad (3)$$

kadgod $P[a, b]_{[a, b] \setminus E} \subset P[a, b]$ i $P[a, b]$ je prebrojiva δ_ε -fina podela intervala $[a, b]$, koja je potpuno tagovana u E .

Na osnovu **Definicija 6.** i **7.** i dvostruke nejednakosti (10) u [6], ako funkcije ΔF i F su diferencijalno uporedive i nisu diferencijalni ekvivalenti, na skupu singularnih tačaka E funkcije $\langle \Delta F - F \rangle$, a funkcija ostatka $\mathfrak{R}_{(\Delta F-F)}$, koja nije nula funkcija na $[a, b]$, je u osnovi zbirljiva nad E , tada na skupu E je zadovoljen opozitni uslov: za svako $\varepsilon > 0$ postoji merač $\delta_\varepsilon > 0$ nad $[a, b]$, takav da

$$\begin{aligned} \varepsilon s(\mu, P[a, b]_E) & \leq s\left(\left|\Delta F - \sigma_{\mathfrak{R}_{(\Delta F-F)}}\right|, P[a, b]_E\right) - s(|F|, P[a, b]_E) \leq \\ & \leq s\left(\left\langle \Delta F - \sigma_{\mathfrak{R}_{(\Delta F-F)}} - F \right\rangle, P[a, b]_E\right) < \varepsilon, \end{aligned} \quad (4)$$

kadgod $P[a,b]_E \subset P[a,b]$ i $P[a,b]$ je prebrojiva δ_ε -fina podela intervala $[a,b]$, koja je potpuno tagovana u E . Iz prethodnog uslova sledi da $\lim_{\delta_\varepsilon \rightarrow 0} s(\mu, P[a,b]_E) = 0$, odnosno $\sigma_{\delta\mu}(E) = 0$, što znači da skup E mora biti nulti skup, odnosno skup *Lebeg*-ove mere nula, a funkcija ostatka $\mathfrak{R}_{(\Delta F-F)}$ nulta funkcija na intervalu $[a,b]$.

Generalno govoreći, funkcija $\mathfrak{R}_{(\Delta F-F)}$ može biti u osnovi prošireno zbirljiva nad skupom E i da ne bude definisana u svakoj tački singularnog skupa. Teorema, koja sledi, tvrdi da ako punktualna funkcija f je generalisano *Riman*-integrabilna nad intervalom $[a,b]$, tada postoji partikularna primitivna L funkcije f , takva da interval $[a,b]$ je podeljen na dva podskupa tačaka, skup regularnih tačaka $[a,b] \setminus E$, u kojima je $f = \delta_\mu L$ i skup singularnih tačaka E funkcije L , koji je apsolutno δL -zanemarljiv skup i obrnuto.

Teorema 1. Za kompaktni interval $[a,b]$ u \mathbb{R} i merljiv skup $E \subset (a,b)$, *Lebeg*-ove mere $\mu_E < (b-a)$, neka f je punktualna funkcija nad $[a,b]$ i neka L je naboj nad $\mathfrak{I}([a,b])$, takav da njegova diferencijalna forma δL je totalni diferencijal na $[a,b]$ i uz to $f = \delta_\mu L$ u tačkama skupa $[a,b] \setminus E$. Tada, naboj L je partikularna (vp) antiderivativna na $\mathfrak{I}([a,b])$ funkcije f , ako i samo ako $\mu_E = 0$ i E je apsolutno δL -zanemarljiv skup.

Dokaz: Neka L je naboj nad $\mathfrak{I}([a,b])$, čija diferencijalna forma δL je totalni diferencijal na $[a,b]$ i skup $E \subset (a,b)$, *Lebeg*-ove mere $\mu_E < (b-a)$, je takav da $f = \delta_\mu L$ u svim tačkama skupu $[a,b] \setminus E$.

Neka naboj L nad $\mathfrak{I}([a,b])$ je partikularna antiderivativna na $\mathfrak{I}([a,b])$ funkcije f . Prema **Definiciji 2.**, δL i δF su apsolutno zbirljivi ekvivalenti na intervalu $[a,b]$, a što implicira da $\sigma_{\delta(L-F)}([a,b]) = 0$. Shodno tome, iz opozitnog uslova

$$\varepsilon s(\mu, P[a,b]_E) \leq s(\langle L - F \rangle, P[a,b]_E) < \varepsilon, \quad (5)$$

sledi da $\lim_{\delta_\varepsilon \rightarrow 0} s(\mu, P[a,b]_E) = 0$, odnosno $\sigma_{\delta\mu}(E) = 0$, što znači da skup E je nulti skup, odnosno skup *Lebeg*-ove mere nula. Uz to, skup E se može podeliti na dva podskupa, od kojih jedan je skup tačaka, u kojima $f \neq 0$. Prema **Lemi 1.**, taj podskup tačaka skupa E je apsolutno δF -zanemarljiv skup, a samim tim i skup E je apsolutno δF -zanemarljiv skup. Prema **Lemi 2.**, skup E je i apsolutno δL -zanemarljiv skup.

Sada, neka skup E je zanemarljiv skup ($\mu_E = 0$) i apsolutno δL -zanemarljiv skup. Prema **Lemi 1.** i **2.**, skup E je apsolutno δF -zanemarljiv skup i apsolutno $\delta(L-F)$ -zanemarljiv skup. Stoga, sledi, iz **Definicije 2.**, da naboj L je partikularna antiderivativna na $\mathfrak{I}([a,b])$ funkcije $f \cdot \lambda$

U **Teoremi 1.**, koja je analogna takozvanoj **Fundamentalnoj teoremi integralnog** računa generalisanih **Riman**-ovih integrala [2], naboj L je partikularna (vp) antiderivativna na $I([a,b])$ funkcije f , što znači da L je partikularna antiderivativna na svakom podintervalu $I = [a,x]$ intervala $[a,b]$, odnosno da je $vp \int_I \delta F(x) = L([a,x])$, za svako $x \in (a,b)$. Dakle, ako se zahteva da je naboj L partikularna antiderivativna na intervalu $[a,b]$, trebalo bi, u **Teoremi 1.**, uslov da skup E je **apsolutno δL -zanemarljiv** skup, zameniti uslovom da E je **u osnovi δL -zanemarljiv** skup. Ako se sve ovo formalizuje u formi teoreme, rezultat te teoreme nas eksplicitno vodi do dobro poznate **Njutn-Lajbnic**-ove formule. Kako je dokaz teoreme, koja sledi, sličan dokazu **Teoreme 1.**, neće se eksplicitno prezentovati u radu.

Teorema 2. Za kompaktni interval $[a,b]$ u \mathbf{R} i merljiv skup $E \subset (a,b)$, **Lebeg**-ove mere $\mu_E < (b-a)$, neka f je **punktualna funkcija** nad $[a,b]$ i neka L je naboj nad $I([a,b])$, takav da njegova **diferencijalna forma δL** je **totalni diferencijal** na $[a,b]$ i uz to $f = \delta_\mu L$ u tačkama skupa $[a,b] \setminus E$. Tada, naboj L je **partikularna (vp) antiderivativna** na $[a,b]$ funkcije f , ako i samo ako $\mu_E = 0$ i E je **u osnovi δL -zanemarljiv** skup.

Dakle, neophodan i dovoljan uslov da **punktualna funkcija f** nad $[a,b]$, bude generalisano **Riman** integrabilna nad $[a,b]$, je da postoji naboj L nad $\mathbf{P}([a,b])$, koji je **ACG _{δ}** funkcija na skupu $\mathbf{P}([a,b])$ [6] i da **totalni diferencijali δL i δF** su u osnovu **zbirljivi ekvivalenti** na $[a,b]$. Preciznije, ako L i F su **derivativni ekvivalenti** na $[a,b] \setminus E$, gde $E \subset (a,b)$, onda oni ne samo da moraju da budu i **diferencijalni ekvivalenti** na intervalu $[a,b]$, već i njihove **diferencijalne forme** moraju da budu u osnovu **zbirljivi ekvivalenti** na $[a,b]$. Stoga, kada je $f = \delta_\mu L$, skoro svuda na $[a,b]$, nije neophodno da **totalna derivativna ΔF** funkcije f [6], bude **ACG _{δ}** funkcija na skupu $\mathbf{P}([a,b])$, kao što bi se, na prvi pogled, moglo pretpostaviti iz tvrđenja **Teoreme 9.17** u [4]. Zabuna, ako je u opšte i ima, u vezi ove teoreme, leži u činjenici da se u njoj eksplicitno ne tvrdi da je **K-H** partikularna derivativna **punktualne funkcije f** **totalna derivativna**. U dokazu i u formulaciji teoreme, naboj $L = \langle \Delta F - \sigma_{\delta(\Delta F - F)} \rangle$ nad $I([a,b])$ je upravo **K-H** partikularna derivativna funkcije f . Funkcija ostatka $\mathfrak{R}_{\langle \Delta F - L \rangle}$ je nula funkcija na $[a,b]$, za razliku od funkcije ostatka $\mathfrak{R}_{\langle \Delta F - F \rangle}$, koja je nulta funkcija na $[a,b]$, sa sumom $\sigma_{\delta L - F}(E)$, na skupu **singularnih tačaka E** , koja je jednaka razlici ovih dveju derivativnih [5]

$$vt \int_a^b \delta F(x) - vp \int_a^b \delta F(x) = \Delta F(a,b) - L(a,b) = \sigma_{\mathfrak{R}_{\langle \Delta F - F \rangle}}(E). \quad (6)$$

Shodno svemu ovome, da bi **punktualna funkcije f** bila generalisano **Riman** integrabilna nad intervalom $[a,b]$, **singularni skup E** mora biti **zanemarljiv skup** ($\mu_E = 0$), sa jedne strane, a sa druge, **diferencijalna forma δL** mora biti **nula funkcija** na intervalu $[a,b]$ i sa nultom sumom $\sigma_{\delta L}$ na skupu E , što znači da **partikularna derivativna $L = \langle \Delta F - \sigma_{\delta(\Delta F - F)} \rangle$** mora biti **ACG _{$\delta$}** funkcija na skupu $\mathbf{P}([a,b])$, [4,6].

Rezultat (6) se može formalizovati i generalizovati u formi teoreme, koja sledi, a za koju se može reći da je integralana verzija **Teoreme 1.** u [6].

Teorema 3. Za kompaktni interval $[a, b]$ u \mathbf{R} , neka f je punktualna funkcija nad $[a, b]$ i ΔF je naboj nad $\mathbf{I}([a, b])$, takav da diferencijalna forma δF je totalni diferencijal na $[a, b]$. Tada, funkcija ostatka $\mathfrak{R}_{(\Delta F - F)}$ je u osnovi zbirljiva nad intervalom $[a, b]$, ako i samo ako postoji naboj Q nad $\mathbf{I}([a, b])$, takav da diferencijalna forma δQ je totalni diferencijal na $[a, b]$ i $\langle \Delta F - Q \rangle$ je partikularna antiderivativna funkcije f na $\mathbf{I}([a, b])$, što znači da

$$vp \int_a^x \delta F(t) = \langle \Delta F - Q \rangle([a, x]), \quad (7)$$

kadgod $x \in (a, b]$ je regularna tačka funkcije $\langle \Delta F - F \rangle$. Ovde, $Q = \sigma_{\delta Q} = \sigma_{\delta(\Delta F - F)}$.

Ako funkcija ostatka $\mathfrak{R}_{(\Delta F - F)}$ je u osnovi prošireno zbirljiva na $[a, b]$ i $\sigma_{\delta(\Delta F - F)}([a, b]) = \pm \infty$, tada punktualna funkcija f nije generalisano Riman integrabilna nad $[a, b]$, $vp \int_{[a, b]} \delta F(x)$ ima beskonačnu vrednost, tako da razlika $vp \int_{[a, b]} \delta F(x) - \sigma_{\delta(\Delta F - F)}([a, b])$, kao neodređen izraz $\infty - \infty$, u ovom slučaju je totalna integralna vrednost $vt \int_{[a, b]} \delta F(x) = F(b) - F(a)$.

Kao što je rečeno u [6], kada su u pitanju funkcije, koje imaju ili konačan ili beskonačan broj diskontinuiteta u kompaktnom intervalu I , mi po pravilu usvajamo konvenciju da su te funkcije jednake 0 , u svim tačkama nultog skupa $E \subset I$, na kojem imaju beskonačnu vrednost ($\pm \infty$) ili uopšte nisu definisane. Na taj način, sve ove funkcije dobijaju proširene vrednosti sa domena $I \setminus E$ na domen I . Ako punktualna funkcija F ima definisanu i desnu i levu graničnu vrednost: $\lim_{\varepsilon \rightarrow 0^+} F(x + \varepsilon) = F(x^+)$ i $\lim_{\varepsilon \rightarrow 0^+} F(x - \varepsilon) = F(x^-)$, u svim tačkama x skupa E , funkcija F se proširuje, sa domena $I \setminus E$ na domen I , do funkcije F_c , tako da $F_c(x) = F(x^+)$, kadgod $x \in E$. U tom slučaju, ako nulta funkcija ostatka $\mathfrak{R}_{\Delta F_c}$ je u osnovi zbirljiva nad E , tada pridružena intervalna funkcija $L = \langle \Delta F_c - \sigma_{\delta F_c} \rangle$, takozvanoj “*peglananj*” punktualno-intervalnoj funkciji $\langle F_c - \sigma_{\delta F_c} \rangle$, je kontinualna, preciznije ACG_δ , funkcija na skupu $\mathbf{I}(I)$. Jasno, $L = \langle \Delta F_c - \sigma_{\delta F_c} \rangle$ je partikularna antiderivativna na intervalu I funkcije f , takve da je $f = 0$ u tačkama singularnog skupa E i $f = \delta_\mu L$ u tačkama skupa $I \setminus E$, što znači da

$$vp \int_a^x \delta F(t) = L([a, x]) = \langle \Delta F_c - \sigma_{\mathfrak{R}_{\Delta F_c}} \rangle([a, x]), \quad (8)$$

kadgod $x \in I$, a a je donja granična tačka intervala I .

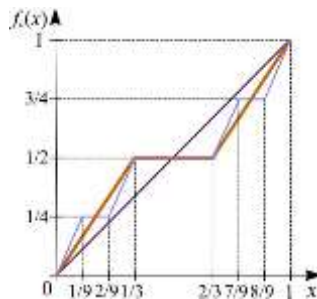
4. PRIMERI

1. Neka $C : [0, 1] \mapsto \mathbf{R}$ je *Kantor*-ova funkcija [3]. Njena derivativna c nije definisana na *Kantor*-ovom skupu tačaka $C \subset [0, 1]$.

$$C = \{x \in [0, 1] : x = \sum_{k=1}^{+\infty} \frac{\varepsilon_k}{3^k}, \text{ gde } \varepsilon_k = 0 \vee 2\} \quad 349$$

$$f_{n+1}(x) = \begin{cases} f_n(3x)/2, & \text{za } 0 \leq x \leq 1/3 \\ 1/2, & \text{za } 1/3 \leq x \leq 2/3 \\ [1 + f_n(3x-2)]/2, & \text{za } 2/3 \leq x \leq 1 \end{cases}$$

$$\square(x) = \lim_{n \rightarrow +\infty} f_n(x) = \begin{cases} \square(3x)/2, & \text{za } 0 \leq x \leq 1/3 \\ 1/2, & \text{za } 1/3 \leq x \leq 2/3 \\ [1 + \square(3x-2)]/2, & \text{za } 2/3 \leq x \leq 1 \end{cases}$$



Kako je generalisani **Riman**-ov integral derivativne c , proširene sa skupa $[0,1] \setminus C$ na skup $[0,1]$, na taj način da $c = 0$ u tačkama skupa C (c je nula funkcija na $[0,1]$), jednak nuli nad $[0,1]$, sledi iz (6) da

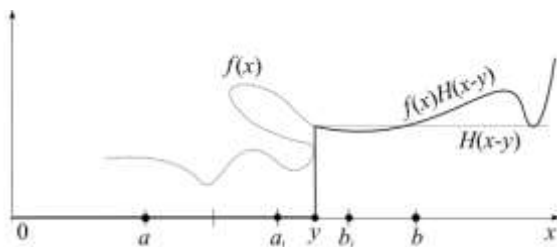
$$\sigma_{\mathfrak{R}_{\Delta}}(C) = \Delta \square([0,1]) - \nu p \int_0^1 \langle c \delta \mu \rangle(x) = 1 - 0 = 1. \quad (9)$$

Dakle, suma vrednosti funkcije ostataka $\mathfrak{R}_{\Delta C}$, **Kantor**-ove funkcije ΔC , na **Kantor**-ovom skupu C , svodi se na neodređeni izraz $\infty \cdot 0$, koji u ovom slučaju ima numeričku vrednost **1**, što znači da **Kantor**-ova funkcija ΔC nije apsolutno kontinualna funkcija i **Kantor**-ov skup C nije ΔC -zanemarljiv skup. Funkcija ostataka $\mathfrak{R}_{\Delta C}$, identički jednaka nuli na skupu $[0,1]$, s obzirom na činjenicu da **Kantor**-ova funkcija C je kontinualna funkcija na $[0,1]$, je nula funkcija na $[0,1]$, koja nema nultu sumu na **Kantor**-ovom skupu C . Pokažimo to i eksplicitno. Za **Kantor**-ovu funkciju C , totalne dužine **2** na intervalu $[0,1]$, totalna dužina svih segmenata, **Kantor**-ove funkcije C , na skupu $[0,1] \setminus C$, na kome **Kantor**-ova funkcija C ima konstantne vrednosti, je

$$\frac{1}{2} \sum_{n=1}^{+\infty} \left(\frac{2}{3}\right)^n = \frac{1}{2} \left(\frac{2}{3} \frac{3}{3-2}\right) = 1. \quad (10)$$

Stoga, suma vrednosti funkcije ostataka $\mathfrak{R}_{\Delta C}$, **Kantor**-ove funkcije ΔC , na **Kantor**-ovom skupu C , jednaka je razlici ovih dveju totalnih dužina, tako da $\sigma_{\mathfrak{R}}(C) = 2 - 1 = 1$.

2. Za kompaktni interval $I = [a,b]$, koji sadrži tačku $x = y$, totalna vrednost (νt) integrala **Dirac**-ove delta funkcije $\delta(x-y)$, koja je derivacija **Hevisajd**-ove funkcije $H(x-y)$, jednak je ostatku intervalne funkcije ΔH , pridružene funkciji H , u singularnoj tački $x = y$, budući da $\nu p \int_{[a,b]} \delta(x-y) dx = 0$. Dakle, $\nu t \int_{[a,b]} \delta(x-y) dx = \nu t \int_{[a,b]} \mathfrak{R}_{\Delta H}(x) = \sigma_{\mathfrak{R}H}([a,b]) = \mathfrak{R}_{\Delta H}(y) = 1$.



U slučaju da punktualna funkcija f nad $[a, b]$ je neprekidna funkcija na intervalu $I = [a, b]$, totalna vrednost (vt) konvolucijskog integrala $\text{vt} \int_{[a,b]} \mathfrak{R}_{\Delta}(fH)(x)$, sa jedne strane, jednaka je $\sigma_{\mathfrak{R}}(fH)([a,b]) = f(b)$, a sa druge, $\text{vt} \int_{[a,b]} \mathfrak{R}_{\Delta}(fH)(x) = \text{vt} \int_{[a,b]} f(x) \delta(x-y) dx + \text{vt} \int_{[y,b]} f'(x) dx$, odnosno $\text{vt} \int_{[a,b]} f(x) \delta(x-y) dx = f(y)$, budući da $\text{vt} \int_{[y,b]} f'(x) dx = f(b) - f(y)$.

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ON TOTAL INTEGRABILITY

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ABSTRACT: In this paper, we explicitly prove that a necessary and sufficient condition for some point function f on $[a, b]$, to be generalized **Riemann** integrable over $[a, b]$, is that there is a charge \mathfrak{F} on $\mathfrak{l}([a, b])$, such that the differential forms $\delta\mathfrak{F}$ and δF , where $F = \langle \mu f \rangle$ and μ is the **Lebesgue** measure, are basically summable equivalents on $[a, b]$ and that $\delta\mathfrak{F}$ is the total differential on $[a, b]$. In addition, \mathfrak{F} must be the generalized absolutely continuous (ACG_δ) function on the null subset of points E of the interval $[a, b]$, in which the charge \mathfrak{F} is not differentiable. It will be shown that the difference between the total and particular antiderivative on $[a, b]$, is equal to the sum of the residue function $\mathfrak{R}_{\Delta F}$ of the total antiderivative ΔF of the function f on the set E . Finally, all of this is illustrated by a couple of representative examples.

Keywords: basic summability, total integrability

LUMINESCENT PROPERTIES OF PRASEODYMIUM-DOPED PHOSPHATE TUNGSTEN BRONZE

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ABSTRACT:

Nowadays phosphate tungsten bronzes (PWBs) attract a lot of attention due to their interesting chemical, mechanical, and optical features. Moreover, tungsten bronzes as inert inorganic solids, with incorporated rare-earth ions in their structure, show interesting and useful electronic properties. Praseodymium doped phosphate tungsten bronze (Pr-PWB) is obtained in the process of phase transformations of $\text{PrPW}_{12}\text{O}_{40} \cdot 6\text{H}_2\text{O}$ (Pr-PWA) salt. The green crystals of Pr-PWB are formed after the heating of Pr-PWA in a furnace, in a temperature range from room temperature to 650 °C. In the present paper the fluorescent properties are analyzed of Pr-PWB, its precursor – 12-tungstophosphoric heteropoly acid, $\text{H}_3\text{PW}_{12}\text{O}_{40} \cdot 29\text{H}_2\text{O}$ (PWA) with Keggin's anion structure, as well as the intermediate – Pr-PWA salt. The luminescent properties were characterized and the obtained results showed that both samples emit in the deep blue region, indicating their potential use as a blue emitting source for white light LED's.

Keywords: phosphate tungsten bronzes, praseodymium, luminescent properties

1. INTRODUCTION

Keggin-type heteropolyacids (HPAs) with the general formula $\text{H}_{(8-x)}\text{XM}_{12}\text{O}_{40} \cdot n\text{H}_2\text{O}$ ($\text{X}^{x+}=\text{P}^{5+}, \text{Si}^{4+}, \text{As}^{5+}, \text{Ge}^{4+}, \text{Ce}^{4+}, \text{Th}^{4+}$, where x is the oxidation number of X, M=Mo, W, V, Nb and n=6-31), have been of interest in basic and applied science for more than a century because of their high protonic conductivity at room temperature [1-3]. As shown by our previously conducted studies of 12-tungstophosphoric praseodymium salt 6-

hydrate at high temperature, this heteropoly compound could be used as a precursor for the synthesis of praseodymium doped phosphate tungsten bronze (Pr-PWB) [4-7]. Phosphate tungsten bronzes (PWBs) continue to attract considerable attention, due to their interesting chemical, mechanical, electrical, and optical properties. As inert inorganic solids with alkali, alkaline earth, or rare earth ions incorporated into their structure, PWBs exhibit particularly interesting and useful electronic and magnetic features [8]. The structure of PWBs can be described as a ReO_3 -like structure, divided by slices of phosphate (PO_4) or diphosphate (P_2O_7) groups and a collection of WO_6 units repeated along three bearings by common corners [9-11]. This type of structure allows the formation of cavities into which various ions can be inserted. The incorporation of small cations such as Li^+ and Na^+ leads to the formation of perovskite-type and tetragonal-type PWBs, while the incorporation of larger cations such as K^+ , Rb^+ , Cs^+ leads to the formation of hexagonal-type PWBs [11]. A further subdivision of PWBs can be made by substituting WO_6 units into ReO_3 structures: monophosphate tungsten bronzes with pentagonal channels, in which one WO_6 octahedron is replaced by a PO_4 tetrahedron, and diphosphate tungsten bronzes with hexagonal channels, in which two adjacent WO_6 octahedra are replaced by a P_2O_7 group consisting of two PO_4 tetrahedra with a common O atom [9]. This work deals with monophosphate tungsten bronze doped with praseodymium ions, which belong to the rare earth group. In this work, the luminescence properties of praseodymium doped PWB (Pr-PWB), its precursor-12-tungstophosphoric heteropoly acid, $\text{H}_3\text{PW}_{12}\text{O}_{40}\cdot 29\text{H}_2\text{O}$ (29-PWA), and the intermediate - Pr-6-PWA salt, are analyzed to obtain more information about their behavior and possible practical applications.

2. EXPERIMENTAL

2.1. Synthesis of HPA hydrate $\text{H}_3\text{PW}_{12}\text{O}_{40}\cdot 6\text{H}_2\text{O}$ (6-PWA)

The HPA 29-hydrate solution (29-PWA) was prepared by mixing the aqueous $\text{Na}_2\text{WO}_4\cdot 2\text{H}_2\text{O}$ solution, prepared by dissolving 100 g $\text{Na}_2\text{WO}_4\cdot 2\text{H}_2\text{O}$ (Carl Roth, Germany) in 100 mL distilled water with the H_3PO_4 -HCl mixture, prepared by mixing 10 mL 85% H_3PO_4 (Merck, Germany) with 80 mL 35% HCl (Merck, Germany). The precipitate was then extracted with 40 mL of 35% HCl and 70 mL of ether (Merck, Germany) at room temperature [12]. HPA 6-hydrate was obtained by the dehydration method by heating 29-PWA in an oven at 80 °C [4]. Subsequently, 6-PWA was used as a starting material for the synthesis of doped PWB.

2.2. Synthesis of Pr-PWA and Pr-PWB

Pr-PWA was prepared by mixing the aqueous solution of 6-PWA, prepared by dissolving 8 g of 6-PWA in distilled water, with an aqueous $\text{PrCl}_3\cdot \text{H}_2\text{O}$ solution, prepared by dissolving 0.7102 g of $\text{PrCl}_3\cdot \text{H}_2\text{O}$ (Acros Organics, Belgium) in distilled water. The obtained solution was slightly heated and left overnight at room temperature to complete the crystallization process. Subsequently, the synthesized Pr-PWA salt was heated in a

furnace in a temperature range from room temperature to 650 °C (at 10 °C min⁻¹), and greenish crystals of Pr-PWB were formed.

2.3. Luminescence measurements

Luminescence measurements were performed using an Edinburgh Instruments FLSP920 UV-Vis-NIR spectrometer. A 450W Xe lamp was used as a stationary excitation source. Time-resolved measurements were recorded using a 60 W Xe lamp at a frequency of 100 Hz. A Hamamatsu R928P photomultiplier tube was used to record the emission signal in the visible region. All luminescence measurements were recorded at room temperature. Powders were sandwiched between quartz plates (Starna cells for powder samples, type 20/C/Q/0.2). The time-resolved measurements were fitted with a monoexponential function.

3. RESULTS AND DISCUSSION

The photoluminescence properties of PWA, PWB, Pr-PWA and Pr-PWB have shown only the phosphorescence of the matrix PWA and PWB, while the dopant Pr³⁺ has no significant effect on the change of emission spectra with characteristic emission for this ion. When excited in one of the W=O charge transfer bands, the emission of Pr³⁺ was not observed, which can be attributed to a low doping fraction of this lanthanide ion or to its inability to integrate into the PWA and PWB matrix, making it impossible to excite the lanthanide ion. These results may be due to the different synthetic route of the PWA precursors and PWB, which are synthesized in a slightly different way compared to the Keggin-type single-crystalline polyoxometallates (POMs), which may affect the polycrystalline structure in which the lanthanide ions may be coordinated differently while shifting the charge transfer band. The matrix itself exhibits fluorescence properties with broadband emission in the range of 400 to 500 nm. The matrix doped with Pr³⁺ does not show the characteristic emission peaks of the Pr³⁺ ion emission spectrum. The decay dynamics of the matrices and the matrices doped with praseodymium ions showed no differences, suggesting that there is no energy transfer from the matrix to the Pr³⁺ ions. The results of the lifetime measurements of pure matrices and doped samples are shown in Table 1 and Fig. 1.

Table 1. The results of lifetime measurements of pure matrixes and doped samples

<i>Sample</i>	τ_1 (μ s)	R^2
PWA	2.91	0.9938
Pr-PWA	3.29	0.9834
PWB	2.66	0.9860
Pr-PWB	2.70	0.9842

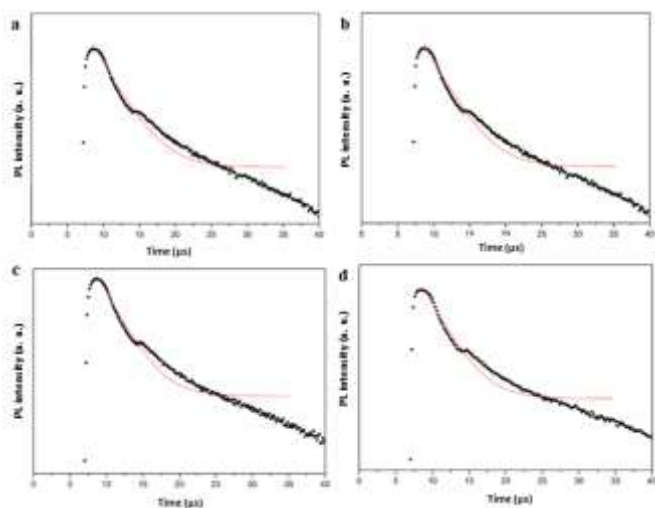


Fig. 1. Decay profiles of: **a** PWA excited at 320 nm, **b** Pr-PWA, **c** PWB, and **d** Pr-PWB excited at 376 nm and measured at room temperature

The CIE chromaticity diagrams have shown that all samples emit in deep blue region which can exhibit potential use as blue emitting source for white light LEDs (presented in Fig. 2).

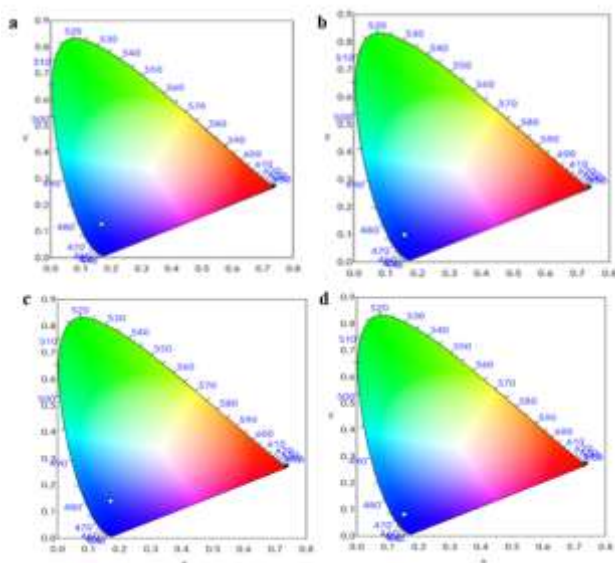


Fig. 2. The CIE chromaticity diagrams of: **a** PWA ($x=0.167$, $y=0.127$), **b** Pr-PWA ($x=0.158$, $y=0.099$), **c** PWB, and **d** Pr-PWB excited at 376 nm

3. CONCLUSION

In the present work, Pr-PWB is obtained by thermal conversion of Pr-PWA starting from 12-tungstophosphoric heteropolyacid as precursor. Praseodymium, a lanthanide ion belonging to the group of rare earth metals, was used for the first time, as a dopant for PWB. The green crystals of Pr-PWB form after heating Pr-PWA in a furnace, in a temperature range from room temperature to 650 °C. In this work, the luminescence properties of all undoped and doped samples were analyzed: PWA, Pr-PWA, PWB and Pr-PWA. The results obtained show that all samples emit in the deep blue range, which may represent a potential use as a source of blue emission for white light LEDs.

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SYNTHESIS, CHARACTERIZATION AND HSA/DNA INTERACTIONS OF NEW $[Rh_2(CH_3COO)_4L_2]$ COMPLEX

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ABSTRACT:

In this report, we have synthesized a complex of $[Rh_2(CH_3COO)_4(H_2O)_2]$ and 1-butylimidazole ligand (L). To a solution of $[Rh_2(CH_3COO)_4(H_2O)_2]$ (0.0478 g, 0.10 mmol) in toluene (10 mL) the 1-butylimidazole ligand (L) (0.0290 mL, 0.22 mmol) was added. The resulting mixture was stirred at room temperature for 1 hour until the reagents were completely dissolved. The solution was left at room temperature to evaporate slowly to a volume of 6 to 7 mL and then stored overnight in the refrigerator. The precipitated purple crystals were filtered off under vacuum and washed with diethyl ether. Characterization of the synthesized complex $[Rh_2(CH_3COO)_4L_2]$ was carried out by elemental microanalysis, IR, NMR and by determination of the melting point. The interactions of the new complex with molecules of human serum albumin (HSA) and calf thymus DNA (CT-DNA) were studied by fluorescence spectroscopy as well as by docking experiments on the mentioned molecules. The high value of the binding constant, K_b , and the Stern-Volmer quenching constant, K_{SV} , are the result of good binding of the complex to HSA and CT-DNA.

Keywords: rhodium(II), metal complex, CT-DNA interactions, HSA interactions, docking experiment

1. INTRODUCTION

The success of cisplatin as an antitumor agent has encouraged many research groups worldwide to direct their efforts toward the synthesis of other clinically important metal complexes [1-4]. Indeed, besides its advantages in cancer treatment, cisplatin also shows resistance and some toxic effects after long-term use, such as cardiotoxicity, neurotoxicity, nephrotoxicity, etc. [5,6]. Due to these side effects, the efforts of many scientists are focused on the synthesis of new platinum complexes with improved properties [7]. An ideal anticancer drug must be able to destroy tumor cells while leaving adjacent healthy tissue unharmed. Great attention is paid to platinum group metals, i.e., their complexes, including rhodium complexes. The electronic configurations of the ions of rhodium(I), rhodium(II), and rhodium(III) (d^8 , d^7 , and d^6 , respectively) suggest that they are

isoelectronic with the ions of ruthenium(II), platinum(II), and platinum(IV), whose complexes exhibit significant antitumor activity [8,9]. The dinuclear complexes of rhodium(II) have been studied in detail, and their physicochemical properties and reactivity are such that they are among the most promising antitumor complexes [10-17]. The subject of this work was the synthesis and characterization of a new dinuclear rhodium(II) complex of formula $[\text{Rh}_2(\text{CH}_3\text{COO})_4\text{L}_2]$, where L = 1-butylimidazole (Fig. 1.). In addition, fluorescence spectroscopy was used to investigate the structural changes in the HSA molecule caused by the addition of the complex, and the binding constant and the number of binding sites were determined simultaneously. The ability of the complex to displace ethidium bromide from the EB-DNA system was tested using the same method.

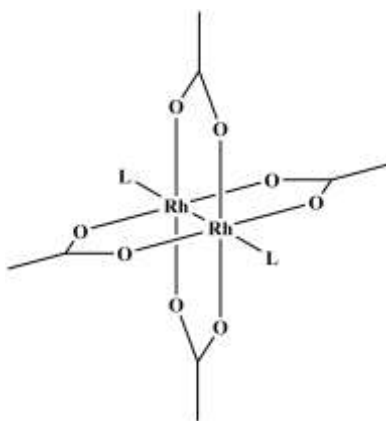


Fig.1. The structural formula of the investigated complex

2. EXPERIMENTAL

2.1. Materials and physical measurements

1-Butylimidazole, toluene, CH_3OH , CDCl_3 , human serum albumin (HSA), highly polymerized calf thymus DNA (CT-DNA), phosphate-buffered saline (PBS) and ethidium bromide were purchased from Sigma-Aldrich, and used as received. $[\text{Rh}_2(\text{CH}_3\text{COO})_4(\text{H}_2\text{O})_2]$ was purchased from Acros Organics and used as received.

Elemental microanalyses for C, H, N were performed in the Microanalytical laboratory, of the Faculty of Chemistry, University of Belgrade, Serbia. IR spectra in the range $400\text{--}4000\text{ cm}^{-1}$ were recorded on a Perkin Elmer FT-IR spectrophotometer Spectrum Two, using the KBr pellet technique. ^1H and ^{13}C NMR spectra were recorded using a Varian Gemini 2000 spectrometer (200 MHz). Chemical shifts are reported as δ values (ppm) relative to TMS as an internal standard. Fluorescence spectra were performed using a RF-

1501 PC spectrofluorometer (Shimadzu, Japan). Melting point was measured on the Stuart melter with an accuracy of ± 1 °C.

2.2. Synthesis of the complex

The $[\text{Rh}_2(\text{CH}_3\text{COO})_4\text{L}_2]$ was synthesized following by the method described elsewhere [18]. To a solution of $[\text{Rh}_2(\text{CH}_3\text{COO})_4(\text{H}_2\text{O})_2]$ (0.0478 g, 0.10 mmol) in toluene (10 mL) the 1-butylimidazole ligand (L) (0.0290 mL, 0.22 mmol) was added. The resulting mixture was stirred at room temperature for 1 hour until the reagents were completely dissolved. The solution was left at room temperature to evaporate slowly to a volume of 6 to 7 mL and then stored overnight in the refrigerator. The precipitated purple crystals were filtered off under vacuum and washed with diethyl ether (45 mg, 65%). Anal. Calcd. for $(\text{C}_{22}\text{H}_{36}\text{O}_8\text{N}_4\text{Rh}_2)$ C: 38.28; H: 5.26; N: 8.12. Found: C: 38.20; H: 5.23; N: 18.48.

^1H NMR (200 MHz, CDCl_3): δ = 8.41 (m, Ar-CH, 2H), 7.91 (m, Ar-CH, 2H), 7.25 (m, Ar-CH, 2H), 4.15 (t, N-CH₂-, 4H), 1.94 (m, -CH₂-, 15H), 1.91 (s, CCH₃, 12H), 1.50 (m, -CH₂-, 20H), 1.02 (t, -CH₃, 5H). ^{13}C NMR (50 MHz, CDCl_3): 191.80 (COO⁻), 138.21 (Ar-CH), 129.99 (Ar-CH), 119.29 (Ar-CH), 47.57 (N-CH₂), 33.05 (-CH₂-), 23.91 (-CH₂-), 20.03 (C-CH₃), 13.66 (-CH₃). IR(KBr, 4000-400 cm⁻¹): 1597 ($\nu_{\text{as}}\text{COO}^-$), 1518 ($\nu_{\text{as}}\text{COO}^-$), 1426 ($\nu_{\text{s}}\text{COO}^-$), 1410 ($\nu_{\text{s}}\text{COO}^-$). Melting point: 203 °C.

2.3. Interactions of the complex with HSA and DNA by fluorescence spectroscopy

Double distilled water was used to prepare all solutions. The solutions of HSA and EB were prepared by dissolving in a phosphate buffer (PBS, 5×10^{-2} mol dm⁻³, pH 7.4). The stock solution of CT-DNA was prepared in 5×10^{-2} M PBS buffer (pH 7.24), stored in the dark at 4 °C, and used within four days. The purity of DNA was checked by monitoring the ratio of absorbance at 260 nm to that at 280 nm. The solution gave a ratio of 1.8-1.9 at A₂₆₀/A₂₈₀, indicating that the DNA was sufficiently free of proteins [19]. The concentration of CT-DNA in the stock solution was determined by UV absorbance at 260 nm using a molar absorption coefficient ($\epsilon_{260} = 6600 \text{ M}^{-1} \text{ cm}^{-1}$) [20].

2.3.1. HSA binding experiments

For all experiments, the complex was dissolved in PBS buffer at room temperature. Fluorescence spectra were measured to investigate the structural changes in HSA caused by the addition of the complex and to determine the binding constant (K) and the number of binding sites (n) for the compound formed between the complex and HSA. The HSA concentration was fixed at 2.0 μM and the concentration of the compound was varied from 0 to 50.0 μM . Fluorescence quenching spectra were measured at an excitation wavelength of 295 nm between 310 and 460 nm. The fluorescence quenching is described by the Stern-Volmer equation [21]:

$$\frac{F_0}{F} = 1 + K_q \tau_0 [\text{complex}] = 1 + K_{sv} [\text{complex}] \quad (1)$$

where F_0 is the emission intensity in the absence of the compound, F is the emission intensity in the presence of the compound, K_{sv} is the Stern-Volmer quenching constant, k_q is the bimolecular quenching constant, τ_0 (10^{-8} s) is the lifetime of the fluorophore in the absence of the quencher, and $[\text{complex}]$ is the concentration of the compound. The K_{sv} value is determined as the slope from the plot of F_0/F versus $[\text{complex}]$. The binding constant (K) and binding stoichiometry (n) of the HSA compound system can be estimated from the following equation (2) [21] using the fluorescence intensity data:

$$\log \frac{F_0 - F}{F} = \log K + n \log [Q] \quad (2)$$

The values of K and n were obtained from the intercept and slope of the plots of $\log (F_0 - F)/F$ versus $\log [Q]$.

2.3.2. DNA binding experiments

EB competition studies of the complex were performed using fluorescence emission spectroscopy. To study the interactions of the rhodium(II) complex with DNA-EB and the possibility of displacement of EB, solutions were prepared with the same equilibrium concentration of EB/DNA (0.0241 mM) and different equilibrium concentrations of the complexes (between 0.023 and 0.162 mM). DNA-EB Solutions were prepared by mixing 31 μL CT DNA (concentration 1.95 mM) and 61 μL EB (concentration 1 mM) in PBS buffer (pH = 7.4). The excitation wavelength was 527 nm, while the emission range was 550-750 nm. The Stern-Volmer constant K_{sv} is described by the Stern-Volmer relationship (equation (1)), similar to that described above for HSA binding studies.

2.4. Docking experiment

Structure of rhodium(II) complex for docking experiments was prepared using Amsterdam density functional (ADF) program [22] to obtain optimized geometry and atomic partial charges. Starting geometry was taken from x-ray structure that was optimized using unrestricted B3LYP [23] functional with Slater type TZP basis set. The calculations were done with conductor-like screening model (COSMO) [24], with water as a solvent. Target structure of HSA was obtained from RCSB protein data bank site [25] with code 1HK1. Docking experiment and target molecule were prepared using AutoDockTools. Docking processes were run using AutoDock 4.2 [26] with extended parameter library for Rh atoms. A total of 10 Lamarckian hybrid genetic algorithm-local search runs and maximum of 2.5×10^7 energy evaluations per run were performed.

3. RESULTS AND DISCUSSION

In this work, we synthesised a new dinuclear rhodium(II) complex with the formula $[\text{Rh}_2(\text{CH}_3\text{COO})_4\text{L}_2]$, where $\text{L} = 1\text{-butylimidazole}$ (Fig. 2). The complex was obtained in

good yield as a purple crystals and is stable both in the solid state and in solution in air. It is soluble in methanol, ethanol, DMSO, DMF, slightly soluble in acetone and acetonitrile and insoluble in diethyl ether and water. The IR and NMR spectra are consistent with the complex structure.

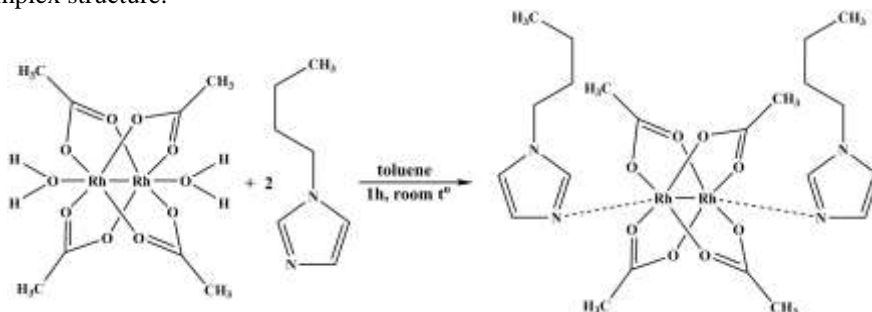


Fig. 2. Synthesis of a dinuclear rhodium(II) complex

3.1. Interaction of the complex with HSA

It is known that the most important task of serum albumin is the transport of metal ions and metal complexes and other biologically active compounds in the blood. To study the structural changes in HSA caused by the addition of ligands or complexes and to determine the quenching constants (k_q), binding constant (K), and number of binding sites (n) for the complex formed between the rhodium(II) complex and HSA, fluorescence spectra were measured. HSA solutions exhibit strong fluorescence emission with a peak at about 350 nm, which is due to the tryptophan residues when excited at 295 nm [27]. The fluorescence spectra of HSA with different concentrations of the new rhodium(II) complex were recorded and are shown in Figure 3.

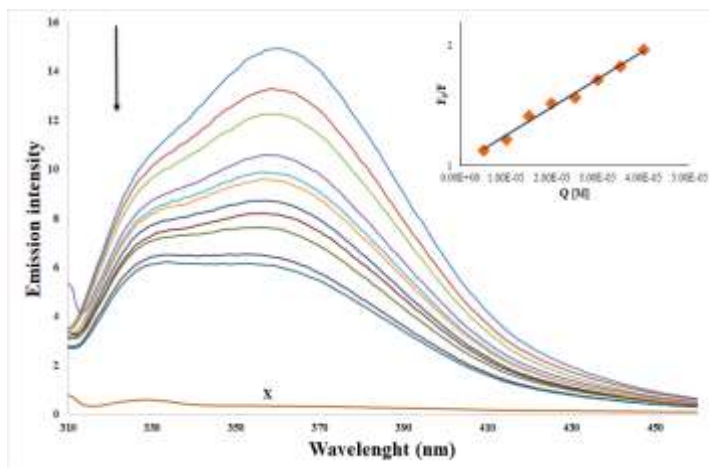


Fig. 3. Fluorescence emission spectra of HSA in the presence of different concentrations of the complex ($T = 298 \text{ K}$, $\text{pH} = 7.4$). $[\text{HSA}] = 2.0 \text{ } \mu\text{M}$. $[\text{Complex}] = 0\text{-}50 \text{ } \mu\text{M}$. Curve x shows the emission spectrum of the complex only. The arrow shows the change in intensity as the complex concentration is increased. Inset: plot of F_0/F versus $[\text{complex}]$.

The K_{SV} and quenching constants (k_q) of the interactions of the complex with albumin were calculated using the Stern-Volmer quenching equation (Eq. (1)) (Table 1), where the fluorescence lifetime of tryptophan in HSA was assumed to be $\tau_0 = 10^{-8} \text{ s}$. As can be seen from Table 1, the quenching constants ($>10^{12} \text{ M}^{-1} \text{ s}^{-1}$) are higher than the different quenching types for biopolymer fluorescence ($10^{10} \text{ M}^{-1} \text{ s}^{-1}$), indicating that a new conjugate was formed between the complex and HSA and that the interaction of the complex with albumins occurs by a static quenching mechanism. Using the equation (Eq. (1)), the values of K (association binding constant) and n (number of binding sites per albumin) for the complex were determined from the intercept and slope of the plots of $\log (F_0 - F)/F$ versus $\log [Q]$. The values for the binding constant K and for n are given in Table 1. The calculated value for n is one, indicating the presence of only one binding site in HSA.

Table 1. The binding constants and parameters (K_{sv} , k_q , K_b , n) derived for complex

biomolecule	$K_{SV} (\text{M}^{-1})$	$k_q (\text{M}^{-1} \text{ s}^{-1})$	R^{2a}	$K_b (\text{M}^{-1})$	n	R^{2a}
HSA	2.35×10^4	2.35×10^{12}	0.9891	1.79×10^4	1.02	0.9900
DNA	7.51×10^4	7.51×10^{12}	0.9964	5.49×10^3	0.97	0.9971

^a R is the correlation coefficient

3.2. Interaction of the complex with DNA

Determination of the interactions between the small molecules and DNA is important in pharmacology when evaluating the potential of new antitumor complexes [28], and therefore the interactions between the DNA and the synthesized complexes must be studied. The mode and strength of binding of the synthesized complex with rhodium(II) to CT-DNA were studied by fluorescence spectroscopic methods.

To investigate the ability of the complex to displace EB from the EB-DNA complex, competitive EB binding studies were performed with fluorescence measurements. The compounds competing with EB for intercalation with DNA result in displacement of the bound EB, causing a decrease in fluorescence intensity. EB is a typical indicator of intercalation because it forms soluble complexes with nucleic acids and emits intense fluorescence in the presence of CT DNA [29]. The emission spectra of EB bound to CT DNA in the presence of complex were recorded and are shown in Fig. 4.

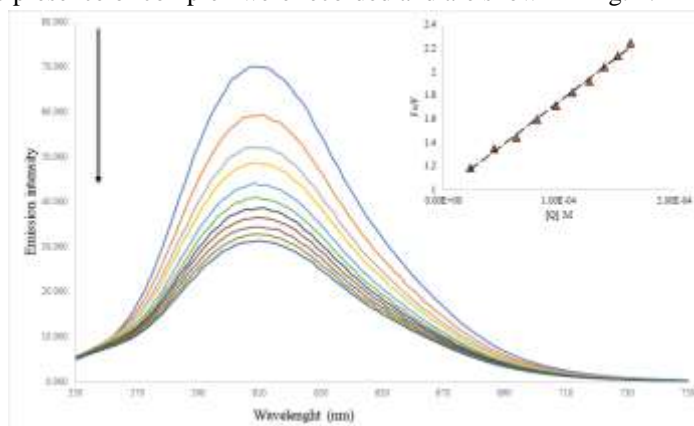


Fig. 4. Fluorescence emission spectra ($\lambda_{\text{ex}} = 520 \text{ nm}$) of ethidium bromide bound to DNA. $[\text{DNA}] = 24.1 \text{ } \mu\text{M}$, $[\text{EB}] = 24.1 \text{ } \mu\text{M}$, and $[\text{compound}] = 0\text{--}162 \text{ } \mu\text{M}$. The arrow shows the change in emission intensity with increasing complex concentration. Inset: plot of F_0/F versus $[\text{compound}]$.

The fluorescence intensity of EB bound to DNA at 613 nm shows a decreasing trend with increasing concentration of compound. The k_q values reported in Table 1 were greater than $10^{10} \text{ M}^{-1} \text{ s}^{-1}$, indicating that the quenching mechanism is a static quenching process due to the formation of the CT DNA-EB complex.

3.3. Docking

Docking experiments complement *in vitro* studies of interactions by providing means to calculate energy of binding between studied compound and target molecules and allowing visualization for study of different binding modes.

After screening solvent accessible surface of HSA it was determined that best binding pocket for our Rh(II) complex was in vicinity of TRP214. Actual binding mode derived from experiment does not include interaction with that residue. Insetead, acetate oxygen atoms act as electron donors for hydrogen bonds with ARG218 and ARG222 residues. Alyphatic butyl chains interact with hydrophobic parts of LYS444 and PRO447 on one side and LYS195 and PHE157 on the other side of the molecule. These, and other important interactions are shown in Figure 5. Energy of binding was $-3.23 \text{ kcal mol}^{-1}$.

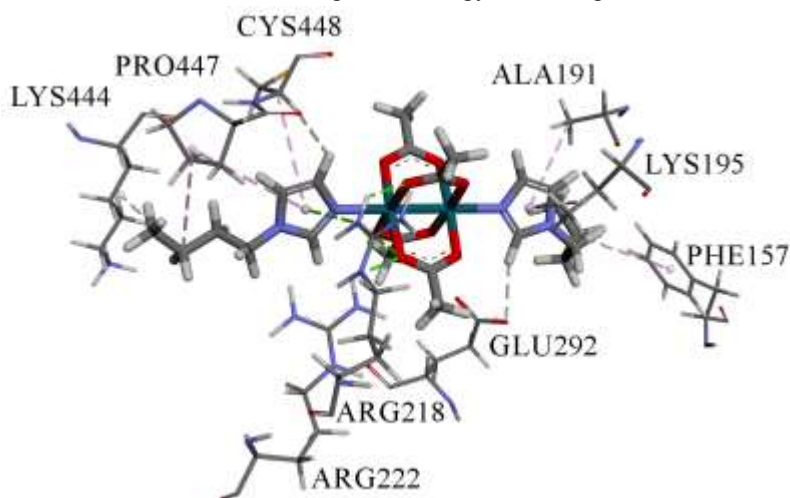


Fig. 5. Crucial interactions of Rh(II) complex with residues of HSA derived from docking experiment.

3. CONCLUSION

In the frame of this work, we have described the synthesis and characterization of a new dinuclear Rh(II) complex, $[\text{Rh}_2(\text{CH}_3\text{COO})_4\text{L}_2]$, ($\text{L} = 1\text{-butylimidazole}$). The results of elemental microanalysis, melting point as well as IR and NMR spectra are in agreement with the proposed structure of the complex. The complex showed moderate binding ability for CT DNA with $K_b = 5.49 \times 10^3$. The fluorescence intensity of EB bound to DNA at 613 nm showed a decreasing trend with increasing concentration of the compound. This may

indicate that the complex can replace EB from EB-DNA and interact with CT-DNA via intercalation. The results of the complex-HSA interaction study showed good binding of the complex to protein, which means that this complex could be transported by the bloodstream via protein to the target cells. Docking study showed that the aliphatic butyl chains interact with hydrophobic parts of LYS444 and PRO447 on one side and LYS195 and PHE157 on the other side of the HSA.

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COSMIC RAY FLUX-APPLICATIONS AND MEASUREMENTS

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ABSTRACT:

It has been well known for more than half a century that solar activities have a strong influence on cosmic ray flux reaching to the Earth. Since most of the cosmic ray showers are occurring between the upper troposphere and lower stratosphere, simultaneous cosmic ray flux measurement at the Earth surface around the world could help to determine the dynamical changes of the air density in this region at global scale in real time. An interdisciplinary team of faculty at Georgia State University and University of Montenegro among others, is developing a novel tool for studying climate science on a global scale. The long-term goal of this project is to construct and deploy a network of detectors in participating institutions around the world. The data from this detector network will be used to characterize and forecast space and earth weather in real-time.

Keywords: cosmic ray flux, detectors, muon, terrestrial and space weather, climate studies

1. INTRODUCTION

Climate change is associated with widespread changes in weather patterns, especially over the past 50 years. Scientific studies indicate that extreme weather events such as heat waves and large storms are likely to become more frequent or more intense which can significantly affect public health, agriculture, water supplies, energy production, land use and development, and recreation worldwide [1]. The climate system consists of the atmosphere, land, oceans, cryosphere, and biosphere which is a complex and highly coupled environment. Climate models are used for a variety of purposes from studying the dynamics of the weather and climate system to providing projections for future climate. However, the spatial and temporal uncertainties of climate models are large, and prediction and prevention of extreme events is still out of reach [2]. Therefore, a multidisciplinary approach is needed to solve these problems and make progress in climate science.

The main topics of this article include the study of climate change in connection to the dynamical properties of the earth atmosphere and activity of our nearest star, the Sun. The relationships between the solar activity and the terrestrial environment (also known as “space weather”) are non-trivial and include many interacting factors. The Sun modulates the Earth’s climate on the timescales of tens and hundreds of years [3, 4, 5]. The 11-year solar cycle [6] and solar transient events such as the Coronal Mass Ejections (CMEs) and

Solar Energetic Particle (SEP) events may be also reflected in sensing the terrestrial weather [7, 8]. The influence of galactic cosmic rays (GCRs) is also significant. Therefore, understanding, analyzing, and predicting space weather becomes important for the climate study [9, 10, 11, 12, 13].

An interdisciplinary team of faculty at Georgia State University is developing a novel tool for studying climate science on a global scale. The long-term goal of this project is to construct and deploy a network of detectors in participating institutions around the world and build a foundation to develop as a Center on Cosmic Ray Climate Science. University of Montenegro is one of the participants in this project.

2. THE GALACTIC COSMIC RAYS

Cosmic rays were discovered in 1912 by Austrian physicist Victor Hess who in 1936 was awarded the Nobel Prize in Physics for his discovery. The term “rays” does not mean that this radiation has purely electromagnetic nature, as sunlight, radio waves or X-rays. This term was introduced after the discovery of the phenomenon of cosmic rays whose nature was not known at that time. Later, however, it became clear that the main component of cosmic rays is related to energetic particles, mostly protons.

The galactic cosmic rays are high energy particles originating outside the solar system. The main source of GCRs in the Galaxy is believed to be explosions of supernova. The GCRs intensity reflect solar activity. The larger solar activity, the stronger the shielding, and the lower the cosmic ray intensity penetrating into the atmosphere. There is therefore an inverse relationship between solar activity and the incidence of GCRs. The solar wind (a stream of charged particles which continuously flows from the Sun into the interplanetary space) and the solar magnetic field provide protection for the Earth from these rays, Figure 1.

In the atmosphere cosmic rays interact with nitrogen and oxygen, producing cosmogenic radionuclides such as ^{10}Be and ^{14}C , so that measuring amounts of ^{10}Be and ^{14}C stored in terrestrial reservoirs provides a means to reconstruct the history of solar activity over millennia [9]. These data are known as solar proxy. They can be stored in the ice cores and tree rings. The ^{14}C data have been obtained from tree cores in many parts of the world, but the ^{10}Be data are from only two ice cores, one from Antarctica and another from Greenland.

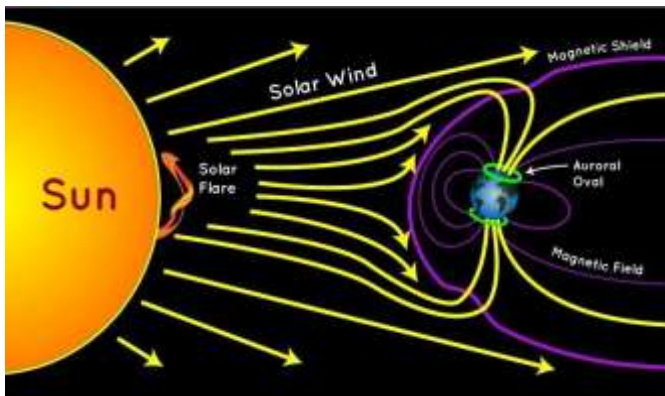


Figure 1. Solar wind affects the Earth's magnetic field, compressing the field on solar side and forming a comet-like tail in the nightside.

The possible influence of GCRs on the clouds formation has induced the attention of scientists. Namely, clouds transport latent heat from the oceans to the atmosphere and have a large effect on the Earth's radiation balance. They reflect about 15% of the incoming solar radiation directly back to the space, thus tending to cool the surface, but they also trap infrared radiation acting in a similar way to greenhouse gases to warm the surface [14]. Galactic cosmic rays have been proposed as a factor which could influence cloud formation through their role in atmospheric ionisation [15].

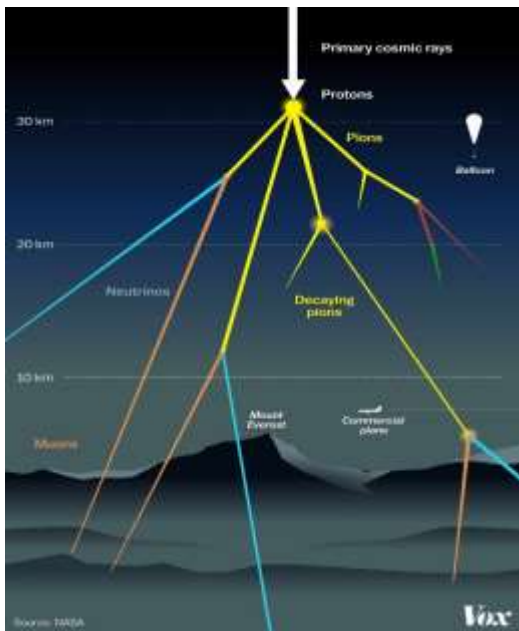


Figure 2. Protons in the cosmic rays interact with molecules in the atmosphere and produce a shower of elementary particles. Near the Earth surface more than 80% particles are muons.

3. COSMIC RAY DETECTOR NETWORK

Earth is constantly bombarded by cosmic ray particles (mostly protons) which have galactic origin but are modulated by the solar activity (the so called 11-year cycle). They are the main source of ionisation in the troposphere, peaking at about 15 km altitude. Driven by the advancements in particle detection technologies, in recent years, there has been a growing interest in using cosmic rays, particularly muon particles, for many practical applications. One of them is space and earth weather monitoring by cosmic ray detectors. The goal is to study long-term climate changes on a global scale using cosmic ray flux. This requires continuous monitoring of cosmic rays at different parts of the globe i.e. worldwide cosmic ray detector network. The key challenge in space and earth weather monitoring on a global scale using cosmic rays is to develop efficient, low-cost, and portable detectors that can provide accurate correlations between cosmic ray flux variations and weather conditions. A state-of-the-art portable muon particle detector consists of three plastic scintillators (20cm x 20cm x 1cm) embedded with wavelength shifting fibers and readout, Figure 3.



Figure 3. Low-cost and portable cosmic ray detector. (a) Simulation study of the detector efficiency and acceptance; (b) Demonstration of a running detector at the International Cosmic Ray Conference, Madison, Wisconsin, July 2019; (c) Making scintillator tiles by an undergraduate; and (d) Low cost readout unit.

Indicator of solar activity is derived from surface measurements of neutrons or muons produced by the impact of GCRs on the atmosphere. The signal detected by ground-based cosmic ray detectors (neutron or muon monitors) represents a complex result of transfer of the energetic particles in the solar and terrestrial magnetic fields, and their interaction with the terrestrial atmosphere of a certain temperature and pressure distribution. The GCRs represent a major relatively stationary contributor modulated by the 11-year solar cycle [6]. This indicates that, to disentangle space weather and terrestrial weather processes, one needs to collect the space weather-related data in addition to the muon monitor data.

4. INTERNATIONAL COLLABORATION AND PARTNERSHIP

The success of the cosmic ray detector network requires international research and educational collaborations and partnerships, to jointly develop this network and create a global education outreach of climate studies using cosmic rays. The proposed effort on this project are: (i) real-time data mining from cosmic ray detectors and supporting terrestrial and space weather data, (ii) data analysis (including cosmic ray shower simulation) for disentangling of space and terrestrial weather effects on the measured cosmic ray fluxes, and nowcasting of weather events, (iii) develop mechanisms for dissemination of collected data to support scientific research in multiple domains, including climate science, environmental science, disaster science, public health.

List of Participating Institutions:

1. Georgia State University (USA)
2. City of Atlanta School Board (USA)
3. Brookhaven National Lab (USA)
4. Oak Ridge National Lab (USA)
5. Northwestern Polytechnical University (China)
6. Meteorological Observation Center, China Meteorological Administration (China)
7. Institute of Physics Belgrade (Serbia)
8. **University of Montenegro (Podgorica, Montenegro)**
9. Institute of Astronomy and National astronomical Observatory (Bulgaria)
10. Uva Wellassa University (Sri Lanka)
11. Vellore Institute of Technology Chennai (India)
12. Norwegian University of Science and Technology (Norway)
13. Singapore Management University (Singapore)
14. University of Oulu (Finland)
15. British Geological Society (BGS, UK)

5. CONCLUSION

Galactic cosmic rays refer to the flux of high-energy, extra-solar, particles which constantly impinge upon the Earth's atmosphere from all directions. By colliding with atoms in the atmosphere, they generate cascades of secondary particles that may extend to the Earth's surface, and consequently produce ionisation in the middle and lower atmosphere. GCRs are primarily modulated by the variable solar magnetic field and the geomagnetic field, and, as a result, vary inversely with solar activity. Increased certainty regarding a GCR-cloud link would be gained from improved cloud datasets. Therefore, a large coordinated effort of ground-based observations and experimentation will be required at multiple sites across the globe, with expertise from a range of disciplines including atmospheric electricity and cloud microphysics.

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ALGAL FLORA OF CRVENE BARE PEAT BOG (MT. KOPAONIK, SERBIA)

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ABSTRACT:

The main purpose of the study was to record the floristic characteristics of the algae assemblages of the peat bog Crvene Bare, Mt. Kopaonik, Serbia. Peat bog Crvene Bare is situated on Mt. Kopaonik, Serbia at an altitude of 1645 m.a.s.l. (43°17'47"N, 20°48'37"E), developed on a water-saturated surface of about 2.5 ha, surrounded by spruce forests. It is protected by the national legislation (II protection regime). There are no literature data about the morphology, distribution and ecology of algae from the peat bog Crvene Bare. The algological samples were collected in July 2022. Samples of phytobenthos were collected with a pipette from the surface of the bottom deposits. Epiphytic samples were collected by squeezing out or scraping off dominant mosses. All samples were fixed with formaldehyde to a final concentration of about 4% shortly after sampling. Light microscope observations and micrographs were made using a Zeiss AxioImagerM.1 microscope with DIC optics and AxioVision 4.9 software. On the basis of relevant literature, algae from 7 phylums (Cyanobacteria, Rhodophyta, Chlorophyta, Charophyta, Euglenozoa, Miozoa, Heterokontophyta) were identified. The most diverse and most common were diatoms, desmids and cyanobacteria.

Keywords: algae, peat bog, Kopaonik, Serbia

1. INTRODUCTION

High mountain bogs and wetlands are characterized by specific ecological parameters and a unique, highly diverse and rich algal flora. Unfortunately, these habitats have recently become highly threatened due to climate change and a strong anthropogenic factor [1]. The main objective of this study was to determine the diversity of algal flora of Crvena Bara peat bog on Kopaonik Mountain. According to the available data, this is the first algological study at this specific site.

1.2. Study area

Mt. Kopaonik is the largest mountain massif in Serbia and is located in the southwestern part of the Republic of Serbia. Due to its natural values, Kopaonik was declared a national park in 1981. Kopaonik National Park covers an area of 11 810 ha and, in terms of the number of endemic species, is one of the most important biodiversity centers of endemic flora in Serbia. Peat-bog Crvene Bare (Fig 1) is located in the Ravni Kopaonik area (43°17'47"N, 20°48'37"E; 1642 m.a.s.l.). The area is covered with a dense coniferous forest, through which several streams flow into the Samokovska River.



Fig. 1. Peat bog Crvene Bare (Photo: Sanja Šovran)

2. MATERIAL AND METHODS

The algae samples were collected in July 2022. Epiphyte samples were collected by squeezing and scraping the predominant mosses at the sampled sites. Epipellic samples were collected from the substrate surface using a pipette. Epilithic samples of algae were collected by scraping stones (diameter > 5 cm) using a toothbrush. All algal samples were

fixed with formaldehyde to a final concentration of 4%. For diatoms (Heterokontophyta division, Bacillariophyceae class) analysis, the method with KMnO₄ and HCl was used in order to remove the organic content from the cells [3]. After this laboratory treatment, diatom permanent slides were made using Naphrax[®] mounting medium. Temporary and permanent algal slides were microscopied using a Zeiss AxioImagerM.1 microscope with AxioVision 4.9 software. The material is deposited in the collection of the Department of Algology, Mycology and Lichenology, Faculty of Biology, University of Belgrade. Algae were identified by standard literature [3-12].

3. RESULTS AND DISCUSSION

A total of 128 taxa from 7 algal divisions were determined: Cyanobacteria (20), Rhodophyta (1), Chlorophyta (2), Charophyta (16), Euglenozoa (2), Miozoa (1) and Heterokontophyta (86) (Table 1). The largest number of detected taxa belongs to the group of cyanobacteria, desmids and diatoms, which are very characteristic for this habitat type [13,14,15].

Table 1. List of algae in peat-bog Crvene Bare

Cyanobacteria
<i>Anabaena lapponica</i> BERGE
<i>Anabaena</i> sp.1 BORY ex BORNET & FLAHAULT
<i>Aphanothece microscopica</i> NÄGELI
<i>Chroococcus turgidus</i> (KÜTZING) NÄGELI
<i>Cyanobacterium notatum</i> (SKUJA) KOMÁREK, J.KOPECKÝ & CEPÁK
<i>Cyanothece aeruginosa</i> (NÄGELI) KOMÁREK
<i>Desmonostoc muscorum</i> (BORNET & FLAHAULT) HROUZEK & VENTURA
<i>Dolichospermum zinserlingii</i> (KOSSINSKAJA) WACKLIN, HOFFMANN & KOMÁREK
<i>Komvophoron</i> sp. ANAGNOSTIDIS & KOMÁREK
<i>Limnethrix guttulata</i> (GOOR) UMEZAKI&WATANABE
<i>Lyngbya calcarea</i> (TILDEN) SYMOENS
<i>Merismopedia</i> sp. MEYEN
<i>Nostoc kihlmanii</i> LEMMERMANN
<i>Nostoc microscopicum</i> CARMICHAEL ex BORNET&FLAHAULT
<i>Oscillatoria limosa</i> var. <i>minor</i> A.D.MAHAJEN & R.J.PATEL
<i>Pseudanabaena minima</i> (G.S.AN) ANAGNOSTIDIS
<i>Synechocystis</i> sp. SAUVAGEAU
<i>Spirulina tenerrima</i> KÜTZING ex GOMONT
<i>Tolypothrix</i> sp. KÜTZING ex BORNET & FLAHAULT

<i>Tolypothrix tenuis</i> KÜTZING ex BORNET & FLAHAULT
Rhodophyta
<i>Audouinella hermanni</i> (ROTH) DUBY
Chlorophyta
<i>Coccomyxa confluens</i> (KÜTZING) Fott
<i>Ulothrix</i> sp. KÜTZING
Charophyta
<i>Actinotaenium palangula</i> (BRÉBISSON ex RALFS) TEILING
<i>Closterium closterioides</i> (RALFS) A.LOUIS & PEETERS
<i>Closterium cornu</i> EHRENBERG ex RALFS
<i>Closterium cynthia</i> DE NOTARIS
<i>Cosmarium connatum</i> BRÉBISSON ex RALFS
<i>Cosmarium hammeri</i> REINSCH
<i>Cosmarium porteanum</i> W.ARCHER
<i>Cosmarium subimpressulum</i> BERGE
<i>Euastrum insulare</i> (WITTRICK) J.ROY
<i>Hyalotheca mucosa</i> RALFS
<i>Penium margaritaceum</i> BRÉBISSON
<i>Staurostrum boreale</i> W. ET G. S. WEST
<i>Staurostrum brachiatum</i> RALFS ex RALFS
<i>Staurostrum</i> sp. MEYEN ex RALFS
<i>Teilingia excavata</i> (RALFS ex RALFS) BOURRELLY
<i>Tetmemorus laevis</i> RALFS ex RALFS
Euglenozoa
<i>Euglenaria caudata</i> (E.F.W.HÜBNER) KARNKOWSKA-ISHIKAWA & E.W.LINTON
<i>Trachelomonas</i> sp. EHRENBERG
Miozoa
<i>Gymnodinium fuscum</i> (HER ENBERG) F.STEIN
Heterokontophyta
Bacillariophyceae
<i>Achnanthes minutissimum</i> (KÜTZING) CZARNECKI
<i>Adlafia briophyla</i> (J.B.PETERSEN) LANGE-BERTALOT
<i>Aulacoseira alpicola</i> (GRUNOW) KRAMMER
<i>Caloneis tenuis</i> (W.GREGORY) KRAMMER
<i>Cavinula</i> sp. 1 D.G.MANN & STICKLE
<i>Chamaepinnularia hassiaca</i> (KRASSKE) CANTONATI & LANGE-BERTALOT
<i>Cymbella aspera</i> (EHRENBERG) CLEVE
<i>Cymbopora naviculiformis</i> (AUERSWALD EX HEIBERG) KRAMMER
<i>Diploneis krammeri</i> LANGE-BERTALOT & E.REICHARDT
<i>Diploneis marginestriata</i> HUSTEDT
<i>Diploneis oculata</i> (BRÉBISSON) CLEVE

<i>Diploneis</i> sp. 1 EHRENBURG EX CLEVE
<i>Encyonema neogracile</i> KRAMMER
<i>Encyonema vulgare</i> KRAMMER
<i>Eunotia bilunaris</i> (EHRENBURG) SCHAARSCHMIDT
<i>Eunotia boreoalpina</i> LANGE-BERTALOT & NÖRPEL-SCHEMPP
<i>Eunotia exigua</i> (BRÉBISSEON EX KÜTZING) RABENHORST
<i>Eunotia minor</i> (KÜTZING) GRUNOW
<i>Eunotia nymanniana</i> GRUNOW
<i>Eunotia paludosa</i> GRUNOW
<i>Eunotia</i> sp. 1 EHRENBURG
<i>Eunotia</i> sp. 2 EHRENBURG
<i>Eunotia valida</i> HUSTEDT
<i>Fallacia vitrea</i> (ØSTRUP) D.G.MANN
<i>Frustulia crassinervia</i> (BRÉBISSEON EX W.SMITH) LANGE-BERTALOT & KRAMMER
<i>Frustulia vulgaris</i> (THWAITES) DE TONI
<i>Gomphonema acidoclinatum</i> LANGE-BERTALOT & E.REICHARDT
<i>Gomphonema exilissimum</i> (GRUNOW) LANGE-BERTALOT & E.REICHARDT
<i>Gomphonema longiceps</i> EHRENBURG
<i>Gomphonema micropus</i> KÜTZING
<i>Gomphonema parvulum</i> (KÜTZING) KÜTZING
<i>Gomphonema productum</i> (GRUNOW) LANGE-BERTALOT & E.REICHARDT
<i>Gomphonema pumilum</i> (GRUNOW) E.REICHARDT & LANGE-BERTALOT
<i>Gomphonema</i> sp. 1 EHRENBURG
<i>Gomphonema</i> sp. 2 EHRENBURG
<i>Gomphonema subclavatum</i> (GRUNOW) GRUNOW
<i>Hantzschia calcifuga</i> E.Reichardt & Lange-BERTALOT
<i>Humidophila perpusilla</i> (GRUNOW) R.L.LOWE, KOCIOLEK, J.R.JOHANSEN, VAN DE VIJVER, LANGE-BERTALOT & KOPALOVÁ
<i>Kobayasiella parasubtilissima</i> (H.KOBAYASI & T.NAGUMO) LANGE-BERTALOT
<i>Meridion circulare</i> (GREVILLE) C.AGARDH
<i>Meridion constrictum</i> RALFS
<i>Navicula cryptotenella</i> LANGE-BERTALOT
<i>Navicula lanceolata</i> EHRENBURG
<i>Navicula rhynchocephala</i> KÜTZING
<i>Navicula</i> sp. 1 BORY
<i>Navicula</i> sp. 2 BORY
<i>Navicula veneta</i> KÜTZING
<i>Neidium bisulcatum</i> (LAGERSTEDT) CLEVE
<i>Nitzschia acidoclinata</i> LANGE-BERTALOT
<i>Nitzschia hantzschiana</i> RABENHORST
<i>Nitzschia</i> sp. 1 HASSALL

<i>Odontidium mesodon</i> (EHRENBERG) KÜTZING
<i>Pinnularia isselana</i> KRAMMER
<i>Pinnularia kuetzingii</i> KRAMMER
<i>Pinnularia oriunda</i> KRAMMER
<i>Pinnularia persudetica</i> KRAMMER
<i>Pinnularia rupestris</i> HANTZSCH
<i>Pinnularia sinistra</i> KRAMMER
<i>Pinnularia</i> sp. 1 EHRENBERG
<i>Pinnularia</i> sp. 2 EHRENBERG
<i>Pinnularia</i> sp. 3 EHRENBERG
<i>Pinnularia stomatophora</i> (GRUNOW) CLEVE
<i>Pinnularia substreptoraphe</i> KRAMMER
<i>Pinnularia subrupestris</i> KRAMMER
<i>Pinnularia tirolensis</i> (METZELTIN & KRAMMER) KRAMMER
<i>Placoneis ignorata</i> (SCHIMANSKI) LANGE-BERTALOT
<i>Placoneis rostrata</i> (A.MAYER) E.J.COX
<i>Planothidium frequentissimum</i> (LANGE-BERTALOT) LANGE-BERTALOT
<i>Planothidium lanceolatum</i> (BRÉBISSEON EX KÜTZING) LANGE-BERTALOT
<i>Platessa oblongella</i> (ØSTRUP) C.E.WETZEL, LANGE-BERTALOT & ECTOR
<i>Psammothidium daonense</i> (LANGE-BERTALOT) LANGE-BERTALOT
<i>Pseudostaurosira brevistriata</i> (GRUNOW) D.M.WILLIAMS & ROUND
<i>Reimeria sinuata</i> (W.GREGORY) KOCIOLEK & STOERMER
<i>Rhopalodia gibba</i> (EHRENBERG) O.MÜLLER
<i>Sellaphora nigri</i> (DE NOTARIS) WETZEL & ECTOR
<i>Sellaphora pseudopupula</i> (KRASSKE) LANGE-BERTALOT
<i>Sellaphora saugerresii</i> (DESMAZIÈRES) C.E.WETZEL & D.G.MANN
<i>Sellaphora seminulum</i> (GRUNOW) D.G.MANN
<i>Stauroneis gracilis</i> EHRENBERG
<i>Stauroneis kriegeri</i> R.M.PATRICK
<i>Stauroneis parathermicola</i> LANGE-BERTALOT
<i>Staurosira venter</i> (EHRENBERG) CLEVE & J.D.MÖLLER
<i>Staurosirella pinnata</i> (EHRENBERG) D.M.WILLIAMS & ROUND
Chrysophyceae
<i>Ochromonas</i> sp. VYSOTSKII
Xanthophyceae
<i>Tribonema affine</i> (KÜTZING) G.S. WEST
<i>Vaucheria</i> sp. A.P. de CANDOLLE

A total 20 cyanobacteria species were identified in the peat bog Crvene Bare. Desmids species-rich genera were *Cosmarium* (4), *Closterium* (3) and *Staurostrum* (3).

Cyanobacteria and desmids are common in peat bogs where peat moss consumes the nutrients from water and thus maintains the oligotrophic conditions necessary for their thriving. In those specific acid ecosystem it is reported a higher number of cyanobacteria and desmids taxa [14].

The most diatom species-rich genera were *Pinnularia* (13), *Gomphonema* (10) and *Eunotia* (9). Many studies of peat bogs in Europe and Asia also reported these genera as the most abundant [16, 17]. The results of this study indicate high diatom diversity, which is consistent with algological study of the Pešter plateau peat bog in Serbia [14]. Contrary to that, Stanković et al. [18] recorded a total of 50 diatom taxa from 24 samples of a Đon Močvar mire (Croatia). They pointed out that high diversity of diatoms in similar habitats was found only in case of large studied area or a large number of sampling sites. Considering this hypothesis and our results (83 diatom taxa from 3 samples), it is clear that the size of the area and the number of samples are not always a necessary condition for a high diatom diversity in these habitats.

4. CONCLUSION

This is the first algological survey of peat-bog Crvene Bare on Mt. Kopaonik. In all, 128 algal taxa have been determined. The most diverse groups were diatoms, cyanobacteria and desmids. The largest number of identified cyanobacteria and desmids are cosmopolitans which prefer slightly acidic to neutral water habitats. The high diatom diversity was recorded from this peat-bog indicating that this group of algae should be considered in protection of these unique habitats across the Europe.

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RJEŠAVANJE PROBLEMA JEDNAČINA MATEMATIČKE FIZIKE PARABOLIČNOG TIPA POMOĆU FOURIEROVIH REDOVA

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SAŽETAK:

Fourierov red je relativno mladi matematički alat. Međutim njegova primjena u raznim granama ostalih srodnih nauka, je postala toliko široka da se u pojedinim studijima elektrotehnike i matematike osnovao kolegij Fourierova analiza. Fourierova analiza nam izučava i uvodi Fourierove redove, preko trigonometrijskih funkcija, opisuje analogije između reda i transformacije i integralne sume. Fourierov red je najpoznatiji matematički alat za rješavanje običnih parcijalnih diferencijalnih jednačina. U ovom radu smo tumačili primjenu Fourierovog reda i metoda za rješavanje nekih fizičkih problema kao što su: oscilacija žice, oscilacija membrane, toplotna jednačina, problem trodimenzionalne sredine, Dirihlevoi problemi. Tačnije rečeno, pomoću Fourierovog reda mi smo, rješavali jednačine matematičke fizike hiperboličkog i paraboličkog tipa. Dakle, neke konkretne probleme matematičke fizike koji se mogu riješiti i drugim metodama mi smo rješavali pomoću Fourierovog reda. U radu smo na početku definisali Fourierovu metodu razdvajanja promjenljivih u nekim naučnim krugovima poznatu i kao metodu proizvoda. Potom smo za neke granične i rubne uslove pojedine probleme matematičke fizike eliptičkog, paraboličkog i hiperboličkog tipa prikazali u softveru Matlab.

Ključne riječi: Jednačine matematičke fizike, Fourierov red, Jednačine paraboličkog tipa i primjena mreža

1. UVOD

Problem istraživanja ovog rada je na koji način se mogu rješavati parcijalne diferencijalne jednačine. Zbog obimnosti pojma parcijalne diferencijalne jednačine mi ćemo se ovdje konkretno bazirati na parcijalne diferencijalne jednačine koje su naše primjenu u fizici konkretno u predstavljajući talasa. Dakle predmet istraživanja ovog rada

su parcijalne diferencijalne jednačine koje se mogu rješavati pomoću Fourierovog reda, a svoju primjenu su našle u jednačinama matematičke fizike.

Parcijalna diferencijalna jednačina je linearna ako je prvog stepena zavisne varijable i njenih parcijalnih derivacija. Ukoliko izraze parcijalne diferencijalne jednačine zadrži izvod ili jednu zavisnu varijablu u tom slučaju je ta jednačina homogena, a u suprotnom slučaju nehomogena.

Parcijalna diferencijalna jednačina u nekom definicionom području R čije su varijable nezavisne, je funkcija čiji su svi parcijalni izvodi koji se pojavljuju u jednačini i zadovoljavaju jednačinu za svaku skup brojeva iz definicionog područja R .

Svakako potrebno je naglasiti da nas zanimaju parcijalne diferencijalne jednačine koje se mogu predstaviti pomoću Fourierovog reda i metode Fouriera razdvajanja promjenljivih. Dakle, predmet istraživanja ovog rada su jednačine matematičke fizike koje se mogu rješavati pomoću Fourierovog reda.

2. JEDNAČINE MATEMATIČKE FIZIKE

Parcijalne diferencijalne jednačine koje ćemo posmatrati u nastavku su jednačine klasične matematičke fizike. One su linearne i koeficijenti su im konstantni. Za neke od njih kao što je jednačina žice koja treperi moguće je odrediti opšte rješenje, mada u opštem slučaju to nije moguće kao na primjeru jednačine provođenja toplote. Međutim, uz jednačine matematičke fizike postavljaju se dopunski početni i konturni uslovi i traži se ono rješenje date jednačine koje zadovoljava i date dopunske uslove. Zato se nećemo koristiti opštim rješenjima, već ćemo direktno tražiti ona partikularna rješenja koja su potrebna. Važnu ulogu pri određivanju takvih rješenja imaju slijedeće dvije osobine linearnih homogenih jednačina:

1. Ako su u_k , $k=1,2,\dots$ rješenja linearne homogene jednačine

$$au_{xx}+2bu_{xy}+cu_{yy}+2du_x+2eu_y+fu=0 \quad (1)$$

tada funkcija u definisana redom

$$u(x,y)=\sum_{k=1}^{\infty} C_k u_k(x,y), \quad (C_k \text{ su proizvoljne konstante}),$$

koji je konvergentan i koji se može diferencirati član po član, takođe rješenje jednačine (6).

2. Ako je $u(x,y,\alpha_1, \dots, \alpha_n)$ rješenje jednačine (6), gdje $\alpha_k, k=\overline{1,n}$ ne zavisi od x i y , tada je i funkcije u , definisana sa:

$$u(x, y) = \int_{a_1}^{b_1} \int_{a_2}^{b_2} \dots \int_{a_n}^{b_n} u(x, y, \alpha_1, \dots, \alpha_n) d\alpha_1 \dots d\alpha_n,$$

je rješenje jednačine (1).

Objekti navedne osobine se neposredno provjeravaju. One važe i u slučaju linearne homogene jednačine sa više promjenljivih. Nazivaju se principima linearne superpozicije.

3. FOURIEROV METOD RAZDVAJANJA PROMJENJIVIH

U ovom radu posmatrat ćemo razne varijante jednačina provođenja toplote i dati njihova rješenja u obliku reda ili integrala kada su zajedno sa jednačinom dati početni i konturni uslovi. Posebno ćemo obratiti pažnju na one jednačine koje se rješavaju upotrebom Fourierovih redova, iako se gotovo sve jednačine ovog tipa rješavaju metodom razdvajanja promjenljivih o kojoj smo govorili nešto ranije. Mi ćemo u našem razmatranju malo odstupiti od uobičajene metode, jer ćemo često pretpostaviti da su funkcije T i X u rješenju $U(x, t) = T(t)X(x)$ datog oblika, uglavnom eksponencijalne ili trigonometrijske.

Jedan od najkorisnijih metoda za određivanje traženih partikularnih rješenja koje zadovoljavaju početne uslove ili konturne uslove matematičke fizike je Fourierov metod razdvajanja promjenljivih. Fourierov metod može se primijeniti na jednačine oblika:

$$a(x) \cdot r + c(y) \cdot t + d(x) \cdot p + e(y) \cdot q + (f_1(x) + f_2(y)) \cdot u = 0 \quad (8) \dots (2)$$

s početnim uslovima

$$u(x, 0) = e_1(x), u_y(x, 0) = e_2(x), \dots (3)$$

i konturnim uslovima:

$$A_1 \cdot u(0, y) + A_2 \cdot u_x(0, y) = 0, B_1 \cdot u(c, y) + B_2 \cdot u_x(c, y) = 0, \dots (4)$$

gdje su e_1, e_2 date funkcije i A_1, A_2, B_1, B_2, c su date konstante.

Na osnovu principa linearne superpozicije, dobijamo slijedeća rješenja jednačine (2) koje zadovoljavaju uslove (4):

$$u(x, y) = \sum_{n=1}^{\infty} X_n(x) (R_n Y_n^{(1)}(y) + S_n Y_n^{(2)}(y)). \quad (4)$$

4. JEDNAČINA PROVOĐENJA TOPLOTE

Diferencijalna jednačina provođenja toplote je zasnovana na zakonu održanja energije i Fourierovom zakonu provođenja toplote. Razmotrimo proces nestacionarnog provođenja toplote kroz homogeno, izotropno, čvrsto tijelo. Pretpostavka je da ne postoje unutrašnji izvori toplote i da su fizikalne veličine koeficijenti provođenja toplote λ , specifična toplota c i gustina ρ konstante.

Izdvojimo iz razmatranog tijela elementarni paralelopiped čije su stranice dx, dy, dz .

Koristeći Fourierov zakon provođenja toplote napisaćemo jednačine toplotnog balansa za

dati element. Kroz elementarnu površinu dydz u pravcu ose x za vrijeme $d\tau$ prema $dQ = -\lambda \cdot \text{grad}T \cdot S \cdot d\tau$

gdje je λ -koeficijent provođenja toplote [W/mK] i ulazi elementarna količina toplote:

$$dQ_x' = -\lambda dydz \left(\frac{\partial T}{\partial x} \right) d\tau. \quad (5)$$

Količina toplote koja izlazi iz paralelopipeda kroz suprotnu stranicu, čija je temperatura $T + \frac{\partial T}{\partial x} dx$, za isto vrijeme $d\tau$:

$$dQ_x'' = -\lambda \frac{\partial}{\partial x} \left(T + \frac{\partial T}{\partial x} dx \right) dydz d\tau. \quad (6)$$

Akumulirna toplota u paralelopipedu u pravcu ose x je:

$$dQ_x = dQ_x' - dQ_x'' = \lambda \frac{\partial^2 T}{\partial x^2} dx dydz d\tau. \quad (7)$$

Analogno jednačini (15) za ose y i z biće:

$$dQ_y = dQ_y' - dQ_y'' = \lambda \frac{\partial^2 T}{\partial y^2} dx dydz d\tau \quad (8)$$

$$dQ_z = dQ_z' - dQ_z'' = \lambda \frac{\partial^2 T}{\partial z^2} dx dydz d\tau \quad (9).$$

Na osnovu (7), (8) i (9) ukupna akumulirana energija u paralelopipedu zapremine $dV = dx dydz$ za vrijeme $d\tau$ iznosi:

$$dQ = dQ_x + dQ_y + dQ_z = \lambda \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2} \right) dV d\tau \quad (10)$$

Ta energija, na osnovu zakona o održanju energije troši se na povećanje unutrašnje energije razmatranog paralelopipeda:

$$dU = c \rho dV \frac{\partial T}{\partial \tau} d\tau, \quad (11)$$

gdje $\frac{\partial T}{\partial \tau} d\tau$ predstavlja promjenu temperature paralelopipeda za vrijeme $d\tau$.

Izjednačavanjem desne strane jednačine (10) i desne strane jednačine (11) dobijamo

$$\frac{\partial T}{\partial \tau} d\tau = \alpha \left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2} \right) \quad (12)$$

gdje je $\alpha = \frac{\lambda}{c\rho} \left[\frac{m^2}{s} \right]$ predstavlja koeficijent temperaturne provodljivosti.

4.1. Početni i granični uslovi

Diferencijalna jednačina provođenja toplote matematički opisuje prenos toplote unutar tijela. Ona istovremeno daje vezu između vremena i prostornih koordinata u tijelu tj., ona predstavlja temperaturno polje u svakom trenutku vremena.

Pri rješavanju diferencijalne jednačine provođenja toplote moramo poznavati početno temperaturno polje u datom tijelu, jer početno temperaturno polje utiče na raspored temperatura u posmatranom intervalu vremena. Ovi uslovi koje diferencijalna jednačina mora zadovoljiti nazivaju se početni uslovi. Matematički rečeno:

$$T(x, y, z, \tau) \text{ za } \tau = 0 \quad (13)$$

ukoliko je početna temperatura konstantna, što je veoma čest slučaj u praksi jednačina (5) se svodi na:

$$T(x,y,z,\tau)=T_0 = const \quad (14)$$

(A. N.Tihonov, V.Y.Arsenin, *Metode rješavanja nekorektnih zadataka*, Moskva 1979 str. 58-60.)

4.2.Slučaj ograničenog štapa

Širenje toplote kroz štap ograničene dužine može se opisati pomoću funkcije $u(x,t)$ koja predstavlja temperaturu t u tačkama poprečnog presjeka štapa, koje se nalaze na rastojanju x od kraja koji je uzet za koordinatni početak. Već smo napomenuli da jednačina (12) nema opšte rješenje već samo partikularna rješenja tj., rješavani su samo konkretni problemi. Takođe smo naglasili da je glavni problem za dobijanje opštijeg rješenja definisanje početnih i graničnih uslova. Mi ćemo zbog toga se zadržati na rješavanju problema provođenja toplote kroz ograničen homogen štap.

Napišimo sada jednačinu (12) u slijedećem obliku:

$$u\tau = C^2 \nabla^2 u, \quad \left(\nabla^2 u = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} \right). \quad (15)$$

gdje je sada $u=u(x,y,z,\tau)$ - temperatura u tački (x,y,z) u trenutku τ , $C^2 = \alpha = \frac{\lambda}{c\rho}$.

Početni uslov koji se zadaje uz jednačinu jeste raspodjela temperature po tačkama posmatranog tijela u trenutku $\tau = 0$, odnosno temperaturno polje u početnom trenutku:

$$u=u(x,y,z,0)=f(x,y,z) \quad (16)$$

pri čemu je f poznata funkcija.

Pored početnog uslova zadaje se i granični uslov koji, kako smo već naveli, može imati različite oblike ali u suštini on zadaje vrijednost funkcije u na rubu S datog tijela.

Neka je štap homogen kao što smo rekli na početku i neka je njegova dužina l . *Osu štapa postavimo na x osu od tačke $x=0$ do tačke $x=l$.* Pretpostavimo da je štap apsolutno toplotno izolovan sa strane. Ovom pretpostavkom naš se slučaj svodi na jednodimenzionalno provođenje toplote tj., u pitanju je jednodimenzionalno temperaturno polje. Temperatura je sada funkcija samo vremena i koordinate x . Jednačina (15) se sada svodi na oblik:

$$u\tau = C^2 u_{xx} \quad (16)$$

koji predstavlja jednodimenzionalnu jednačinu provođenja toplote. Početni uslov biće:

$$u(x,0)=f(x) \text{ za } 0 \leq x \leq l \quad (17)$$

gdje je f data funkcija. Tada će granični uslov prema jednačini (34) biti :

$$u_x \pm h(u - u_{ok}) = 0 \text{ na krajevima.} \quad (18)$$

Znak minus važi za lijevi a plus za desni kraj štapa.

Neka je u razmatranom slučaju temperatura okoline 0°C ($273,15\text{K}$) i neka se u lijevom kraju štapa održava temperatura od 0°C , dok na desnom kraju štap zrači toplotu u okolnu sredinu tj.,

$$u(0,\tau)=0, u_x(l,\tau)+hu(l,\tau)=0. \quad (19)$$

Znači u našem slučaju potrebno je riješiti jednačinu (16) uz početni uslov (17) i granične uslove (38). Za rješavanje datog problema primjenićemo Fourierovu metodu koja se u naučnim krugovima prikazuje kao i metoda razdvajanja promjenljivih odnosno, metoda proizvoda. Proces rješavanja može se podijeliti u tri koraka. Prvi korak podrazumijeva da se parcijalna diferencijalna jednačina (16) svede na dvije obične diferencijalne jednačine. U drugom koraku dolazi do beskonačno mnogo rješenja jednačine (16) koja zadovoljava granične uslove (18) i konačno u trećem koraku može se formirati beskonačan Fourierov red od tih rješenja kako bismo dobili rješenje koje zadovoljava i početni uslov (17).

5. IMPLEMENTACIJA U MATLAB-u

MATLAB je popularan softver za rješavanje problema matematičke fizike eliptičkog, paraboličkog i hiperboličkog tipa. Pomoću sljedećih koraka mogu se riješiti navedeni problemi:

1. Prvi korak je definiranje geometrije problema i stvaranje mreže. To se može učiniti pomoću PDE toolboxa u MATLAB-u.
2. Nakon što su definirani geometrija i mreža, može se definirati parcijalnu diferencijalnu jednačbu (PDE) koja opisuje fizički problem koji pokušavate riješiti. MATLAB nudi nekoliko funkcija za definiranje PDE-ova, uključujući funkciju *pdepe* za parabolične i hiperboličke probleme i funkciju *pdenonlin* za eliptičke probleme.
3. Zatim trebate specificirati rubne uslove za dati problem. MATLAB nudi nekoliko funkcija za definiranje rubnih uvjeta, uključujući funkciju postavljenih rubnih uslova.
4. Nakon što definirate PDE i rubne uslove, može se riješiti problem pomoću jednog od ugrađenih rješavatelja u MATLABU. Na primjer, možete koristiti funkciju *pdepe* za parabolične i hiperboličke probleme i funkciju *pdenonlin* za eliptičke probleme.
5. Na kraju, možete vizualizirati rješenje pomoću funkcija crtanja u MATLAB-u. Mogu se izraditi 2D i 3D crteži kako bi se vizualizirala rješenja preko cijele domene ili određene dijela.

Jednadžba provođenja topline za jednodimenzionalni štap ograničene duljine može se dati kao:

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2}$$

gdje je $u(x,t)$ temperatura na poziciji x i vrijeme t , a α je koeficijent toplinske difuzije materijala.

Rubni uslovi za ograničeni štap mogu se odrediti na oba kraja štapa kao:

$$u(0,t) = u_0 \text{ i } u(L,t) = u_L$$

gdje je L dužina štapa, a u_0 i u_L su temperature na dva kraja štapa.

Početni uvjet za raspodjelu temperature duž štapa može se specificirati kao:

$$u(x,0) = f(x)$$

gdje je $f(x)$ početna raspodjela temperature u trenutku $t=0$. Primjer MATLAB koda za rješavanje jednadžbe provođenja topline za ograničeni štap s navedenim rubnim i početnim uslovima.

```
% Define parameters L = 1; % length of the rod
alpha = 1; % thermal diffusivity coefficient
dx = 0.1; % spatial step size
dt = 0.01; % time step size
t_final = 1; % final time x = 0:dx:L; % spatial grid
t = 0:dt:t_final; % time grid
u = zeros(length(x), length(t)); % initialize temperature matrix
% Set initial condition
u(:,1) = sin(pi*x);
% Set boundary conditions
u(1,:) = 0; u(end,:) = 0;
% Solve using the explicit finite difference method
for j = 1:length(t)-1
    for i = 2:length(x)-1
        u(i,j+1) = u(i,j) + alpha*dt/dx^2 * (u(i+1,j) - 2*u(i,j) + u(i-1,j));
    end
end
% Plot the temperature distribution at final time
plot(x, u(:,end))
xlabel('Position')
ylabel('Temperature')
title('Temperature distribution at final time')
```

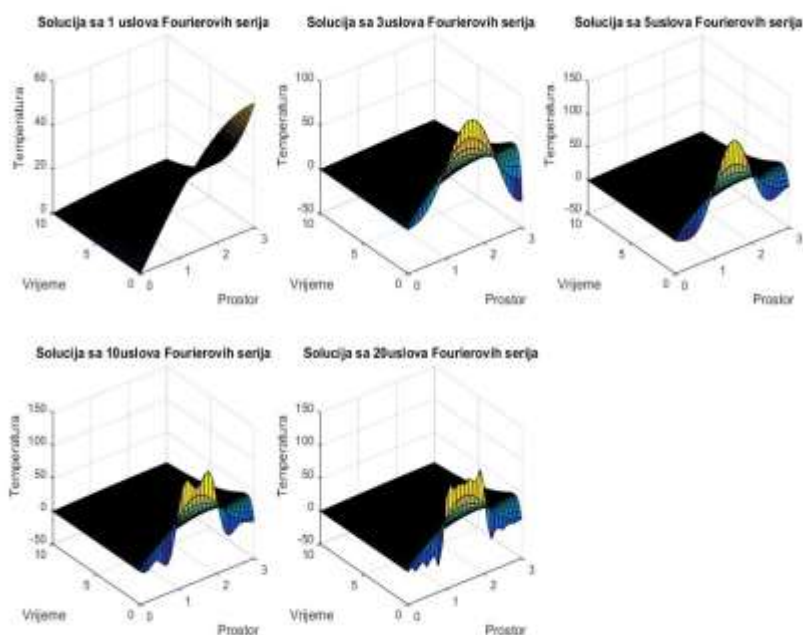
Prvo se definiraju parametri problema, uključujući dužinu šipke L , koeficijent toplinske difuzije α , prostornu veličinu koraka dx , vremensku veličinu koraka dt , konačno vrijeme t_final , te prostornu i vremensku mrežu x i t , odnosno. U matrica se također inicijalizira

kao matrica nula s dimenzijama dužina (x) po dužini (t), koja će držati vrijednosti temperature na različitim pozicijama i vremenima.

Početna raspodjela temperature postavljena je kao sinusni val pomoću funkcije \sin , s maksimalnom temperaturom na sredini šipke. Rubni uslovi su postavljeni kao nulta temperatura na oba kraja štapa.

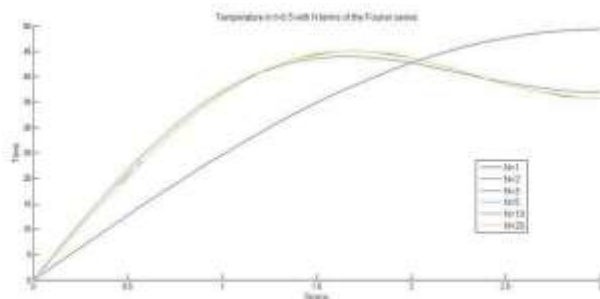
Također, eksplicitna metoda konačnih razlika koristi se za numeričko rješavanje jednačine provođenja toplote. Ugniježdene for petlje ponavljaju kroz svaki položaj i vremenski korak, ažurirajući temperaturu u svakoj tački na temelju temperature u prethodnom vremenskom koraku i temperaturnog gradijenta u prostoru, koristeći jednadžbu provođenja toplote. Završna faza jeste distribucija temperature koja se u konačnom vremenu iscrtava pomoću funkcije dijagrama, s položajem x na x-osi i temperaturom u u konačnom vremenskom koraku na y-osi. Za iscrtavanje distribucije temperature u različitim vremenima tijekom simulacije, možete modificirati kod tako da uključi petlju kroz vremenske korake i iscrtati temperaturu u svakom vremenskom koraku pomoću funkcije iscrtavanja.

```
plot(x, u(:,j+1))  
xlabel('Position')  
ylabel('Temperature')  
title(['Temperature distribution at time t = ', num2str(t(j+1))]) axis([0 L -1 1])  
pause(0.01)  
end
```



U ovom modificiranom kodu, nakon svakog vremenskog koraka u ugniježđenoj *for* *petlji*, raspodjela temperature u tom vremenskom koraku iscrtava se pomoću funkcije crtanja. Funkcije *xlabel*, *ylabel* i *title* koriste se za označavanje osa i davanje naslova za svaki dijagram. Funkcija *axis* koristi se za postavljanje ograničenja osi *x* na dužinu šipke *L* i ograničenja ose *y* na -1 i 1 kako bi se vrijednosti temperature zadržale unutar vidljivog raspona. Konačno, funkcija *pause* koristi se za dodavanje male odgode između svakog dijagrama kako bi se vizualizirale promjene temperature tijekom vremena.

```
% Set up plot and animated line figure
ax = gca;
ax.XLim = [0 L];
ax.YLim = [-1 1];
line = animatedline('Color', 'b', 'LineWidth', 2);
% Solve using the explicit finite difference method and animate for j = 1:length(t)-1 for i
= 2:length(x)-1 u(i,j+1) = u(i,j) + alpha*dt/dx^2 * (u(i+1,j) - 2*u(i,j) + u(i-1,j));
end
% Add data to animated line addpoints(line, x, u(:,j+1));
title(['Temperature distribution at time t = ', num2str(t(j+1))]) drawnow
end
```



U ovom kodu, funkcija *animatedline* koristi se za stvaranje linijskog objekta koji će se ažurirati u svakom vremenskom koraku kako bi se vizualizirala distribucija temperature. Objekt *axe* kreiran je za postavljanje granica x- i y-osi dijagrama. Petlje *for* rješavaju jednačinu provođenja toplote kao i prije, a u svakom vremenskom koraku koristi se funkcija *addpoints* za dodavanje vrijednosti temperature u tom vremenskom koraku linijskom objektu. Funkcija *title* koristi se za dodavanje naslova dijagramu koji prikazuje trenutno vrijeme. Konačno, funkcija *drawnow* koristi se za ažuriranje dijagrama novim podacima.

6. ZAKLJUČAK

U samom početku razvoja parcijalnih diferencijalnih jednačina smatralo se da je problem integracije parcijalnih diferencijalnih jednačina riješen ako se može svesti na problem integracije jedne ili više odgovarajućih običnih diferencijalnih jednačina. Problem rješavanja parcijalnih diferencijalnih jednačina prvog reda može se svesti na rješavanje odgovarajućeg sistema karakteristika običnih diferencijalnih jednačina prvog reda i to tako da se pomoću opšteg integrala karakteristika mogu odrediti sve vrste rješenja date parcijalne diferencijalne jednačine prvog reda: opšti, potpuni Košijev integral. Međutim što se tiče parcijalnih diferencijalnih jednačina drugog i višeg reda, pitanje njihove veze sa običnim diferencijalnim jednačinama ni izbliza nije tako jednostavno, a još manje je tako uspješno riješeno kao što je slučaj u teoriji parcijalnih diferencijalnih jednačina prvog reda. U teoriji parcijalnih diferencijalnih jednačina višeg reda nije samo teškoća u određivanju odgovarajućih sistema običnih diferencijalnih jednačina, već prvenstveno i u tome da na osnovu pronađenog rješenja običnih diferencijalnih jednačina se pronađe rješenje tražene osobine date parcijalne diferencijalne jednačine višeg reda. Naglašena teškoća je utoliko očividnija ako se uzme u obzir velika razlika koja postoji velika razlika koja postoji između uslova koje treba da zadovolji rješenje obične diferencijalne jednačine i parcijalne diferencijalne jednačine. Pomenute teškoće su uticale da se razvoj teorije parcijalnih diferencijalnih jednačina višeg reda usmjeri u drugim pravcima a ne samo u pravcu njenog povezivanja sa običnom diferencijalnom jednačinom. Takva odgovarajuća teorija dala je odgovarajuće rezultate i korisne teorije.

Matematičko proučavanje mnogih pojava kojima se bave fizika, mehanika, elektrotehnika, informatika, dovode do raznih tipova parcijalnih diferencijalnih jednačina kako prvog tako i višeg reda. U ovom radu smo proučavali parcijalnu diferencijalnu jednačinu primjenjenu na jednalinu provođenja toplote pod slučajem ograničenog štapa koja je uspješno riješena pomoću Fourierove metode.

Osnovni zakoni iz fizikalnog okruženja opisuju se diferencijalnim jednačinama, a zatim su određeni fenomeni izdvajani iz beskonačnog skupa rješenja tih jednačina određivanjem početnih i graničnih uslova. Pojava u kontinualnoj sredini, kao što su elastično tijelo ili gas, fluid vodi ka parcijalnoj diferencijalnoj jednačini.

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SOLVING PROBLEMS OF MATHEMATICAL PHYSICS EQUATIONS OF THE PARABOLIC TYPE USING FOURIER SERIES

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ABSTRACT:

The Fourier series is a relatively young mathematical tool. However, its application in various branches of other related sciences has become so broad that a course on Fourier analysis was established in some electrical engineering and mathematics studies. Fourier analysis studies and introduces Fourier series, via trigonometric functions, describes analogies between series and transformation and integral sum. The Fourier series is the most famous mathematical tool for solving ordinary partial differential equations. In this paper, we interpreted the application of Fourier's order and methods for solving some physical problems such as: string oscillation, membrane oscillation, heat equation, three-dimensional environment problem, Dirichlet problems. More precisely, with the help of Fourier's series, we solved mathematical physics equations of hyperbolic and parabolic type. So, we solved some specific problems of mathematical physics that can be solved by other methods using the Fourier series. In the paper, we initially defined Fourier's method of separation of variables in some mathematical circles, also known as the product method. Then, for some boundary and marginal conditions, we presented certain mathematical physics problems of elliptic, parabolic and hyperbolic type in the Matlab software.

Keywords: *Mathematical physics equations, Fourier series, Parabolic type equations and application.*

SYNTHESIS AND CHARACTERIZATION OF PLATINUM(IV) COMPLEX WITH 2-AMINO-6-CHLOROBENZOTHAZOLE

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ABSTRACT: The synthesis of novel platinum(IV) complex of general formula $[PtL_2Cl_4]$ are reported. The complex (C) has been obtained by direct reaction of potassium-hexachloroplatinate(IV) with derivative of 2-aminothiazole ($L =$ 2-amino-6-chlorobenzothiazole). Thiazole, a 5-membered unique heterocyclic compound containing sulphur and nitrogen atoms, serves as an essential core scaffold in several medicinally important compounds. Thiazole nucleus is a fundamental part of some clinically applied anticancer drugs. Thiazole and its derivatives are amongst most active classes of compounds that are known for their broad spectrum of activity. The reported platinum(IV) complex was characterized by elemental microanalysis and their structure was discussed based on the results of infrared, 1H and ^{13}C NMR spectroscopy.

Keywords: synthesis, 2-aminothiazole, platinum(IV) complex

1. INTRODUCTION

Cisplatin is one of the most effective anticancer drugs in the treatment of a variety tumors [1-2]. But, its clinical application has been limited by several negative side effects. So it has also stimulated new researches based on the sintesis of new metal-based complexes with lower toxicity and more improved therapeutic properties [3-4]. The thiazole nucleus is a very important heterocycle in many biologically active compounds that makes it one of the extensively studied heterocycles [5]. Thiazole plays vital roles in many drug structures. The recent reports have been declared the applications of thiazole core structure in drug design and development of novel therapeutic agents. Also, the presence of thiazole ring as a part of drug structure can be determinant for its psysicochemical and pharmacokinetic propreties.

Thiazole is a five-membered heterocyclic ring with nitrogen and sulfur atom. Thiazole and related compounds are called 1,3-azoles (nitrogen and one other heteroatom in a five-membered ring). They are isomeric with the 1,2-azoles, containing nitrogen and sulfur

atoms called isothiazole. Thiazole itself is a clear to pale yellow liquid with a boiling point of 116 - 118 °C.

Its specific gravity is 1.2 and it is sparingly soluble in water. It is soluble in alcohol and ether [6]. Thiazole is an aromatic ring on the basis of delocalization of a lone pair of electrons from the sulfur atom [7]. The resonance forms of thiazole are shown in Fig. 1.

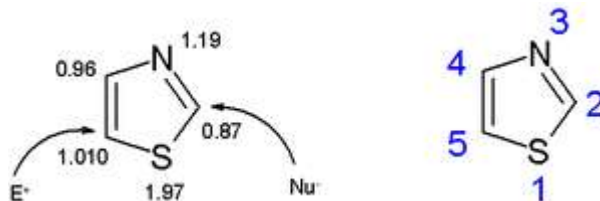


Fig. 1. The resonance forms of thiazole

The aromatic character of thiazole ring is also evidenced by ^1H NMR spectroscopy. The chemical shift of the ring hydrogens is between 7.27 and 8.77 ppm, clearly indicating a strong diamagnetic effect. The calculated π -electron density indicates that C-5 position is the primary site for electrophilic substitution, and C-2 position is the site for nucleophilic substitution. The changes in strength of basicity or acidity inevitably arise from the type of substituents at different positions of thiazole ring. It is obvious that the basicity and nucleophilicity of a molecule increases when an electron-donating group such as methyl is placed at C-2, C-4 or C-5 positions. The greatest substituent effect is observed when the methyl group placed at C-2 of the thiazole molecule that can be attributed to the closeness of the methyl group to the protonation center and being between two heteroatoms. When a strong electron-withdrawing group, such as nitro group is placed on the thiazole ring, the basicity and the nucleophilicity of the molecule decreases [8]. Thiazole and its derivatives are amongst most active classes of compounds that are known for their broad spectrum of activity e.g. antibacterial activity [9], antifungal activity [10], antimalarial activity [11], antitubercular activity [12], antiviral activity [13], anti-inflammatory activity [14], antidiabetic activity [15], anthelmintic activity [16], anticonvulsant activity [17], anticancer activity [18] and cardiovascular activity [19], etc. Due to all the aforementioned activities, this paper examines the synthesis and characterization of new platinum(IV) complex, general formula $[\text{PtL}_2]\text{Cl}_4$, where L is 2-amino-6-chlorobenzothiazole. The structure of above mentioned compound was determined by elemental microanalysis, infrared, ^1H and ^{13}C NMR spectroscopy.

2. EXPERIMENTAL

2.1. Chemistry

2.2. Synthesis of the complex

0.05 g $K_2[PtCl_6]$ was dissolved in 10 mL of water and placed on magnetic steerer. An appropriate amount of the ligand (2-amino-6-chlorobenzothiazole) 0.038 g was dissolved in methanol and was added in portions in water solution of $K_2[PtCl_6]$. 2-amino-6-chlorobenzothiazole was purchased commercially and with Pt(IV) ion reacted in molar ratio 1:2 (Fig. 2). The reaction lasted for 3 ours at room temperature. The obtained yellow precipitates were filtered, washed with water and dried on air.

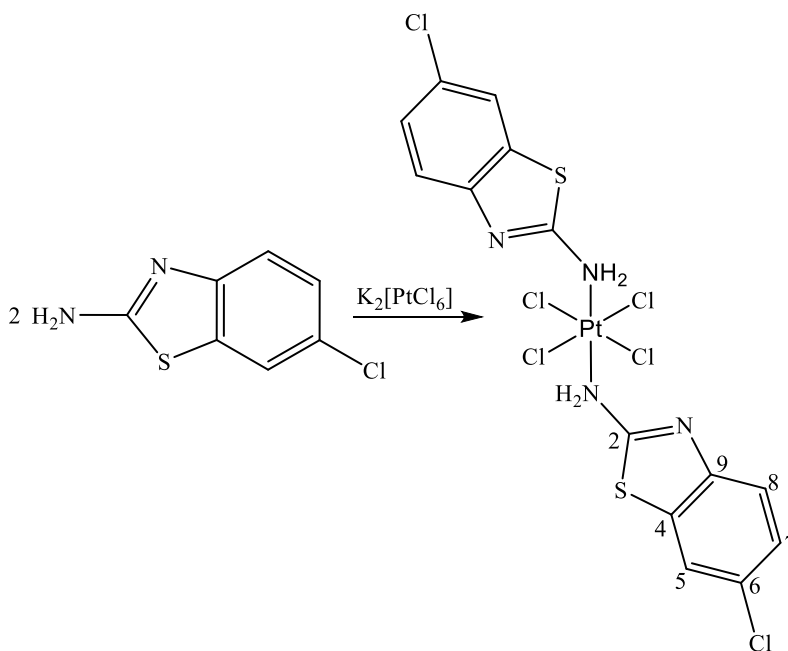


Fig. 2. Synthesis of platinum(IV) complex with 2-amino-6-chlorobenzothiazole with atom numbering in the complex

Yield: 48%. Anal. Calcd for C₁₄H₁₀N₄S₂Cl₆Pt: C, 23.81; H, 1.41; N, 7.93; S, 9.08. Found: C, 23.85; H, 1.43; N, 7.98; S, 9.05.

IR (KBr, cm⁻¹): 3446 (NH), 3078 and 3069 (=CH), 2929 (-CH), 1559, 1532 and 1483 (C=C), 1516 (C=N), 475 (Pt-N).

¹H NMR (200 MHz, DMSO-d₆): 7.61 (d, 2 H, C⁵H), 8.23 (d, 2H, C⁸H), 7.57 (dd, 2H, C⁷H).

¹³C NMR (50 MHz, DMSO-d₆): 174.5 (C²), 151.3 (C⁴), 118.3 (C⁵), 125.8 (C⁶), 129.8 (C⁷), 121.2 (C⁸), 132.3 (C⁹).

2.3. Instruments and measurements

Infrared spectra were recorded by Perkin-Elmer Spectrum One FT-IR spectrometer using the KBr pellet technique (4000-400 cm⁻¹).

¹H and ¹³C NMR spectra were recorded by Varian Gemini-2000 (200 MHz) spectrometer in DMSO using tetramethylsilane as an internal standard.

Elemental microanalysis for C, H, N and S were performed by standard methods by Vario EL. III C, H, N Elemental Analyzer at the Microanalytical Laboratory, Faculty of Chemistry, University of Belgrade, Republic of Serbia.

3. CONCLUSION

This paper examined the synthesis of new platinum(IV) complex with 2-amino-6-chlorobenzothiazole. For determination the coordination of the ligand to the platinum(IV) ion were used NMR (¹H and ¹³C) and IR spectra and the obtained spectral data were in agreement with the proposed structure. Looking at the mentioned literature, we concluded that thiazoles are a very active class of compounds, therefore it is of great importance to synthesize transitional metals complexes with this type of ligands, as well as to continue further investigations of the biological activity of newly synthesized compounds.

Acknowledgements

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SYNTHESIS, CHARACTERIZATION NOVEL LIGAND AND CORRESPONDING COMPLEX WITH PALLADIUM(II) IONE. DNA/HSA BINDING OF PALLADIUM(II) COMPLEX

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ABSTRACT:

In this paper, we presented synthesis, characterization, DNA and HSA binding of novel compounds ligand S,S-propylenediamine-N,N'-di-(4,4'-methyl)pentanoic acid of general formula, H₂-S,S-pddmp·2HCl·2H₂O and their palladium(II) complex of general formula, [PdCl₂(S,S-pddmp)]. The ligand has been obtained in reaction of S-Leucine (2 mol) and 1,3-dibromopropane (1 mol) in base medium (NaOH). The complex has been obtained by direct reaction of corresponding ligand and potassium tetrachloropalladate(II) in wather solution. The ligand and complex were characterised by elemental microanalysis, infrared, ¹H and ¹³C NMR spectroscopy. The interactions of the new palladium(II) complex with calf thymus DNA (CT-DNA) and human serum albumin (HSA) were studied by fluorescence spectroscopy. The high value of the binding constant, K_b, and the Stern-Volmer quenching constant, KSV, are the result of good binding of the complex to CT-DNA and HSA.

Keywords: *synthesis, palladium(II), propylenediamine, DNA/HSA interaction*

2.

3. 1. INTRODUCTION

4.

Ethylenediamine-N,N'-diacetic acid (edda) has two donor nitrogen atoms and two oxygen donor atoms from carboxyl group. In case of complete coordination, it behave as a tetradentate ligand. In some cases hydrolysis of one or both carboxyl group may occur, and then the ligands behave as tridentate and bidentate ligands. Together with the ligands ethylenediamine-N,N'-di-3-propanoic acid (eddp), 1,3-propylenediamine-N,N'-diacetic acid (1,3-pdda), S,S-propylenediamine-N,N'-di-(2,2'-benzyl)acetic (H₂-S,S-pddba), belongs to the group of acids classified as as edda type ligands [1,2].

Therefore, herein we described the synthesis and characterization of the new ligand propylenediamine derivate with amino acid L-leucine S,S-propylenediamine-N,N'-di-

(4,4'-methyl)pentanoic acid dihydrate dihydrochloride. Fluorescence spectra were recorded to study the structural changes in HSA induced by the addition of the complex and to determine their binding constants (K) and the number of binding sites (n) for this biomolecule. The interactions of the complex with DNA in the presence of EB were studied by fluorescence spectroscopy to assess the ability of the compound to displace ethidium bromide (EB) from the complex EB-DNA.

2. EXPERIMENTAL

2.1. Reagents and instruments

IR spectra in the range 400-4000 cm^{-1} were recorded on a Perkin Elmer FT-IR spectrophotometer Spectrum Two, using the KBr pellet technique. ^1H and ^{13}C NMR spectra were recorded by Varian Gemini-2000 (200 MHz) spectrometer in $\text{D}_2\text{O}/\text{NaOD}$ (for ligand) and DMSO (for complex) using tetramethylsilane as an internal standard.

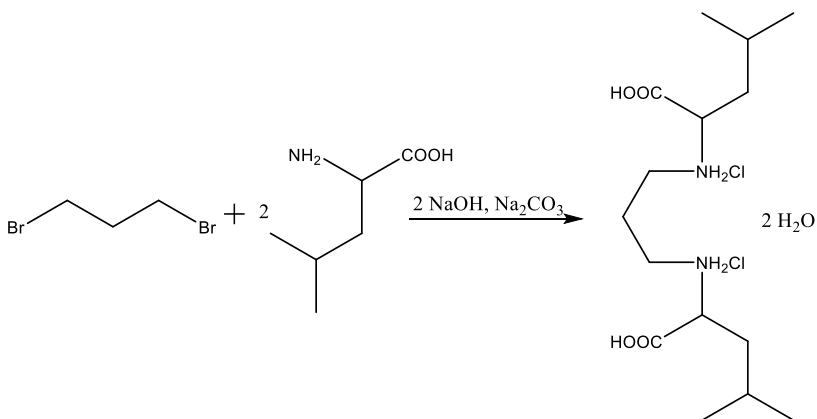
Elemental microanalyses for C, H and N were performed by standard methods by Vario EL III C, H, N Elemental Analyzer at the Microanalytical Laboratory, Faculty of Chemistry, University of Belgrade, Republic of Serbia.

The fluorescence measurements were collected on an RF-6000 spectrofluorometer (Shimadzu, Japan) with excitation at 295 nm and 520 nm, using 1.0 cm quartz cells.

2.2. Synthesis of the ligand

S,S-propylenediamine-*N,N'*-di-(4,4'-methyl)pentanoic acid dihydrate dihydrochloride, $\text{H}_2\text{-S,S-pddmp}\cdot 2\text{HCl}\cdot 2\text{H}_2\text{O}$ was synthesized according to the previously described procedure [3].

5 g (0.038 mol) of leucine is added in small portions into the solution obtained by dissolving 1.52 g (0.038 mol) of sodium hydroxide. The reaction mixture was stirred by refluxing and dropping 3.84 g (0.019 mol) of 1,3-dibromopropane at the same time adding 2.01 g (0.019 mol) of anhydrous sodium carbonate. The solution was refluxed for another 3 hours. After cooling the reaction mixture and adjusting the pH to 5 with HCl solution (1:1), a white precipitate of S,S-propylenediamine-*N,N'*-di-(4,4'-methyl)pentanoic acid separated in the form of inward salt - Zwitter ion (Scheme 1).



Scheme 1. S,S-propylenediamine-*N,N'*-di-(4,4'-methyl)pentanoic acid dihydrate dihydrochloride

The precipitate obtained is filtered off, washed well with water and dried in air.

Yield: 6.01 g (76.67 %).

Results of elemental microanalysis for H₂-S,S-pddmp·2HCl·2H₂O

M(C₂₁H₃₂Cl₂N₂O₆) = 411.33 g/mol

	C(%)	N(%)	H(%)
Calculated:	43.80	6.81	8.82
Found:	43.11	6.68	8.91

The obtained ligand was characterized by infrared and ¹H, ¹³C NMR spectroscopy.

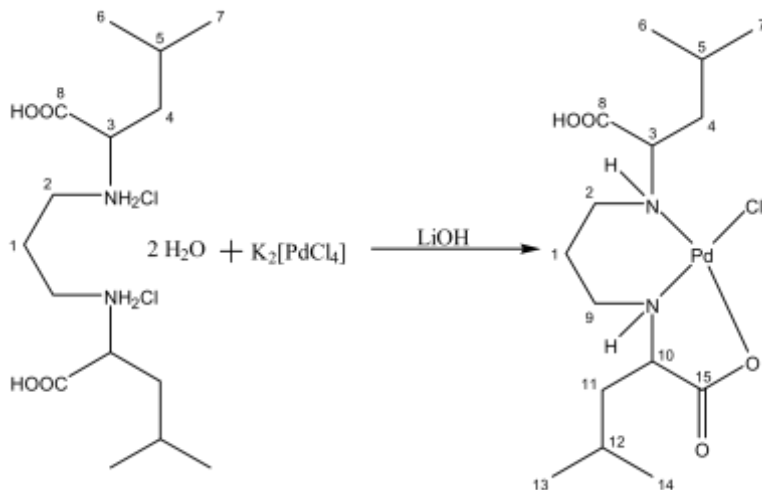
¹H NMR (200MHz, D₂O/NaOD, δ ppm): 2.99 (t, 2H, C³H), 2.38 (m, 4H, C²H₂), 1.55 (m, 2H, C¹H₂), 1.42 (m, 2H, C⁵H₂), 1.26 (m, 4H, C⁴H₂), 0.81 (dd, 12H, C^{6,7}H₃).

¹³C NMR (50MHz, D₂O/NaOD, δ ppm): 185.83 (C⁸), 65.19 (C³), 47.88 (C²), 45.29 (C⁴), 31.55 (C¹), 27.51 (C⁵), 25.38 (C⁶), 24.47 (C⁷).

IR(cm⁻¹): 3434.62, 2959.29, 1630.95, 1376.05

2.3. Synthesis of the complex

In the solution obtained dissolving 0.0700 g (0.214 mmol) potassium-tetrachloropalladate(II) in 10.00 mL of water 0.0880 g (0.214 mmol) S,S-propylenediamine-*N,N'*-di-(4,4'-methyl)pentanoic acid (Scheme 2).



Scheme 2. Synthesis of corresponding palladium(II) complex

The reaction mixture was heated at 60 °C for 2 hours with stirring. During this period, a solution of 0.0103 g lithium hydroxide (0.428 mmol) in 10 mL of water was added in small portions [2]. The resulting other yellow precipitate of the complex is separated by filtering, washed with water and dried in air. Yield: 0.0445 g (47.06 %).

Results of elemental microanalysis for complex:

$M(C_{15}H_{29}ClN_2O_4Pd) = 443.28 \text{ g/mol}$

	C(%)	N(%)	H(%)
Calculated:	40.64	6.32	6.59
Found:	40.51	6.20	6.63

The obtained complex was characterized by infrared and 1H , ^{13}C NMR spectroscopy.

1H NMR (200MHz, DMSO δ ppm): 3.33 (m, 1H, C^3H), 3.00 (t, 1H, $C^{10}H$), 2.6 (m, 2H, C^2H_2), 2.34 (m, 2H, C^9H_2), 1.78 (m, 6H, $C^{1,4,11}H_2$), 1.24 (m, 2H, $C^{5,12}H$), 0.92 (m, 12H, $C^{6,7,13,14}H_3$).

^{13}C NMR (50MHz, DMSO, δ ppm): 179.46 (C^{15}), 178.95 (C^8), 65.06 (C^3), 64.08 (C^{10}), 40.40 (C^{11}), 39.14 (C^4), 48.39 (C^9), 44.03 (C^2), 27.53 (C^1), 25.26 (C^{12}), 25.10 (C^5), 23.86 (C^7), 23.01 (C^6), 21.95 (C^{14}), 21.79 (C^{13}).

IR(cm^{-1}): 3436.61, 3161.08, 2958.43, 1727.01, 1642.87, 1368.98

2.4. Interaction of Pd(II) complex with DNA and HSA by fluorescence spectroscopy

Highly polymerized calf thymus DNA (CT-DNA), human serum albumin (HSA), ethidium bromide (EB), and DMSO were purchased from Sigma-Aldrich and used as received. The solutions of DNA, HSA, and EB were prepared by dissolving them in a phosphate buffer (PBS, $5 \times 10^{-2} \text{ mol dm}^{-3}$, pH 7.4) and 0.15 mol dm^{-3} NaCl and then stirred at 4°C for three days and stored for no more than one week. The concentration of the DNA stock solution was determined by UV absorption at 260 nm with a molar absorption coefficient of $6600 \text{ dm}^3 \text{ mol}^{-1} \text{ cm}^{-1}$ [4]. The purity of the DNA was checked, yielding a ratio of UV absorbance at 260/280 nm of 1.8-1.9, indicating that the DNA was sufficiently free of proteins [5]. Double distilled water was used to prepare all solutions.

2.4.1. DNA-binding experiments

Experiments with CT-DNA were studied by emission spectroscopy at room temperature. PBS buffer solution (pH 7.4) was used for all experiments. The complex was dissolved in a solvent mixture of 5% DMSO and 95% PBS buffer. Ethidium bromide displacement experiments were performed with fluorescence measurements. In the experiments, DNA ($[\text{DNA}] = 2.4121 \cdot 10^{-3} \text{ mol dm}^{-3}$) was pre-treated with ethidium bromide ($[\text{EB}] = 2 \cdot 10^{-5} \text{ mol dm}^{-3}$) for 30 min. Then to these solutions were added a solution of the test compound at different concentrations ($0\text{--}6 \cdot 10^{-5} \text{ mol dm}^{-3}$), and the change in the fluorescence intensity was measured. The excitation and the emission wavelength were 520 nm and 550-700 nm, respectively.

2.4.2. HSA-binding experiments

The HSA stock solution was prepared in PBS buffer (pH 7.4) and stored in the dark at 4°C for further use. The concentrated stock solution of the compound was prepared as described for the DNA binding experiments. Fluorescence spectra were measured to investigate the structural changes in HSA caused by the addition of the complex and to determine the binding constant (K) and the number of binding sites (n) for the complex formed between the complex and HSA. The HSA concentration was fixed at $2.0 \mu\text{M}$ and the concentration of the complex was varied from 0 to $60.0 \mu\text{M}$. Fluorescence quenching spectra were measured at an excitation wavelength of 295 nm and a slit width of 10 nm between 300 and 450 nm.

3. RESULTS AND DISCUSSION

Ligand and neutral palladium(II) complex were prepared by using appropriate modifications of known methods (**Shema 1**, **Shema 2**). The mode of coordinating ligands to the palladium(II) ion was predicted based on their infrared and NMR (^1H and ^{13}C) spectra. Ligand is soluble in base water. Complex is soluble in dimethyl sulfoxide and chloroform. Although we expected bidentate coordination of synthesized acid, the results of elemental microanalysis, IR, NMR (^1H and ^{13}C) spectra suggest that tridentate

coordination (*N, N, O*) to the palladium(II)-ion occurred which was confirmed by spectral data.

3.1. Spectroscopic analysis

The results of microanalysis confirmed the predicted content of the isolated ligand and complex. The most important bands in the infrared spectra of the isolated ligand and corresponding palladium(II) complex are given to part 2.2. and 2.3. Absorption bands for secondary amino groups were found for complex at 3161.08, respectively, indicating coordination via nitrogen atoms (for ligand precursors only bands for secondary ammonium groups can be observed: $m(R_2NH_2^+)$ at 3434.62. There is one absorption band at 1630.95 cm^{-1} in the spectra of ligand characteristic for C=O carboxylic acid group. There are two absorption bands for $\nu(C=O)$ in spectra for complex, which indicates two different C=O groups, being in correspondence to the coordination of the residual oxygen atom. All other specific bands were found at similar positions for corresponding ligand precursor and complex. The expected signals were found in 1H NMR and ^{13}C NMR spectra. The signals of CH_2 protons of the propylenediamine bridge showed coordination induced shifts in the spectra of complex (up to 0.5 ppm) giving a clear indication of nitrogen coordination. The appearance of double C^3H (3.33 ppm) and $C^{10}H$ (3.00 ppm) signals in the complex in relation to the ligand C^3H (2.99 ppm) and their shifts confirm the assumption that tridentate *N, N, O* coordination has occurred for the palladium(II)-ion [6]. The signals for all methyl (CH_3) protons for all compounds were found within the range of 0.76–0.88 ppm. In ^{13}C NMR spectra of complexes carbon atoms resonances were found as expected. There are two signals around 180 ppm for complex, signal at a lower chemical shift belongs to the free carbon atom and signal at a higher chemical shift belongs to the carbon atom of the carboxyl group that participates in coordination with its oxygen atom. Also, the appearance of all double signals for C atoms in the ^{13}C spectrum confirms that the molecule is no longer symmetrical and that in addition to two nitrogens, one oxygen atom participates in coordination with palladium.

3.2. DNA binding experiments

Determining the interactions between small molecules and DNA is important in pharmacology when evaluating the potential of new antitumor complexes [7], so the interaction between the DNA and the synthesized complex must be studied. To investigate the ability of complex to displace EB from the complex EB–DNA, competitive EB binding studies were performed using fluorescence measurements. The compound competing with EB for intercalation with DNA results in displacement of bound EB, leading in a decrease in fluorescence intensity. EB is a typical indicator of intercalation because it forms soluble complex with nucleic acids and emits intense fluorescence in the presence of CT–DNA [8]. The emission spectra of EB bound to CT–DNA in the absence and presence of compounds

were recorded and are shown in Fig. 1. The fluorescence intensity of EB bound to DNA at 618 nm shows a decreasing trend with increasing concentration of the compound.

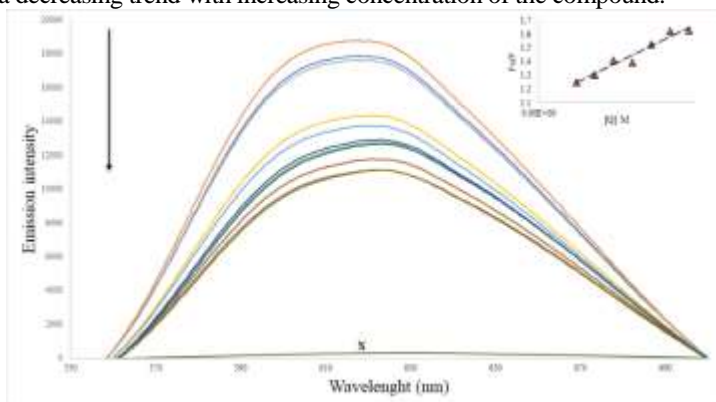


Fig. 1. Fluorescence emission spectra ($\lambda_{\text{ex}} = 520 \text{ nm}$) of ethidium bromide bound to DNA. $[\text{DNA}] = 25 \text{ } \mu\text{M}$, $[\text{EB}] = 50 \text{ } \mu\text{M}$, and $[\text{compound}] = 0\text{--}150 \text{ } \mu\text{M}$. Arrow shows the emission intensity changes upon increasing complex concentration. x represents $150 \text{ } \mu\text{M}$ compound only. Inset: plot of F_0/F vs. $[\text{compound}]$.

The observed decrease in fluorescence intensity clearly indicates that the EB molecules were displaced from their DNA binding sites and replaced by the compound. The quenching parameter can be analyzed according to the Stern–Volmer equation [9]:

$$\frac{F_0}{F} = 1 + k_q \tau_0 [Q] = 1 + K_D [Q] = 1 + K_{SV} [Q] \quad (2)$$

where F_0 is the emission intensity in the absence of the compound, F is the emission intensity in the presence of the compound, K_{SV} is the Stern–Volmer quenching constant, K_q is the bimolecular quenching constant, τ_0 (10^{-8} s) is the lifetime of the fluorophore in the absence of the quencher and $[\text{Complex}]$ is the concentration of the compound. The K_{SV} value is obtained as a slope from the plot of F_0/F versus $[\text{Complex}]$.

The quenching parameter can be analyzed according to the Stern–Volmer equation (1). The calculated constants in Table 1 show that the complex can insert between DNA base pairs. The binding constant (K_b) of the complex with DNA is also given in Table 1. The calculated K_b values for the complex indicate moderate binding of the compound to DNA.

Table 1.

The binding constants and parameters (K_{sv} , k_q , K_b , n) derived for complex

	$K_{SV} (\text{M}^{-1})$	$k_q (\text{M}^{-1} \text{ s}^{-1})$	R^{2a}	$K_b (\text{M}^{-1})$	n	R^{2a}
HSA	1.38×10^4	1.38×10^{12}	0.985	2.74×10^2	0.9	0.98
DNA	1.12×10^4	1.12×10^{12}	0.9556	6.52×10^2	0.9	0.9608

^a R is the correlation coefficient

3.3. HSA binding studies

Human serum albumin (HSA) is the most abundant protein in plasma, indicating its considerable binding capacity making it the most important drug-bearing protein [10, 11]. Fluorescence spectra were measured to investigate the structural changes in HSA caused by the addition of Pd(II) complexes and to determine the binding constant (K_b) and the number of binding sites (n) of our complexes for HSA. The fluorescence spectra of HSA with different concentrations of the complex were recorded and are shown in Fig. 2. As can be seen in Fig. 2, when a Pd(II) complex was added to the HSA solution, the HSA fluorescence intensity gradually decreased with increasing complex concentration. That is, the result indicates that the complex can interact with HSA and quench its internal fluorescence.

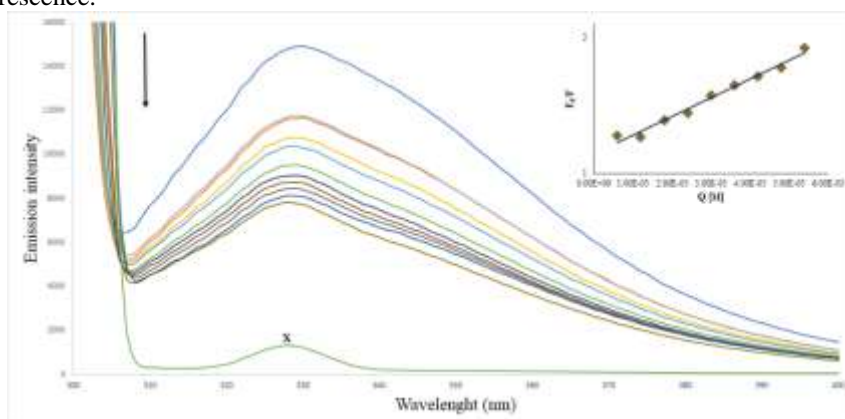


Fig. 2. Fluorescence emission spectra of HSA in the presence of various concentrations of complex ($T = 298\text{ K}$, $\text{pH} = 7.4$). $[\text{HSA}] = 2\text{ }\mu\text{M}$; $[\text{complex}] = 0\text{--}60\text{ }\mu\text{M}$. The inset shows the Stern–Volmer plots of the fluorescence quenching of HSA by complex. x represents $60\text{ }\mu\text{M}$ complex only.

The K_{SV} and quenching constants (k_q) of the interactions of the complex with albumin were calculated using the Stern–Volmer quenching equation (Eq. (1)), (Table 1) where the fluorescence lifetime of tryptophan in HSA was assumed to be $\tau_0 = 10^{-8}\text{ s}$. As can be seen from Table 1, the quenching constants ($> 10^{12}\text{ M}^{-1}\text{ s}^{-1}$) are higher than the different quenching types for biopolymer fluorescence ($10^{10}\text{ M}^{-1}\text{ s}^{-1}$), indicating that a new conjugate was formed between the complex and HSA and that the interaction of the complex with albumins occurs by a static quenching mechanism.

The binding constant (K) and binding stoichiometry (n) of HSA compound system can be estimated from the following equation (2) [9] using the fluorescence intensity data:

$$\log \frac{F_0 - F}{F} = \log K + n \log [Q] \quad (2)$$

The values of K and n were determined from the intercept and slope of the plots of $\log (F_0 - F)/F$ versus $\log [Q]$. The values of the binding constant K and of n are given in Table 1. The calculated value of n is around one, indicating the presence of only a single binding site in HSA.

4. CONCLUSION

Ligand precursor and corresponding palladium(II) complex were synthesized and characterized by IR, ^1H and ^{13}C NMR spectroscopies and elemental analysis. The interactions of CT-DNA and HSA with the new palladium(II) complex were studied by fluorescence measurements. The high value of the binding constant, K_b , and the Stern–Volmer quenching constant, K_{sv} , is the result of good binding of the complex for CT-DNA and HSA.

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TEMPERATURE PATTERN MEASUREMENTS IN BRIGGS- RAUSCHER OSCILLATORY REACTION WITH THE STATE I TO THE STATE II TRANSITION

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ABSTRACT:

Thermal monitoring of a Briggs-Rauscher oscillatory reaction with a phase transition or the state I (low concentration of iodide and iodine) to the state II (high concentration of iodide and iodine) transition with formation of new solid iodine phase is presented. This is the very first time that an oscillatory reaction and the state I to state II transition have been monitored using a thermal camera. It should be pointed out, that the BR reaction solution is not homogenized by stirring, and that only oxygen production influence the solution mixing. Therefore, the analysis was done at three sampling points on the cuvette where temperature change over time was observed, and compared with average temperature distribution. The first point is chosen to correspond to the top of the solution in the cuvette, followed by one in the middle of the volume and one at the very bottom of the cuvette. Although the state I to the state II transition itself is not reproducible (investigated transition exhibits crazy clock behavior), the overall temperature pattern has shown a reproducible character.

Keywords: temperature distribution, Briggs-Rauscher reaction, crazy clock, solid iodine, nonlinear phenomena

1. INTRODUCTION

This article reports the analysis of the results obtained by examining the temperature profile of the Briggs-Rauscher (BR) reaction.¹ This non-equilibrium oscillatory reaction is particularly interesting for this observation angle since it happens with phase transition, e.g. solid iodine formation.^{2,3} The phase transition occurs between two BR reaction states: state I (low iodide and iodine concentration) when oxygen bubbles are dominantly visible and state II (high iodide and iodine concentration, with solid iodine) when the coloration of the solution becomes dominant.⁴ This analysis enables the correlation of the dynamics of the phase transition and the temperature change using very precise measurements by thermal camera⁵. It should be pointed out, that the BR reaction solution is not homogenized by stirring, and that only oxygen production influences the solution mixing. It is also important to note that the phase transition in BR reaction is characterized by crazy clock behavior, which means that its induction period is not repeated i.e. the phase transition is irreproducible.² Presented results are the first of this kind in oscillatory reaction measurements and could have the great importance in understanding local temperature distribution when there is no mixing.

2. EXPERIMENTAL

The phase transition phenomena occurring in the oscillating BR reaction was carried out with concentrations of reactants: $[\text{CH}_2(\text{COOH})_2]_0 = 0.0789 \text{ mol dm}^{-3}$, $[\text{MnSO}_4]_0 = 0.0075 \text{ mol dm}^{-3}$, $[\text{HClO}_4]_0 = 0.03 \text{ mol dm}^{-3}$, $[\text{KIO}_3]_0 = 0.0752 \text{ mol dm}^{-3}$ and $[\text{H}_2\text{O}_2]_0 = 1.269 \text{ mol dm}^{-3}$ equal to the ones in the study by Pagnacco et al.², but with reaction volume divided by ten. The total volume used for the BR reaction was equal to 2.5 ml and reaction is followed in plastic cuvette. The experiments are done in ambient temperature.

The change in temperature is monitored by a thermal camera "FLIR A65" (640 x 512 pixel, thermal resolution 50 mK, focal length 13 mm, field of view angle 45°x37°). The camera is calibrated before experiments on ambient temperature 26 °C measured by mercury thermometer. The temperature change was observed at three points during the entire BR reaction. The reference points were chosen to be at the top, i. e., on the surface of the solution, in the middle of the same volume, and at the bottom of the cuvette. The setup used in experiment is presented in Fig. 1.

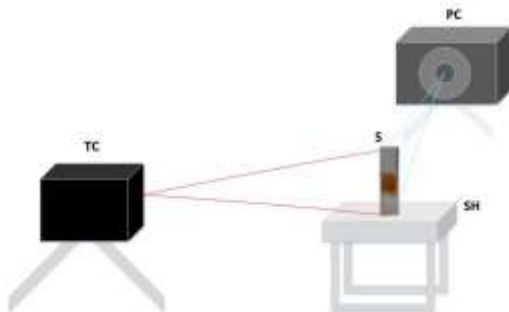


Fig. 1. The setup: photo camera (PC), thermal camera (TC), sample (S): BR reaction in cuvette and sample holder (SH)

3. RESULTS AND DISCUSSION

The temperature profile was observed during the entire reaction in the three previously mentioned points (see Fig. 2). It is important to note that the upper point was chosen as a point on the surface of the solution at the moment of adding the reagent (necessary to cause a reaction), and that during the reaction, the volume of the solution in the cuvette increases, and therefore the surface of the solution is no longer at the same height in the cuvette. This level change occurs when oxygen begins to intensively leave the reaction. Thus, the point chosen at the beginning does not change its place, but at certain moments, it is no longer on the surface of the solution. Another important factor regarding these three positions is that the lowest selected point is positioned at a very small distance from the metal support of the cuvette.



Fig. 2. The three points on the cuvette in which the dynamics of temperature change is observed.

It should be pointed that regardless of the position of the point, the temperature dynamics is almost the same. Only a slight shift in a moment of increasing the temperature was observed, which was attributed to the gradual coloration from top to bottom. This result must be verified by observing a large number of reactions and, if possible, by catching and measuring the reaction with a thermal camera when the coloration moves in the opposite direction.

When attention is paid to the degree of heating, it is observed that on average the cuvette is heated by about two degrees due to the phase change, i.e. the coloring of the reaction (see Fig. 3). The recorded result refers to the BR reaction recorded with a thermal camera for the case when mixing occurs only naturally due to the dynamics of oxygen bubbles.

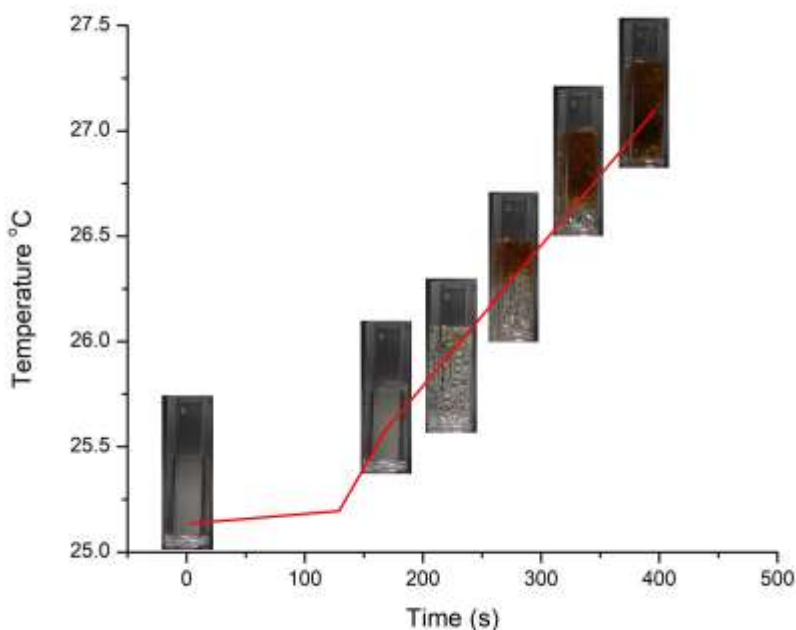


Fig. 3. Temperature profile of the BR reaction.

Fig. 3 shows a rough temperature profile, while for a precise representation it is necessary to analyze and define various factors that affect heating and are not part of the process itself. For example, such a comparative measurement in three points showed that although an almost identical temperature profile is observed, the lowest point still lags behind in terms of temperature increase. The reason for obtained temperature behavior could be cold metal cuvette supporter. It is an important conclusion that metal supporter has significant impact on reaction temperature. This measurement is also related to the conditions found

in the laboratory. For future measurements, it is planned to take into account different external temperatures, as well as different circumstances in terms of air oscillation around the cuvette caused by other laboratory equipment.

The most important conclusion from the obtained measurements is that although a completely non-reproducible reaction was observed, the temperature profile is somewhat reproducible. This point of view opens numerous questions and defines the further course of research.

3. CONCLUSION

The non-equilibrium oscillatory Briggs-Rauscher (BR) reaction was monitored with a thermal camera. The recorded temperature changes were analyzed. Changes were recorded in three key points of cuvette (top, middle and bottom) during BR reaction. Although the state I to the state II transition itself is not reproducible (investigated transition exhibits crazy clock behavior), the overall temperature pattern in three points has shown a reproducible character. Additionally, the upper and the middle spots also have the identical temperature, while the bottom temperature significantly distinguish. The reason for obtained temperature behavior could be cold metal cuvette supporter, indicating the significant impact of laboratory measurement conditions on temperature of BR reaction mixture.

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STRUCTURED LIGHT FOR LASER PROCESSING OF POLARIZATION-SENSITIVE MATERIALS

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ABSTRACT:

In this paper, we present some examples of the use of structured laser beams for laser processing of thin films of carbazole-based polymer 9-(2,3-epoxypropyl) carbazole (EPC) and azo dye Disperse Orange 3 (DO3) as well as nanomultilayer structures based on the chalcogenide glasses As₂S₃ and a-Se. These materials are well-known because of their sensitivity to the polarization of the illuminating radiation. Recently, the unique possibilities of processing of such materials using structured laser radiation with the predetermined amplitude and polarization distributions have been demonstrated. Structured laser beams provide more opportunities for the formation of unusual two-dimensional and three-dimensional reliefs that, in principle, cannot be produced using Gaussian laser beams. The distributions of polarization and the longitudinal component of light play the key role in determining the shape of nano and microstructures formed on the surface of thin films of these materials. We present both numerical and experimental results demonstrating the possibilities of controlling the profiles of the formed microstructures.

Keywords: azopolymer, chalcogenide glasses, structured light, polarization, laser processing

1. INTRODUCTION

In recent years, structured laser beams with a complex distribution of amplitude, phase, and polarization have been increasingly used for precision laser material processing [1, 2]. These laser beams make it possible to control the morphology of structures formed on the surface and in the volume of materials both at the nano- and micro-levels [3, 4]. For example, the linear polarization orientation makes allows one to control the orientation of laser-induced periodic surface structures (LIPSSs) [5]. Laser beams with a helical wavefront and their superpositions can be used to form twisted microstructures even inside polymeric materials [3, 4]. Even more opportunities arise when using structured laser radiation in the processing of polarization-sensitive materials, such as various azopolymers and chalcogenide glasses (CGs) [6]. Multilayer structures based on CGs and

azopolymers are promising optically sensitive materials used for dynamic systems of optical conversion and signal transmission, data recording, and storage [7]. The structure of these materials changes under the influence of the illuminating laser radiation - not only depending on the amplitude but also the polarization of the radiation.. Recent studies have shown the high sensitivity of such materials to both transverse and longitudinal components of the light field [8]. Previously, mass transfer induced by the longitudinal component of light in the case of azopolymers and CGs was demonstrated using radially, azimuthally, and circularly polarized Bessel beams and showed the sensitivity of azopolymers to the polarization state causes surface deformations that are proportional to the longitudinal component of the electric field [9]. The joint consideration of the action of transverse and longitudinal components should provide an unprecedented level of control over the profiles of nano- and microstructures formed in polymers, which is necessary for the creation of various elements of planar and three-dimensional micro-optics and components of nanophotonics.

Here, we demonstrate examples of the use of thin azopolymer films for detection of the polarization state of the illuminating uniform and non-uniformly polarized laser radiation. Also, we present methods for direct laser processing of thin films of azopolymers and CGs and creation of different two- and three-dimensional microstructures by using structured laser beams and their superpositions. In particular, we demonstrate formation of compound fork-shaped surface relief gratings (SRGs), space variant SRGs with a discrete and continuous reorientation of the grooves, as well as spiral-shaped microstructures for the generation of optical vortex beams bearing non-zero orbital angular momentum (OAM) at the microscale. Such structures are supposed to be formed through the use of polarization-mode states of structured light fields. The demonstrated results show the high potential of the use of structured laser beam for laser processing of polarization sensitive materials and realization of high-performance fabrication of diffractive optical elements and metasurfaces.

2. DETECTION OF THE POLARIZATION STATE OF LIGHT USING AZOPOLYMER THIN FILMS

For the realization of direct laser processing of carbazole-containing azopolymer thin films using uniformly and non-uniformly polarized laser radiation, we used an optical setup based on a reflective spatial light modulator (SLM) HOLOEYE PLUTO VIS (see Fig. 1). The SLM was used for implementation of phase masks of diffractive optical elements generating desired amplitude/phase distributions. To transform the linear polarization of the output laser radiation into a rotated linear polarization, circular/elliptical polarization, or nth cylindrical polarization, half-wave plates, quarter-wave plates and commercially available first and second order q-plates as well as their combinations were used. For illumination of the surface of the thin film, a combination of a micro-objective MO2, a mirror M6, a lens L6, and a light bulb IB was used. For observation of the procedure of laser processing, a combination of a videocamera CAM, a neutral density filter F, and a lens L5 was used. The formation and focusing of structured

laser beam used for laser processing, the SLM, a polarizing element PE (a half wave plate, a quarter wave plate, or a q-plate) was used. Lenses L1- L4 as well as mirrors M1- M5 were used to steer and collimate the laser beam. Atomic force microscopy (AFM) was used for analysis of the profiles of all fabricated microstructures.

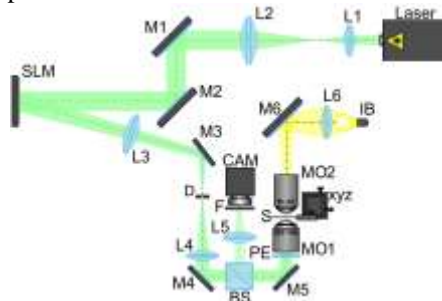


Fig. 1. Optical setup for laser processing of carbazole-containing azopolymer thin films and detection of polarization states of the illuminating laser beams: Laser is a solid-state laser ($\lambda = 532$ nm), L1, L2, L3, L4, L5, and L6 are lenses with the focal lengths of 25, 150, 500, 150, 150, and 50 mm, SLM is a spatial light modulator HOLOEYE PLUTO VIS (1920×1080 pixels, pixel size of 8 μm), M1, M2, M3, M4, M5, and M6 are mirrors, D is a circular diaphragm, MO1, MO2 are micro-objectives, BS is a beam splitter, S is a glass substrate with a carbazole-containing azopolymer thin film mounted on the 3-axis XYZ translation stage, IB is a light bulb, F is a neutral density filter, CAM is a video camera (TOUPCAM UHCCD00800KPA; 1600 × 1200 pixels, with a pixel size of 3.34 μm), and PE is a polarizing element

2.1. Uniformly polarized laser radiation

Figure 2 shows the total intensity distributions and the inverted longitudinal component of a sharply focused (NA = 0.85) linearly polarized Gaussian beam as well as the profiles of the microstructures fabricated during illumination of the used thin azopolymer film with the corresponding laser radiation. The intensity distributions are calculated using the Richards-Wolf equation [10]. A rotation of the polarization direction by an arbitrary angle results in the shaping of a rotated elongated light spot in the focal plane. The profiles of the shaped microstructures repeat the inverted structure of the longitudinal component of the electric field. In this case, the polarization sensitivity of carbazole-containing azopolymer molecules initiates material transfer in accordance with the distribution of the intensity of the longitudinal component of light. Under the action of polarized laser radiation, the azobenzene molecules absorbing light are redistributed perpendicular to the polarization direction at the nanoscale while the material undergoes directional photoinduced motion at the microscale.

It is well known that the use of elliptical polarization provides one additional degree of freedom for encoding information in comparison with the linear polarization—the

ellipticity of a polarization ellipse (see Fig. 2). The intensity distribution of the longitudinal component of the electric field in the case of an elliptically polarized Gaussian beam is a contour of an ellipse. In this case, the ellipticity of the formed microstructures corresponds to the ellipticity of the polarization ellipse of the laser beam illuminating the azopolymer thin film. In addition, the rotation of the polarization ellipse of the illuminating laser beam leads to the rotation of the formed elliptically shaped microstructures. The demonstrated polarization sensitivity of carbazole-containing azopolymers allows one to realize polarization detectors, allowing the determination of the polarization direction and the ellipticity of the polarization ellipse.

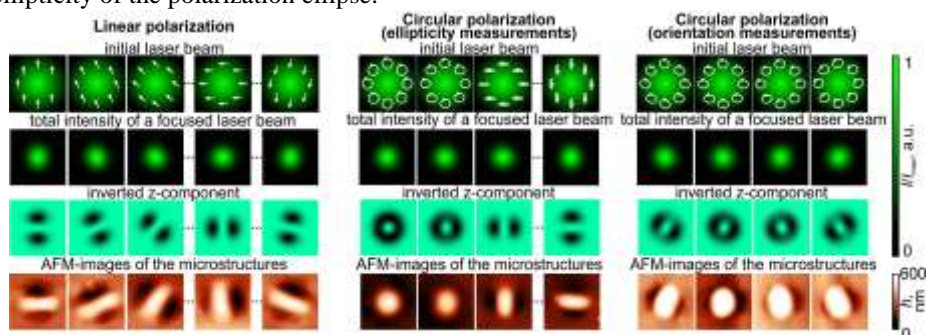


Fig. 2. Uniformly polarized (linearly and elliptically) laser beams for the structuring of azopolymer thin films. The white arrows and ellipse in the initial laser beam intensity distributions show the linear polarization orientation and the polarization ellipses

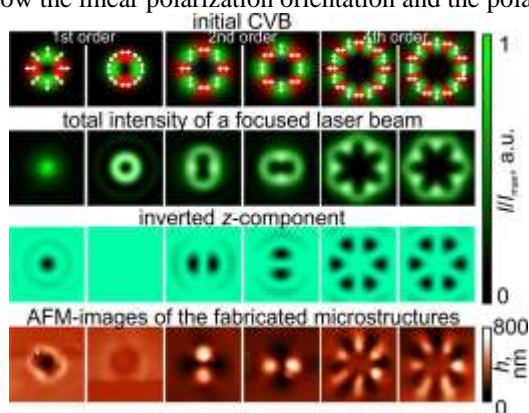


Fig. 3. CVBs for the structuring of azopolymer thin films. The white arrows in the initial laser beam intensity distributions represent the local orientation of the polarization vector

2.2. Cylindrical vector beams

The polarization sensitivity of carbazole-containing azopolymers allows one to determine the polarization characteristics of non-uniformly polarized laser beams, such as CVBs. CVBs are laser beams with an azimuthal symmetry not only in polarization structure but also in transverse intensity, which remains even in the case of focusing [11, 12]. Previously, azimuthally and radially polarized CSVs were used for the processing of thin films of PMMA-DR1 polymer and formation of nano- and micro dips and protrusions [9, 13]. The total intensity of focused higher-order CVBs, taking into account the longitudinal component of the electric field, has a non-annular shape (see Fig. 3) that predicts the formation of complex microstructures, with structures representing the longitudinal component of the focused light field. In the case of the use of CVBs for laser processing of azopolymer thin films, the fabricated microstructures are sets of alternating dips and protrusions located around the circumference. The number of dips and protrusions equals the number of light maxima in the intensity distribution of the longitudinal component of the focused light field. This number is two less than the polarization order. The presented results for higher-order CVBs clearly demonstrate the possibility of determining the polarization order and the inner polarization rotation of the beam.

3. FABRICATION OF SURFACE RELIEF GRATINGS IN CGS

It is well known that interference lithography is an easy and cheap method of fabrication of SRGs including fork-shaped gratings (FSGs). The following results show the possibility of fabrication of different SRGs on a nanomultilayer structure (NMLS) based on the CGs As₂S₃—Se deposited into a glass substrate using structured laser beams.

3.1. Fabrication of compound fork-shaped SRGs using interferometric approach

Compound FSGs are superpositions of two FSGs in different directions [14]. Compound FSGs can be used for the generation of the desired one- and two-dimensional configurations of optical vortex beams due to splitting of an illuminating optical vortex beam. In fact, other types of structured laser beam can also be used for splitting.

For the fabrication of compound fork-shaped SRGs using an interferometric approach, the optical setup based on the Mach–Zehnder interferometer shown in Fig. 4 was used. The interferometer consists of two mirrors, M3 and M4, and two beam splitters, BS1 and BS2. A spiral phase plate (E) in the object arm of the interferometer was used for the generation of optical vortex beams with the desired topological charge. Half-wave plates HP1 and HP2 were used to rotate the polarization direction of the linearly polarized laser beam. A pinhole PH and a lens L1 were used for collimation and extension of the initial laser beam. Mirrors M1 and M2 were used to steer and collimate the laser beam. For observation of the procedure of laser writing of compound FSGs, a combination of a videocamera CAM, a neutral density filter F, and a microobjective MO2 was used. For illumination of the surface of the thin film, a combination of a microobjective MO2, a beam splitter BS3, a lens L2, and a light bulb IB was used. A microobjective MO1 focused the superimposed

laser beams from the object and reference arms of the interferometer onto the surface of a glass plate P covered by an NMLS.

At the first stage of the two-step interferometric laser writing of compound FSGs, the surface of the NMLS is illuminated by two superimposed laser beams: a Gaussian beam from the reference arm of the interferometer and an inclined optical vortex beam with the desired topological charge generated by a spiral phase plate. This led to the formation of a high-quality fork-shaped pattern on the surface of the thin film of the sample. Using different exposure times for each of the steps of the proposed two-step lithography process, we can control the relief depth of both the first and second FSGs written. The change in the orientation of the generated interference fringes (using mirrors M3 and M4) allowed us to write the profile of the second FSG over the initially written profile of the first FSG to form a compound FSG. The locations of the diffraction order generated by the fabricated FSGs can be controlled by the inclination angle of the laser beam from the object arm. At the same time, replacing the initial spiral phase plate with an spiral phase plate with another topological charge, we could also control the number of “teeth” of the second FSG written to produce elements that form two-dimensional arrays of optical vortex beams with different topological charges in given configurations. Examples of the profiles of various compound FSGs fabricated using the described technique are shown in Fig. 5.

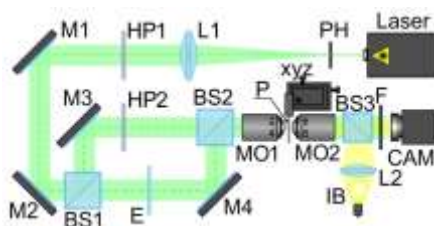


Fig. 4. Optical setup for realization of two-step maskless laser writing of compound FSGs in an As_2S_3 -Se NMLS: Laser is a solid-state laser ($\lambda = 532 \text{ nm}$), L1 and L2 are lenses with the focal lengths of 150 and 50 mm, M1, M2, M3, and M4 are mirrors, PH is a pinhole (aperture size is $40 \text{ }\mu\text{m}$), HP1 and HP2 are half-wave plates, BS1, BS2, and BS3 are beam splitter, MO1 and MO2 are micro-objectives, P is a glass substrate with an As_2S_3 -Se NMLS thin film mounted on the 3-axis XYZ translation stage, IB is a light bulb, F is a neutral density filter, CAM is a video camera (TOUPCAM UHCCD00800KPA; 1600×1200 pixels, with a pixel size of $3.34 \text{ }\mu\text{m}$), and E is a spiral phase plate generating a single optical vortex beam with the desired topological charge

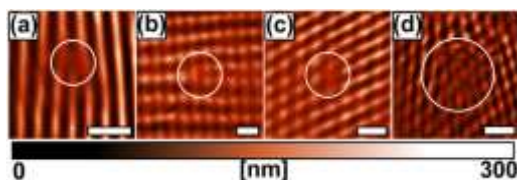


Fig. 5. AFM images of four fabricated FSGs

3.2. Fabrication of space variant SRGs using depolarizers

As was mentioned above, CGs are polarization-sensitive material. The performed comparison of the SRGs formation on the $\text{As}_2\text{S}_3\text{-Se}$ NMLS at different states of the recording beams polarization revealed that the interference of two orthogonal circularly polarized laser beams creates the SRG with higher diffraction efficiency of recording in comparison with the interference of two P-P and S-S polarized laser beams or identical circularly polarized laser beams [15]. The polarization distribution shaped in this case can be directly generated with the so-called liquid crystal polymer (LCP) depolarizers or patterned microretarder arrays widely used for the polarization transformation [16]. A linearly polarized laser beam transmitted through such an element has a polarization state that varies spatially.

To confirm the assumption made about the possibility of using the laser radiation shaped with a depolarizer for fabrication of SRGs and realize laser processing of CGs, we used a LCP depolarizer from Thorlabs Inc. [16] with a distribution of the fast axis orientation shown in Fig. 6. For this element, the angle of the fast axis is increased by 2 degree across each consecutive $25\text{ }\mu\text{m}$ strip. For laser processing of a $\text{As}_2\text{S}_3\text{-Se}$ NMLS thin film, we used the optical setup shown in Fig. 1. In this setup, a depolarizer was used as a polarizing element PE and the SLM was used for laser beam steering. In this case, we continuously displayed phase masks with different phase gradients on the modulator, which deflected the incident beam in the desired direction. This gave us an opportunity to scan the surface of the sample during its processing. The use of the depolarizer makes it possible to change the orientation of the formed surface relief by rotating the depolarizer itself. Figure 7 shows the examples of the SRGs written in a thin film by a scanning laser beam formed using a depolarizer. We can discretely change the orientation of the axis of the depolarizer and thus change the orientation of the formed SRGs or scan the surface of the sample “line-by-line” and change the orientation of the formed SRGs from line to line, forming discrete space-variant gratings. Finally, we can continuously rotate the depolarizer during laser beam scanning of the sample surface. In this case, the formed relief is a continuous space-variant grating.

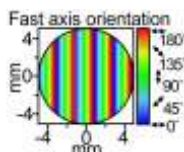


Fig. 6. Distribution of the fast axis orientation of the depolarizer used in the experiments

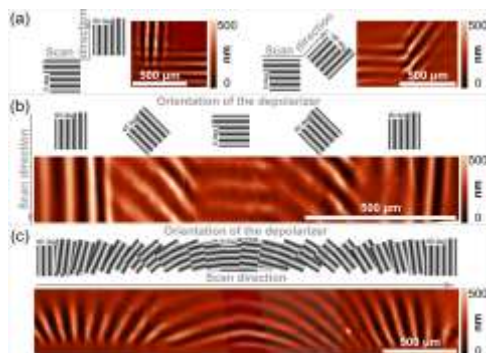


Fig. 7. Examples of SRGs fabricated by scanning the surface of a thin film of NMLSs based on CGs with a laser beam shaped with a depolarizer. (a) and (b) show examples of gratings fabricated using a discretely reoriented depolarizer. (c) illustrates an example of a grating fabricated using a continuously rotating depolarizer

4. MULTI-SPIRAL LASER PATTERNING OF AZOPOLYMER THIN FILMS

It is well known that two-beam interferometric approach can be used to create multi-spiral interference light distributions for the formation of three-dimensional chiral microstructures using the two-photon direct laser writing method [4] and applied it to realize multi-spiral laser patterning of azopolymer thin films. It is well known that the co-axial interference of optical vortex beams with a topological charge m with a different radial wavefront such as conical [17, 18] or spherical [19] leads to the formation of a m -spiral intensity distribution. For the generation of such interference patterns, usually interferometers with two arms are used - for example, Mach-Zehnder interferometers. However, it is possible to use optical schemas with one arm. Such an approach can be realized with one SLM – it is well known that such devices modulate only a part of the incident radiation while some part of the incident radiation does not undergo any modulation and is simply reflected from the display. This part of the radiation propagates along the optical axis. When we use a spherical lens after the SLM, the unmodulated and modulated part of light is focused at the same plane and we can observe the interference between them. However, in this case, we observe the interference of laser beams with plane wavefronts. In order to realize the interference of laser beams with spherical

wavefronts we can make the following steps: 1) a spherical phase term should be added to the phase of an element implemented with SLM and generating an OV beam (see the principal schema of the interference with one SLM shown in Fig. 8; 2) the observation plane of the generated interference patterns should be shifted towards the spherical lens at the plane when the generated OV beam is focused. Using such an approach, it is possible to adjust the phase mask parameters (such as a curvature of the added spherical phase term and the intensity ratio of the modulated and unmodulated parts of the incident laser radiation) to observe spiral-shaped patterns with the de-sired dimensions and contrast.

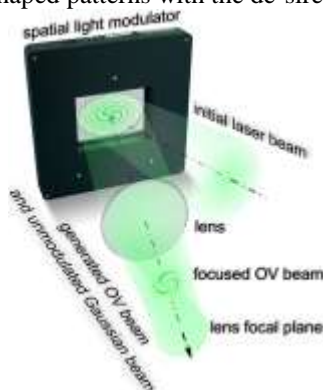


Fig. 8. Principle of generation of the multi-spiral interference fringes using a single

For realization of the proposed approach, we used an optical setup shown in Fig. 1 without any polarizing element. The images of the profiles of the microstructures fabricated with circularly polarized radiation are shown in Fig. 9. The profiles of the fabricated microstructures coincide well with the generated multi-spiral intensity patterns. The number of the formed spirals on the surface of the used azopolymer thin films and the numbers of the light spirals of the generated interference patterns are equal. The height of the microstructures is in the range from 150 nm in the case of 5-spiral microrelief up to 850 nm in the case of 1-spiral microrelief.

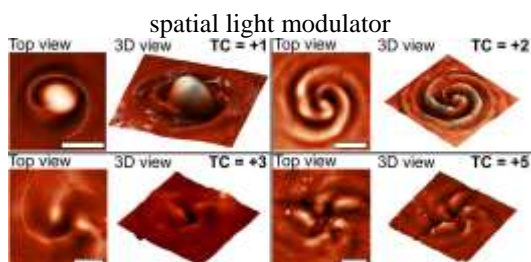


Fig. 9. The images of the profiles of the microstructures fabricated with circularly polarized radiation and measured with a scanning probe microscope. Four different

microstructures fabricated using OV beams with TCs +1, +2, +3, and +5 are shown. The dotted curves indicate the formed spirals. The scale bar is 10 μm

5. CONCLUSION

We demonstrated some examples of the use of structured laser beams for laser processing polarization-sensitive materials such as carbazole-based polymer 9-(2,3-epoxypropyl) carbazole (EPC) and azo dye Disperse Orange 3 (DO3) as well as nanomultilayer structures based on the chalcogenide glasses As_2S_3 and a-Se. The examples include two- and three-dimensional microstructures that can be used for generation of structured light (for example, optical vortex beams) at the microscale. The demonstrated results open a pathway towards easy-to-implement inexpensive fabrication of spiral-shaped microstructures and space variant SRGs with a discrete or continuous reorientation of the grooves for advanced photonics applications. In addition, we demonstrated the possibility of the use of azopolymer thin films for determination of the parameters of the polarization states of uniformly and non-uniformly polarized laser beams.

6. ACKNOWLEDGMENTS

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ISPITIVANJE EFIKASNOST IZLUŽENJA UKUPNOG HROMA IZ PRAŠINASTE ILOVAČE

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SAŽETAK:

U radu se analizira efikasnost ekstrakcije ukupnog hroma iz kompozitnog uzorka prašinate gline (otpadno zemljište). Kao sredstva za izluženje korišćena je ultračista voda, TCLP (Toxicity Characteristic Leaching Procedure) ekstrakcioni rastvor, DTPA (dietilenpentasilrčetna kiselina) ekstrakcioni rastvor i carska voda (Aqua regia, AR). Izluženje vodom određivana je vodorastvorljiva forma Cr, sa TCLP je ispitivana toksična količina Cr, sa DTPA je ispitivana lakopristupačna forma Cr i sa carskom vodom ukupna količina Cr. Rezultati ispitivanja su pokazali da je sadržaj Cr najveći 820 mg/kg u carskoj vodi, u DTPA 56,7 mg/kg, u TCLP sadržaj Cr je 1,65 mg/kg, a u vodi 3,79 mg/kg Cr. Rezultati su ukazivali na to da je najveći udeo Cr vezan za silikatnu frakciju zemljišta, i kao takav se teže izlužuje sa TCLP, DTPA i vodom.

Ključne riječi: *ukupni hrom, životna sredina, zemljište, test luženja*

1. UVOD

Zadnjih decenija XX veka i početkom XXI, problemu sadržaja teških metala u zemljištu posvećena je velika pažnja, delom zato što se razvila naučna i javna svest o zagađenju životne sredine, a delom i zbog razvoja analitičke tehnike za merenje njihovih koncentracija. Među mnogim teškim metalima, jedan od teških metala koji je zagađivač životne sredine jeste i hrom (Cr). Poreklo Cr u zemljištu je iz više izvora: matični supstrat na kome je zemljište formirano kao geohemijski izvor (različiti minerali i rude) i antropogenih izvora kao što su proizvodi industrije, industrija gume i tekstila, energetike, sagorevanja i rad topionica i rudnika, saobraćaja, korišćenje mineralnih i organskih đubriva, pesticida i otpadnih muljeva (kanalizacionog mulja) i dr. [1]. Ulažu se naponi da se osmisle tehnologije i sistemi tretmana za sanaciju kontaminiranog zemljišta na lokaciji od interesa, bez stvaranja značajne količine otpada tokom sanacije. Ispiranje, tj. izluženje je tehnika koja se intenzivno koristi u rudarskoj industriji, istražena je kao metoda za

sanaciju nastalog zagađenja. Teški metali se mogu ukloniti propuštanjem određenog rastvora za luženje kroz definisan sloj zemljišta [2].

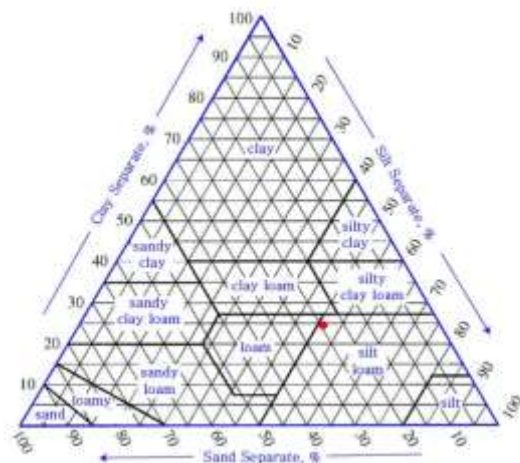
U ovom radu, ispitivanja je efikasnost izluženja ukupnog hroma na već zagađenom zemljištu teksturne klase Ilovača.

2. EKSPERIMENTALNI DEO

Uzorak zemljišta je nakon uzorkovanja, osušen na vazduhu i prosejan kroz sito od 2mm. Nakon sejanja, analiziran je sadržaj vlage tako što je 2-10g uzorka sušeno na $105^{\circ}\text{C} \pm 2^{\circ}\text{C}$ u trajanju od 2h prema metodi SRPS ISO 11465:2002. Nakon ustaljivanja mase, određen je sadržaj vlage. Mehanički sastav tj. teksturna klasa zemljišta je urađena na pripremljenom uzorku, pri čemu je izmereno 20-30g uzorka. Uklonjen je sadržaj organskih materija i sadržaj karbonata korišćenjem 30ml 30% vodonik-peroksida i 1M hlorovodonične kiseline. Nakon uklanjanja smetnji, urađena je disperzija uzorka korišćenjem natrijum-heksametafosfara. Uzoak je mokro prosejan kroz sita od 2-0.063mm, a sadržaj gline je urađen sedimentacijom prema ISO 11277:2020 metodi. Kod testa izluženja ukupnog hroma, odmereno je $10 \pm 0,01\text{g}$ uzorka zemljišta u staklene kolbe, dodato je 50ml ultračiste vode, 50ml rastvora DTPA [3], 50ml TCLP rastvora [4] i 50ml carske vode. Vreme ekstrakcije tj. izleženja je bio 1-6h, na sobnoj temperaturi ($25 \pm 2^{\circ}\text{C}$). Sadržaj hroma je analiziran korišćenjem plamenog atomske apsorpcionog spektrofotometra (FAAS).

3. REZULTATI ISPITIVANJA

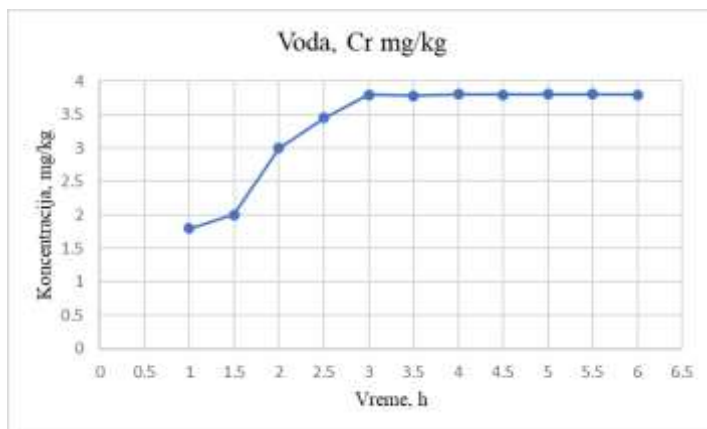
Nakon sušenja, sadržaj vlage je bio 1,55%. Korišćenjem metode sedimentacije i mokrog sejanja, mehanički sastav je dat na slici 1. U tabeli 1 dat je sadržaj ukupnog Cr dobiven luženjem u navedenim sredstvima. Na slikama 2, 3, 4 i 5 dat je hronološki prikaz dobijenih rezultata.



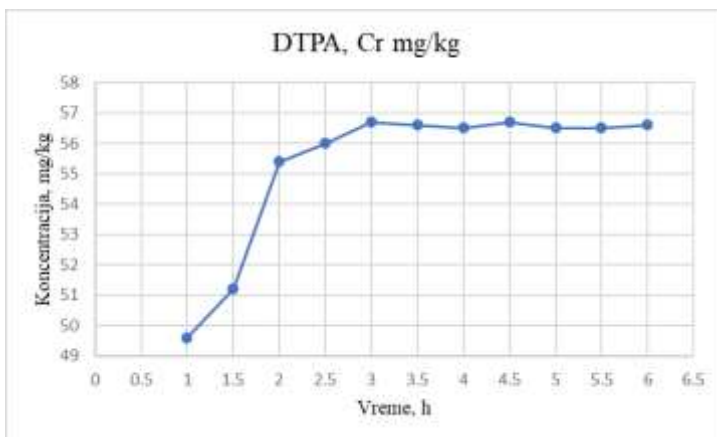
Slika 1. Teksturna klasa ispitivanog zemljišta.

Tabela 1. Sadržaj ukupnog hroma, mg/kg

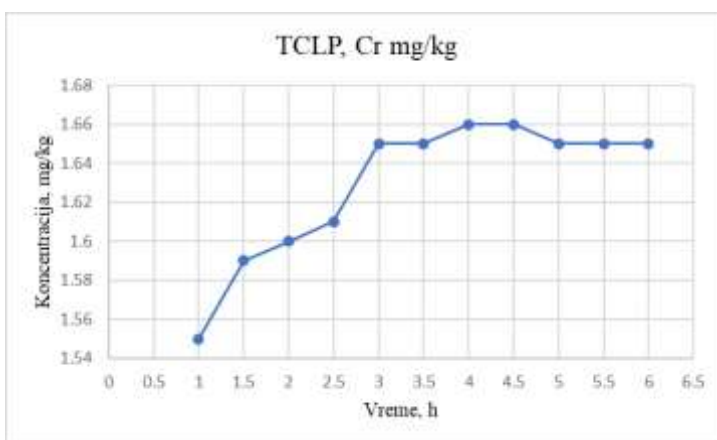
<i>Voda</i>	<i>DTPA</i>	<i>TCLP</i>	<i>AR</i>
3,79	56,7	1,65	820



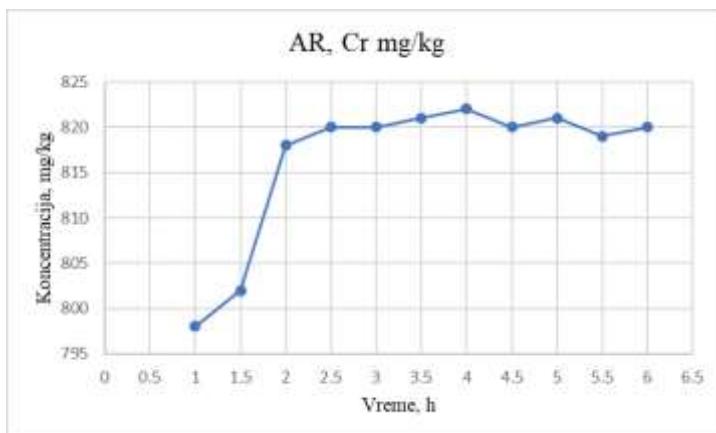
Slika 2. Sadržaj ukupnih Cr nakon izluženja vodom.



Slika 3. Sadržaj ukupnog Cr nakon izluženja sa DTPA.



Slika 4. Sadržaj ukupnog Cr nakon izluženja sa TCLP.



Slika 5. Sadržaj ukupnog Cr nakon izluženja sa carskom vodom.

3. ZAKLJUČAK

Na osnovu dobijenih rezultata može se zaključiti da ustaljivanje odnosno vreme na kome dolazi do ravnotežnog izluženja je nakon 2h. Primenom carske vode kao agresivnog sredstva dobiven je najveći sadržaj ukupnog Cr. Toksične forme ukupnog Cr ima manje u odnosu na vodorastvorljivu formu Cr. Lakopristupačnog Cr ima više nego vodorastvorljive forme. Prema Uredbi o graničnim vrednostima zagađujućih, štetnih i opasnih materija u zemljištu ("Sl. glasnik RS", br. 30/2018 i 64/2019), granična maksimalna vrednost za ukupni Cr je 100 mg/kg, dok je remedijaciona 380 mg/kg, shodno tome primenom AR može se u potpunosti izlužiti ukupni Cr iz zagađene prašinaste ilovače.

Zahvalnica—Autori se zahvaljuju na pomoći i podršci Miphem d.o.o. laboratoriji Beograd i Ministarstvu nauke. Autori se takođe zahvaljuju Ministarstvu nauke, tehnološkog razvoja i inovacije Republike Srbije (ugovor br. 451-03-47/2023-01/200052) na delimičnom učešću u radu.

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INVESTIGATION OF THE EFFICIENCY OF LEACHING TEST OF TOTAL CHROMIUM IN SILT LOAM

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ABSTRACT:

The paper analyzes the efficiency of extraction of total chromium from a composite sample of silt loam (waste soil). Ultrapure water, TCLP (Toxicity Characteristic Leaching Procedure) extraction solution, DTPA (diethylenepentaacetic acid) extraction solution and aqua regia (Aqua regia, AR) were used as leaching agents. The water-soluble form of Cr was determined by water leaching, the toxic amount of Cr was examined with TCLP, the easily accessible form of Cr was examined with DTPA, and the total amount of Cr with aqua regia. The test results showed that the highest Cr content is 820 mg/kg in aqua regis, 56.7 mg/kg in DTPA, 1.65 mg/kg Cr in TCLP, and 3.79 mg/kg Cr in water. The results indicated that the largest concentration of total Cr is bound to the silicate fraction of the soil, and as such is more difficult to leach with TCLP, DTPA and water.

Keywords: total chromium, environment, soil, leaching test

A NOTE ON SYMMETRIC STATISTICAL MANIFOLDS

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ABSTRACT:

Symmetric spaces were studied by Elie Cartan and they are his most important work on Riemannian geometry. We generalize notion of symmetric Riemannian manifold to statistical manifolds and initiate study of symmetric statistical manifolds. We define locally symmetric statistical manifolds as a generalization of locally symmetric Riemannian manifolds. We show that the statistical symmetric manifold is symmetric if and only if its dual statistical manifold is symmetric, define a new tensor R^K dependent on the symmetric tensor K that defines a statistical connection. Using the properties of a tensor R^K we prove our main result which states that a statistical manifold (M, ∇, g) is symmetric if and only if it is flat or the statistical connection ∇ is the Levi-Civita connection.

Keywords: statistical manifolds, symmetric manifolds

1. INTRODUCTION

We say that a Riemannian manifold is symmetric space if it is reflectionally symmetric around any point. For example, projective spaces, Grassman manifolds and their classical generalizations are symmetric spaces. Symmetric spaces are homogeneous. Their classification is given by Cartan.

Condition on the parallelism of of the curvature tensor, $\nabla R=0$, defines the class of locally symmetric spaces.

Statistical manifolds were introduced three decades ago by Amari as manifolds consisting of probability distributions [3].

We study statistical manifolds as a generalization of Riemannian manifolds, and we are interested in purely geometrical view of such objects. Hence, it is naturally to generalize important notions in Riemannian geometry to geometry of statistical manifolds.

A statistical manifold is triple (M, ∇, g) , where ∇ is a torsion-free connection, on which the Codazzi equation is satisfied:

$$(\nabla_X g)(Y, Z) = (\nabla_Y g)(X, Z).$$

Here g denotes Riemannian metric, and $X, Y, Z \in \Gamma(TM)$.

In this paper we will define locally symmetric statistical manifolds using Cartan's characterization of curvature tensor parallelism. Namely, we will define locally symmetric statistical manifolds as manifolds with curvature tensor R parallel with respect to both dual connections ∇ and ∇^* . We will prove that such manifolds are locally flat or that the statistical connection is Levi-Civita one.

2. PRELIMINARIES

A statistical connection ∇ on a statistical manifold (M, ∇, g) is defined as:

$$\nabla_X Y = \nabla_X^0 Y + K_X Y; X, Y \in \Gamma(TM).$$

Its dual connection ∇^* is defined as:

$$\nabla_X^* Y = \nabla_X^0 Y - K_X Y.$$

Here ∇^0 is the Levi-Civita connection on M , and $K_X Y$ is a (1,2)-tensor satisfying the following two properties:

$$K_X Y = K_Y X$$

and

$$g(K_X Y, Z) = g(Y, K_X Z); X, Y, Z \in \Gamma(TM).$$

From the properties of statistical connection ∇ we easily conclude that:

$$(\nabla_X g)(Y, Z) = -2g(K_X Y, Z).$$

Dual connection ∇^* on M is defined by:

$$Xg(Y, Z) = g(\nabla_X Y, Z) + g(Y, \nabla_X^* Z); X, Y, Z \in \Gamma(TM).$$

Curvature tensors R and its dual R^* are defined by:

$$R(X, Y)Z = \nabla_X \nabla_Y Z - \nabla_Y \nabla_X Z - \nabla_{[X, Y]} Z,$$

and

$$R^*(X, Y)Z = \nabla_X^* \nabla_Y^* Z - \nabla_Y^* \nabla_X^* Z - \nabla_{[X, Y]}^* Z.$$

They are related by:

$$g(R(X, Y)Z, W) = -g(R^*(X, Y)W, Z). \quad (1)$$

Corresponding curvature (0,4)-tensors are:

$$R(X, Y, Z, W) = g(R(X, Y)W, Z)$$

and

$$R^*(X, Y, Z, W) = g(R^*(X, Y)W, Z).$$

A curvature tensor R has the following properties:

$$R(X, Y, Z, W) = -R(Y, X, Z, W),$$

$$R(X, Y, Z, W) + R(Y, Z, X, W) + R(Z, X, Y, W) = 0,$$

$$R(X, Y, Z, W) + R(Y, W, Z, X) + R(W, X, Z, Y) = 0.$$

Similarly holds for R^* .

A tensor $K \cdot R$ is defined by:

$$K \cdot R = -R(K_Y X, Y, Z, W) - R(X, K_Y Y, Z, W) - R(X, Y, K_Y Z, W) - R(X, Y, Z, K_Y W).$$

We recall that a Riemannian manifold is called symmetric if the Riemannian curvature tensor R^0 satisfies the condition $\nabla^0 R^0 = 0$, where ∇^0 denotes the Levi-Civita connection and R^0 is defined by:

$$R^0(X, Y)Z = \nabla_X^0 \nabla_Y^0 Z - \nabla_Y^0 \nabla_X^0 Z - \nabla_{[X, Y]}^0 Z.$$

We will generalize this condition to statistical manifolds. That is, we will observe the conditions $\nabla R=0$ and $\nabla^*R=0$ for a statistical connection ∇ and its curvature tensor R .

2. SYMMETRIC STATISTICAL MANIFOLDS

Definition 2.1. A statistical manifold (M, ∇, g) is called symmetric if

$$\nabla R=0$$

and

$$\nabla^*R=0,$$

where R is the curvature tensor of a statistical connection ∇ .

Proposition 2.2. (M, ∇, g) is a symmetric statistical manifold if and only if (M, ∇^*, g) is symmetric statistical manifold.

Proof.

Follows from the Definition 2.1 and (1). \square

In the case of parallel statistical manifolds, for $X, Y, Z, V, W \in \Gamma(TM)$, we get:

$$VR(X, Y, Z, W) = R(\nabla_V^0 X, Y, Z, W) + R(X, \nabla_V^0 Y, Z, W) + R(X, Y, \nabla_V^0 Z, W) + R(X, Y, Z, \nabla_V^0 W). \quad (2)$$

On the other hand,

$$VR(X, Y, Z, W) = Vg(R(X, Y)Z, W) = g(\nabla_V R(X, Y)Z, W) + g(R(X, Y)Z, \nabla_V^* W). \quad (3)$$

From (2) and (3), it follows that

$$K \cdot R(X, Y, Z, W, V) = -2R(X, Y, Z, K_V W).$$

We define (0,5)-tensors R^K and R^{K*} by :

$$R^K(X, Y, Z, V, W) = R(X, Y, Z, K_V W)$$

and

$$R^{K*}(X, Y, Z, V, W) = R^*(X, Y, Z, K_V W).$$

Proposition 2.3. Let (M, ∇, g) be a statistical manifold. For $X, Y, Z, V, W \in \Gamma(TM)$, the tensors R^K and R^{K*} satisfy the following:

$$R^K(X, Y, Z, V, W) = R(X, K_V W, Z, Y) + R(K_V W, Y, Z, X)$$

and

$$R^{K*}(X, Y, Z, V, W) = R^*(X, K_V W, Z, Y) + R^*(K_V W, Y, Z, X).$$

Proposition 2.4. On a statistical manifold (M, ∇, g) , the following properties hold:

$$\begin{aligned} R^K(X, Y, Z, V, W) &= -R^K(Y, X, Z, V, W), \\ R^K(X, Y, Z, V, W) + R^K(Y, Z, X, V, W) + R^K(Z, X, Y, V, W) &= 0, \\ R^K(X, Y, Z, V, W) &= R^K(X, Y, Z, W, V). \end{aligned}$$

The same three properties hold when we replace R^K by R^{K*} .

From the discussion above, we formulate the following.

Theorem 2.5. Let (M, ∇, g) be a symmetric statistical manifold. For vector fields $X, Y, Z \in \Gamma(TM)$, the relation

$$K \cdot R(X, Y, Z, W, V) = -2R^K(X, Y, Z, W, V),$$

holds.

In the case of parallel statistical manifolds, we calculate the derivative of $R(X, Y, Z, W) = g(R(X, Y)Z, W)$ with respect to ∇ . The result is that $(\nabla_V g)(R(X, Y)Z, W) = 0$, i.e. $g(R(X, Y)Z, K_V W) = R^K(X, Y, Z, V, W) = 0$.

From this we conclude that

$$g(R(X, Y)Z, R(U, V)W) = g(R(X, Y)Z, R^*(U, V)W)$$

for vector fields $X, Y, Z, U, V, W \in \Gamma(TM)$.

On the other hand, if we differentiate the equation $R(X, Y, Z, W) = -g(R^*(X, Y)W, Z)$ with respect to the statistical connection ∇ , we get that

$$g(R(X, Y)\nabla_V Z, W) = -g(R^*(X, Y)W, \nabla_V^* Z).$$

This is equivalent to

$$g(R^*(X, Y)W, K_V Z) = 0.$$

Therefore, we can conclude that

$$g(R(X, Y)Z, R(U, V)W) = g(R^*(X, Y)Z, R^*(U, V)W),$$

that is

$$R(X, Y)Z = R^*(X, Y)Z,$$

meaning that the statistical manifold (M, ∇, g) is conjugate symmetric.

Theorem 2.6. Every non-flat symmetric statistical manifold (M, ∇, g) is conjugate symmetric.

In the case of non-flat statistical manifolds, from the theorem above we can conclude the following.

Corollary 2.7. On a symmetric statistical manifold (M, ∇, g) we have that $K_V(R(X, Y, Z, W)) = 0$ for $X, Y, Z, W \in \Gamma(TM)$.

Proof. We have that

$$K_V(R(X, Y, Z, W)) = (K_V R)(X, Y, Z, W) - K \cdot R(X, Y, Z, W).$$

On the other hand,

$$R^K(X, Y, Z, V, W) = g(K_V(R(X, Y)Z), W) = g((K_V R)(X, Y, Z), W) - K \cdot R(X, Y, Z, W, V) - R^K(X, Y, Z, V, W).$$

From the last two equations, we conclude that

$$2R^K(X, Y, Z, V, W) = K_V(R(X, Y, Z, W)). \quad \square$$

From above, it follows that $R(X, Y, Z, K_V W) = 0$. That is, $g(R(X, Y)Z, K_V W) = 0$. From this equation, we conclude that three cases are possible:

- (1) A statistical manifold (M, ∇, g) is ∇ -flat, i.e. $R(X, Y)Z = 0$ for $X, Y, Z \in \Gamma(TM)$.
- (2) A tensor $K_V W = 0$, i.e. $\nabla = \nabla^0$.
- (3) A tensor $R(X, Y, Z, K_V W) = 0$.

Now we will assume that $R^K(X, Y, Z, V, W) = 0$, then $g(R(X, Y)Z, \nabla_V W) = g(R(X, Y)Z, \nabla_V^* W)$. This means that

$$g(R(X, Y)Z, R(X, Y)Z) = g(R(X, Y)Z, R^*(X, Y)Z). \quad (4)$$

Also, because of (1). we have that

$$g(R^*(X, Y)Z, \nabla_V W) = g(R^*(X, Y)Z, \nabla_V^* W),$$

i.e.

$$g(R^*(X, Y)Z, R(X, Y)Z) = g(R^*(X, Y)Z, R^*(X, Y)Z). \quad (5) \text{ From}$$

(5) and (6), we get:

$$g(R(X, Y)Z, R(U, V)W) = g(R^*(X, Y)Z, R^*(U, V)W).$$

Therefore, we conclude that $R(X, Y)Z = R^*(X, Y)Z$, i.e. $\nabla = \nabla^*$.

Lemma 2.8. Let (M, ∇, g) be a non-flat statistical manifold. If the tensor $R^K \equiv 0$, then $\nabla = \nabla^0$.

From the stated above, we can formulate the following result.

Theorem 2.9. A statistical manifold (M, ∇, g) is symmetric if and only if one of the following cases hold:

- (1) M is flat, or
- (2) $\nabla = \nabla^0$.

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***MEDICINSKE, BIOMEDICINSKE I FARMACEUTSKE
NAUKE***

***MEDICAL, BIOMEDICAL AND PHARMACEUTICAL
SCIENCES***

ANTIMICROBIAL ACTIVITY OF OS(II) COMPLEXES CONTAINING N,N,N-INERT LIGANDS DERIVATES OF PYRAZYL-PYRIDINE

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ABSTRAC

*Complexes of transition metals, including osmium complexes, are recognized for their good antitumor activity. Osmium complexes are considered to be potential anticancer agents with some of them also having potential as antimicrobial agents. Therefore, we have examined the antimicrobial activity of Os(II) complexes with N,N,N-inert ligands derivatives of pyrazyl-pyridine that showed good anticancer activity. Antimicrobial activity was tested by determining the minimum inhibitory concentrations (MIC) and minimum microbicidal concentration (MMC) using the microdilution plate method for four gram-positive and three gram-negative bacteria, one probiotic, and one yeast. Gram-positive bacteria showed the highest sensitivity except for the isolate *S. aureus*. MIC was in the range of <3.9 to >1000 µg/mL. The highest resistance was shown by the yeast *Candida albicans* ATCC 10231. Os3 is distinguished from the examined complexes by the strength of the antimicrobial activity. In the activity of this complex, there are no differences in the action between Gram-positive and Gram-negative bacteria. Os3 on bacteria operates in the range of <7.8 for MIC to 250 µg/mL for MMC*

Keywords: *Os(II) complexes, antibacterial, antifungal*

1. INTRODUCTION

According to the World Health Organization, [1] after cardiovascular disease, various cancers are the leading cause of death, with lung cancer having the highest

mortality rate. Cancer-related deaths are followed by the number of HIV-related deaths. Some researches suggest that the increasing occurrence of various viruses such as Covide-19, H1N1, SARS, MERS, etc., which are claiming more and more lives, should be taken into account, and viral infections may be the main cause of death in the future. [2] Every year, billions of Euros are spent on the treatment of these diseases worldwide, which indicates that research in the field of inventing more effective drugs with fewer side effects and more economical drugs is necessary in the present era. The current situation shows that the major challenges in modern medicine are: 1) the resistance of microorganisms, which has become a worldwide problem, 2) the use of drugs, which is increasing dramatically, while the discovery of new drugs is slowing down drastically, 3) the diagnosis of an increasing number of diseases for which new drugs must be found. It is estimated that the number of deaths caused by resistant microorganisms will increase to 10 million by 2050, exceeding the number of deaths from cancer (WHO, 2014).

What is the role of transition metals in this story? It is known that iron compounds have been used since ancient times to treat anemia, silver is known for its antibacterial effects, and lithium compounds are used to treat various forms of depression. After the discovery of the platinum(II) complex known as cisplatin, which has anticancer activity (today, most chemotherapy protocols contain cisplatin), research expanded into the use of transition metal compounds for medical purposes.[3-5] In addition to the intensive use of certain transition metal compounds in chemotherapy, research has shown that transition metal compounds are effective as anti-HIV and anti-malarial agents, and also have antiviral and antibacterial activity[6,7] Research into the use of transition metals is widely justified because they are effective against diseases that cause millions of deaths worldwide each year.

Thus, in the present study, we investigated the antimicrobial activity of Os(II)complexes with N,N,N-inert ligands, which are pyrazyl-pyridine derivatives.

2. Experimental Section

2.1. Chemicals and solutions

Preparation of Os1, Os2 and Os3 complexes were, according to published procedures.[8] Dimethyl sulfoxide (DMSO) was purchased from Acros Organics (New Jersey, USA).

2.1.9. In vitro antimicrobial assay

Test substances, microorganisms, and suspension preparation the tested compounds were dissolved in DMSO and then diluted in a liquid culture medium to reach a concentration of 10%. The antibiotic doxycycline (Galenika A.D., Belgrade) was dissolved in a liquid culture medium, Mueller-Hinton broth (Torlak, Belgrade), while the antifungal fluconazole (Pfizer Inc., USA) was dissolved in Sabouraud dextrose broth (Torlak, Belgrade). The antimicrobial activity of the complexes was tested against four Gram-positive and three Gram-negative bacteria, one probiotic and one yeast (Table 1). The bacterial suspensions were prepared by the direct colony method. The turbidity of the

initial suspension was adjusted using a densitometer (DEN -1, BioSan, Latvia). When adjusted to the turbidity of the 0.5-McFarland standard [9], the bacterial suspension contained approximately 10^8 colony-forming units (CFU)/mL, and the yeast suspension contained 10^6 CFU/mL. Tenfold dilutions of the initial suspension were also prepared in sterile 0.85% saline. Bacterial inoculi were obtained from bacterial cultures incubated for 24 hours at 37°C on Mueller-Hinton agar substrate and brought to approximately 10^6 CFU/mL by dilution according to the 0.5-McFarland standard. Yeast inoculi were incubated for 48 h at 26 °C on tryptone soya agar substrate and brought up to approximately 10^4 CFU/mL by dilution according to the 0.5 McFarland standard.

Microdilution procedure: Antimicrobial activity was tested by determining the minimum inhibitory concentration (MIC) and minimum microbicidal concentration (MMC) using the microdilution plate method with resazurin. [10] The 96-well plates were prepared by adding 100 µl of a nutrient broth, Mueller-Hinton broth for bacteria and Sabouraud dextrose broth for yeast, to each well. An aliquot of 100 µl of stock solution of the tested compound (with a concentration of 2000 µg/ml) was added to the first row of the plate. Then, twofold dilution series were performed using a multichannel pipette. The concentration range obtained was between 1000 and 7.8 µg/mL. The method is described in detail in the report [11]. Doxycycline and fluconazole were used as positive controls. it was found that 10% DMSO (as solvent control) did not inhibit the growth of microorganisms. Each test included a growth control and a sterility control. All tests were performed in duplicate, and MICs were constant. Minimum bactericidal and fungicidal concentrations were determined by plating 10 µl of samples from wells in which no change in indicator color or mycelial growth was detected onto nutrient agar medium. At the end of the incubation period, the lowest concentration with no growth (no colony) was defined as the minimum microbicidal concentration.

3. RESULTS AND DISCUSSION

The antimicrobial activity of Os(II) complexes with *N,N,N*-inert ligands derivatives of pyrazyl-pyridine, that showed good anticancer activity, was investigated. The structure of investigated complexes have shown in Fig. 1., H_2L^{tBu} = 2,6-bis(5-tert-butyl-1H-pyrazol-3-yl)pyridine, Me_2L^{tBu} = 2,6-bis(5-tert-butyl-1 methyl-pyrazol-3-yl)pyridine, terpy = 2,2':6',2''-terpyridine.

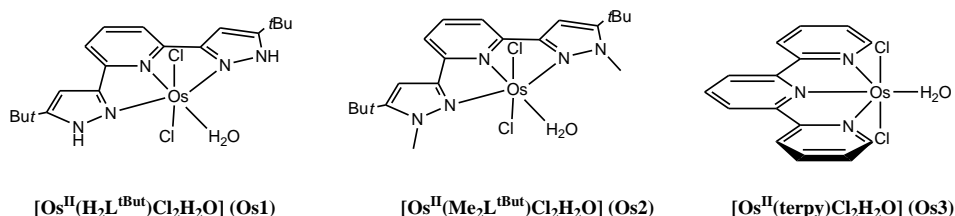


Figure 1. The structure of investigated complexes

The results of *in vitro* antimicrobial activity of studied compounds against four Gram-positive and three Gram-negative bacteria, one probiotic, and one yeast, were determined by the microdilution method. The results are presented in Table 1. Inhibitory effects of 10% DMSO on microorganism's growth was not observed. Generally, the compounds showed different degrees of antimicrobial activity.

Gram-positive bacteria showed the highest sensitivity except for the isolate *Staphylococcus aureus*. MIC was in the range of <3.9 to >1000 µg/mL. The highest resistance was shown by the yeast *Candida albicans* ATCC 10231.

Os3 is distinguished from the examined complexes by the strength of the antimicrobial activity. In the activity of this complex, there are no differences in the action between Gram-positive and Gram-negative bacteria. Os3 on bacteria operates in the range of <7.8 for MIC to 250 µg/mL for MMC. For Gram-negative bacteria, Os3 acts at the same level as positive control doxycycline. Looking at the effect of the positive control, we can see that Os3 acts better than doxycycline on *Proteus mirabilis* ATCC 12453.

Table 1. The results of *in vitro* antimicrobial activity of studied Os1, Os2 and Os3 complexes.

Species / compounds		OS1	OS2	OS3	Doxycycline/ Fluconazole
<i>Lactobacillus plantarium</i>	MIC ^a	15.6	250	<7.8	0.45
	MMC ^b	15.6	1000	15.6	7.8
<i>Staphylococcus aureus</i> ATCC 25923	MIC	<3.9	125	<7.8	0.22
	MMC	375	250	250	3.75
<i>Staphylococcus aureus</i>	MIC	500	>1000	15.6	0.45
	MMC	>1000	>1000	31.25	7.8
<i>Bacillus subtilis</i> ATCC 6633	MIC	15.6	125	<7.8	1.95
	MMC	125	250	15.6	31.25
<i>Bacillus subtilis</i>	MIC	<7.8	250	<7.8	0.11
	MMC	250	250	11.7	1.95
<i>Escherichia coli</i>	MIC	>1000	1000	15.6	15.6
	MMC	>1000	>1000	46.8	31.25
<i>Salmonella enterica</i>	MIC	1000	500	<7.8	15.6
	MMC	>1000	>1000	<7.8	31.25
<i>Proteus mirabilis</i> ATCC 12453	MIC	15.6	31.25	<7.8	250
	MMC	47.3	93.75	<7.8	>250
<i>Candida albicans</i> ATCC 10231	MIC	>1000	>1000	500	31.25
	MMC	>1000	>1000	1000	1000

^a MIC values (µg/mL) – means inhibitory activity

^b MMC values (µg/mL) – means microbicidal activity

Previous research shows different antimicrobial activities of osmium complexes. Some studies show the activity of Os(II) complexes in both Gram-positive and Gram-negative bacteria [12]. The antimicrobial activity of other osmium complexes is very significant as it has been demonstrated against highly resistant strains of both Gram-positive and Gram-negative bacteria such as *E. coli* (EC958), *S. aureus* (MRSA), *A. baumannii* (AB184), and *P. aeruginosa* (PA2017). Antimicrobial activity was demonstrated in MRSA cells, with an MIC was 32 µg/mL [13]. In contrast to our study, one study shows that the osmium complex exhibits significant activity on Gram-positive bacteria and *Candida albicans*, whereas it shows no activity in selected Gram-negative bacteria [14]. Some osmium complexes show no activity on standards of Gram-negative bacteria (*Pseudomonas aeruginosa* ATCC27853, *Escherichia coli* ATCC25922) or clinical isolates of *Acinetobacter baumannii* or yeasts (*Candida albicans* SC5314, *Candida auris* ATCC21092). Conversely, Gram-positive *Staphylococcus aureus* ATCC11007 and *Enterococcus faecalis* ATCC29112 are sensitive to the same complexes. The same complexes show activity against isolates of highly resistant MSSA, MRSA, VSE, and VRE, where they exhibit MIC values in the low micromolar range (MIC<10 µM) [15]. Osmium(II) complex showed antinicrobial activity against *M. smegmatis* and bactericidal activity against drug-resistant *E. faecalis* and methicillin-resistant *S. aureus* ATCC 43300 (Gichumbi et al 2018).

3. CONCLUSION

The obtained data showed that the studied complexes exhibited significant antimicrobial activity. A significant number of Gram-positive bacteria showed the highest sensitivity, with the exception of the isolate *S. aureus*. The highest resistance was shown by the yeast *Candida albicans* ATCC 10231. Os3 differs from the studied complexes in the strength of antimicrobial activity. There are no differences in the activity of this complex between Gram-positive and Gram-negative bacteria

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METHODS FOR EGFR VARIANTS ANALYSIS IN NSCLC PATIENTS

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ABSTRACT:

Lung cancer (LC) is the leading cause of death in the world. NSCLC (non-small cell lung cancer) is the predominant form of LC. In the last decade, research and treatment of NSCLC are improved based on molecular analyses used for the determination of the EGFR (epidermal growth factor receptor) variants. To update the findings from the search we performed ten years ago using just the PubMed database, we recently used 3 electronic databases: Web of Science, PubMed, and Scopus. The aim was to reveal the most often used methods to detect EGFR variants for NSCLC diagnostics, as well as to see the application of new techniques in the last ten years. In the first search from 2000-2011 within 292 papers were identified as eligible, and among various methods, PCR methods were identified in 45.2%. Results from a recent search showed that among 987 selected articles published from 2010-2020 showed that PCR methods were identified in 73.05%. Usage of methods for clinical diagnosis depends on many factors, prevalently economic circumstances. The methods of choice for EGFR variant identification are PCR combined with direct DNA sequencing.

Keywords: PCR, EGFR, NSCLC, lung cancer

1. INTRODUCTION

Non-small cell lung cancer (NSCLC) is a prevailing form of the lung cancer, that is still the deadliest cancers in the world [1]. The epidermal growth factor receptor (EGFR) is the key molecule in lung cancerogenesis. The EGFR protein is usually overexpressed, *EGFR* gene amplified, polymorphic and affected with somatic mutations many epithelial cancers [2-4]. The most examined *EGFR* variants with diagnostic and prognostic potential are mutations in 18-21 exons of the *EGFR* gene, and single nucleotide polymorphisms (SNPs): -216G>T (rs712829), CA repeat (rs11568315), rs712830 (-191C>A), and 181946

C>T, D994D (rs2293347) [5-7]. This paper aimed to review the implementation of standard and novel methods for the detection of *EGFR* variants in clinical research from 2000-2020.

2. LITERATURE SEARCH AND RESULTS

Previously, a literature search was performed from 2000-2011 involving Pub Med database with focus on *EGFR* mutations [8]. In a subsequent study [9], the findings were updated by searching for the studies published from 2010 to 2020 in the three electronic databases: ISI Web of Science, Pub Med, and Scopus. Details of the search methodology and identification of eligible studies, with precise inclusion and exclusion criteria, have already been published [8, 9]. Both studies present the application of the methods over the years, but here we present their percentage usage counted to the total number of eligible studies 292 [8] and 987 [9] (not in the total number of the identified methods).

Within 292 papers identified as eligible, PCR methods were found in 45.21% (Figure 1). Other methods identified were i.e. immunohistochemical analysis (IHC) in 30.48%, denaturing high performance liquid chromatography (dHPLC) with 4.45%, direct DNA sequencing (DS, referring to standard Sanger sequencing) with 14.73%, and recently developed (RD) 5.14% (Figure 1).

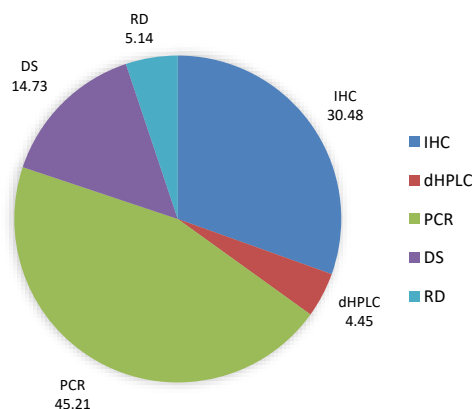


Fig.1. Percent* of methods for *EGFR* variants detection in the literature search from 2000-2011

Legend: *counted in the 292 total number of eligible articles; dHPLC-denaturing high performance liquid chromatography, DS-direct DNA sequencing, IHC-Immunohistochemical analysis, RD-recently developed.

The following study expanded the search not only for EGFR mutations, but also for *EGFR* single nucleotide polymorphisms that have proven clinical significance [5-7, 9]. A final 987 articles were analyzed and among them PCR methods were identified in 73.05% (Figure 2). Other methods identified for *EGFR* variant detection were 12.06% IHC, 7.50% hybridization methods, 40.53% direct DNA sequencing, 19.35% next generation sequencing, 4.96% proteomics, 3.44% recently developed methods (Figure 2).

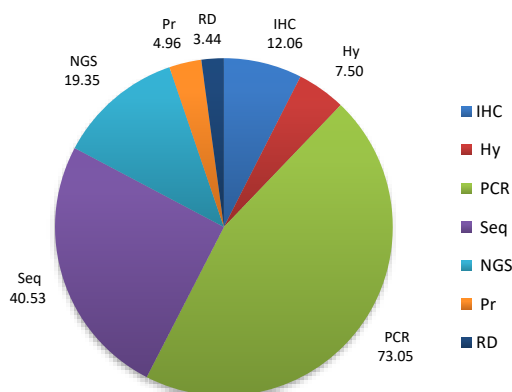


Fig.2. Percent* of methods for EGFR variants detection in the literature search from 2010-2020

Legend: *counted in the 987 total number of eligible articles; IHC-Immunohistochemical analysis, Hy-hybridisation methods, Seq-direct DNA sequencing, NGS-next generation sequencing, Pr-proteomics, RD-recently developed methods.

2. DISCUSSION

In two previous reviews, the methods used in clinical research for identifying the *EGFR* variants in NSCLC patients have been analyzed and compared for the past two decades (2000-2011) and (2010-2020). It was presented here the simplified percentual methods usage in general, not in terms of year of application, or region in the world, as published before [8, 9]. In the two previous studies, it was elaborated on the advantages and disadvantages of screening and target methods applied in twenty years of research [8, 9]. In clinical use, conventional methods were cost effective, with fast results, and much more convenient for diagnostics of target *EGFR* mutations-deletion of exon 19 and point mutation of exon 21 [9-11]. As a result, in 2000-2011 30.48% of the studies applied IHC (Figure 1), but in 2010-2020 they were applied as follows: 12.06% IHC, 7.50% hybridisation methods, and 4.96% proteomics (Figure 2).

The detection of *EGFR* variants relies still on standard techniques, direct DNA sequencing and PCR. In the period of 2000-2011, PCR methods were found in 45.2% and 14.73% direct DNA sequencing of total 292 identified papers (Figure 1). As of 2010-2020, PCR and sequencing dominated clinical research applications with 73.05% and 40.53%, respectively (Figure 2). Their cost-effectiveness and adaptability made them widely applied to the detection of *EGFR* variants [8, 9, 13]. It was evident that the adaptability of PCR methods was of great importance during the Covid-19 pandemic [15].

As fundamental and clinical research progresses throughout the world, advanced methods have emerged. NSCLC treatment in advanced stages often requires approaches like surgical resections or biopsies. After those invasive procedures, DNA from tissue samples is analysed to identify *EGFR* somatic mutations, affecting 18 to 21 *EGFR* gene exons. Particularly the intracellular tyrosine kinase domain is altered in the *EGFR* receptor and promoting signals toward cancerogenesis [5-7, 16, 17]. Therapy involving the tyrosine kinase inhibitors (TKIs) were effective in preventing the spread of the aberrant signals in carriers of these somatic mutations. Unfortunately, mutations connected with resistance appeared shortly after TKI implementation [16-18]. Therapy efficacy may also be affected by other *EGFR* variants, such as germline SNPs that can alter *EGFR* gene regulation. *EGFR* polymorphisms were significantly associated with survival, progression-free survival (PFS), and overall survival (OS) in NSCLC patients treated with *EGFR*-TKIs [19, 20]. On the other hand, different genetic susceptibility to lung cancer was evident considering *EGFR* variants among different ethnic populations [21]. In the future, it will be challenging to identify *EGFR* molecular germline markers with easy and reproducible methods that could replace the diagnostic or prognostic potential of *EGFR* mutations. Recent liquid biopsies could detect *EGFR* mutations from blood which contains circulating free tumor DNA (ctDNA) [22, 23]. But beside blood, samples like saliva, sputum, urine, pleural secretions, could analyse ctDNA by using quantitative polymerase chain reaction (qPCR), digital PCR (dPCR) or digital droplet PCR (ddPCR), or next generation sequencing (NGS) [22-26]. *So instead of complex re-biopsy of NSCLC patients, EGFR resistance mutation could be identified with this less invasive liquid biopsies techniques* which is important for accurate therapy decisions. For example, if the common *EGFR* T790M resistance mutation is confirmed, osimertinib is prescribed, otherwise chemotherapy is recommended [24]. Advanced methods have high sensitivity and specificity, and capacity to detect novel variants of clinical importance in a small sample size [8, 9, 12, 22, 23]. Besides *EGFR* mutations, the other genetic alterations panel was examined by NGS methods: *KRAS*, *NRAS*, *BRAF*, *PIK3CA*, *MET* and *ERBB2* mutations relative to *EGFR*-TKI resistance [25]. That novel methods were evidenced here

in smaller percent of 3.44% (Figure 2). It is likely that these constraints in the application of those advanced methods stem from economic factors as well as limitations on equipment and/or expertise for low- and middle-income counties [8, 9, 13, 14, 24].

3. CONCLUSION

The PCR and sequencing methods were mostly used in clinics for the detection of *EGFR* variants in NSCLC patients. Many advanced methods have emerged, but their costs often limit their broad use.

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A COMPARISON OF THREE DOSIMETRIC PATIENT QUALITY ASSURANCE TOOLS FOR PRECISION RADIOTHERAPY OF HEAD AND NECK CANCER

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ABSTRACT:

Precise and very complex radiotherapy technique Volumetric Modulated Arc Therapy (VMAT) provides uniform and conform dose distribution. Despite that, there is still a possibility that due to precision in the dose calculation of the treatment planning system (TPS) or the errors associated with it, there can be distinctions between dose distributions which are planned and delivered. The gamma index (GI) is the parameter by which is quantified the difference between these dose distributions and this index may depend on the pathology and the area to be treated. The goal of this work is to estimate different parameters of the gamma index (GI) for head and neck cancer treatments. The analysis was based 2%/2 mm, 3%/3 mm criteria. 10 treatment plans were created with the VMAT technique calculated with the TPS Eclipse V.15.6 (Varian Medical Systems, Palo Alto, CA) and measured with the Dolphin (IBA dosimetry, GmbH, Germany), PTW Octavius 4D 1500 (PTW-Freiburg, Freiburg, Germany) and Varian aS1200 electronic portal imaging device-EPID (Varian Medical Systems, Palo Alto, CA) were analyzed. A Varian VitalBeam, linear accelerator with a 6 MV photon beam was used to deliver the dose. The obtained results of the analysis were that a gamma passing rate (%GP) greater than 90% for 2%/2 mm and greater than 95% for 3%/3 mm analysis criteria. The criteria for gamma analysis can be less strict and then the %GP can increase. A significant difference was also observed when the PTV has a greater volume.

Keywords: VMAT; gamma index (GI); patient quality assurance.

1. INTRODUCTION

Radiation therapy is one of the most common and widely used cancer treatment methods. Significant technological and imaging improvements have impacted radiotherapy techniques over the past few decades, increasing their accuracy, flexibility, and efficiency. Three-dimensional conformal radiotherapy (3D CRT) [1], intensity modulated radiation therapy (IMRT) [2], and volumetric modulated arc therapy (VMAT) [3,4,5] are three different techniques of cancer treatment. A techniques IMRT and VMAT demand precise control during radiation delivery and, therefore, in order to determine the distinction between calculated and actual dose distributions, more extensive quality assurance (QA) checks are required. Quality assurance (QA) in radiation therapy aims to minimize the dose deposited in healthy tissue and staff exposure while ensuring adequate patient monitoring to determine the final outcome of treatment. Consists of a series of processes [6]. Due to uncertainty of the target position, patient positioning mistakes, motion organs during therapy, as well as, problems in dose calculation, and errors in plan transfer or beam delivery are all potential risks connected with modern radiotherapy. Therefore, quality assurance should be performed before and/or during patient treatment to provide optimal therapy with minimal damage to normal tissue and minimize errors [7]. In this study, three different dosimetric tools were used to evaluate the quality assurance (QA) results of VMAT plans from ten patients.

2. MATERIALS AND METHODS

VMAT plans for ten patients who underwent radiotherapy were generated at the Centre of Radiation Oncology, the University Clinical Center Kragujevac. All plans were created with Eclipse v.15.6. (Varian Medical Systems, Salt Lake City, UT, USA) radiation planning system using the anisotropic analytical algorithm (AAA). To compare the TPS (treatment planning system) dose with measured doses, the gamma index (GI) method is used. This method integrates, into one parameter, percent dose difference (%Diff) and distance-to-agreement (DTA) [8]. DD (dose difference) is a % directly compares the measured dose at each point to the corresponding calculated dose at that point, DTA (distance to agreement)(mm), tests measure the distance between a point on the measured dose distribution and the nearest point on the calculated distribution with equal dose[9]. There are several criteria for calculating VMAT treatments 1%=1 mm, 2%=2 mm, 3%=2 mm, 2%=3 mm, 3%=3 mm and 5%=3 mm, but 3%=3mm is the most widely used. Acceptance criteria consist of more than 95% of the evaluated points with a global gamma index < 1. Gamma index attempts to combine dose difference and DTA into a single metric that is useable in both areas of dose gradient and homogeneous dose [9]. The comparison of passing rates was made among the three dosimetric tools: Dolphin (IBA dosimetry, GmbH, Germany), PTW Octavius 4D 1500 (PTW-Freiburg, Freiburg, Germany) and EPID QA (Varian aS1200 electronic portal imaging device, Varian Medical Systems, Palo Alto, CA)

EPID QA (electronic portal imaging device quality assurance) detect the radiation transmitted through the patient and treatment couch [10,11]. EPID can be configured in two ways, independent calculation on the patient CT dataset or using the patient/phantom in the beam and the corresponding dose again can be estimated on the patient. EPID QA (Varian aS1200 electronic portal imaging device) was attached to the Varian VitalBeam Linear accelerator (Varian Medical Systems, Palo Alto, CA, USA). For dosimetry mode, the active area of the EPID is $40 \times 40 \text{ cm}^2$, with 1190×1190 pixels arrays and 0.336 mm pixel pitch. Octavius®-4D (PTW-Freiburg, Freiburg, Germany) is a powerful tool for quality assurance (QA) of radiotherapy treatments and can be easily set up [12]. Octavius®-4D use 1405 detectors type plane-parallel vented ionization chambers. The detector size is $4.4 \text{ mm} \times 4.4 \text{ mm} \times 3 \text{ mm}$ (0.06 cm^3), the maximum field size is $27 \text{ cm} \times 27 \text{ cm}$. For analysing data Octavius uses VeriSoft (PTW). A commercially available dosimetry solution, Dolphin-Compass (IBA Dosimetry, Schwarzenbruck, Germany), reconstructs 3D doses of a phantom or patient [13]. The Dolphin uses Compass software to compare 3D dose distributions and Dose Volume Histograms (DVH) between planned and computed doses. The Dolphin is a 2D detector array consisting of 1513 air-vented plain parallel ionization chambers arranged across an area of $40 \times 40 \text{ cm}^2$. The detector size is 3.2 mm (\varnothing) $\times 2.0 \text{ mm}$ (h), (0.016 cm^3), and full treatment fields are $24.3 \times 24.3 \text{ cm}^2$.



(a)



(b)



(c)

Fig.1 Machine set up for: (a) EPID QA, (b) Octavius®-4D, (c) Dolphin

3. RESULTS

Using three prescription dose verification tools, gamma analysis was performed on ten selected VMAT plans as shown in Table 1. The criteria applied to the gamma index analysis were 2%/2 mm, and 3%/3 mm. For the 2%/2mm criterion, the mean pass rates for Dolphin, EPID, and Octavius 4D were $93.2\% \pm 2.6\%$, $95.1\% \pm 1.9\%$, and $91.1\% \pm 2.8\%$, respectively. When the criteria was 3%/3 mm, the average pass rates were $99.3\% \pm 0.7\%$, $99.7\% \pm 0.3\%$, and $98.4\% \pm 1.3\%$ for Dolphin, EPID, and Octavius 4D, respectively.

Based on the results of all three prescription dose verification tools, the criteria were satisfied. It can be noted that when changing the criteria from 2%/2m to 3%/3mm, the cases satisfying the > 95% pass rate criteria were considerably increased. While, the mean standard deviations of all three tools tended to decrease gradually in the order of EPID, Dolphin and Octavius 4D.

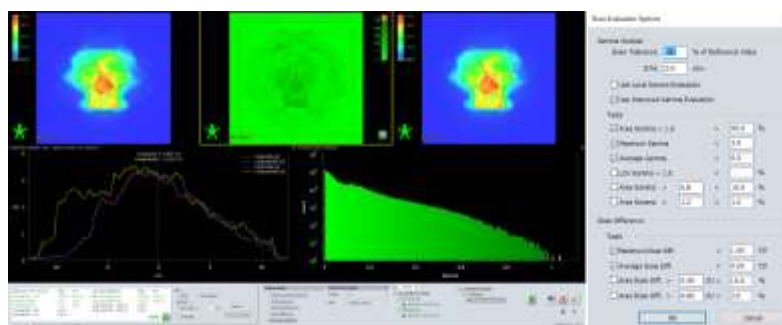


Figure 2. The interface of evaluation gamma analysis 3%/3 mm with potral dosimetry for EPID aSi-1200.

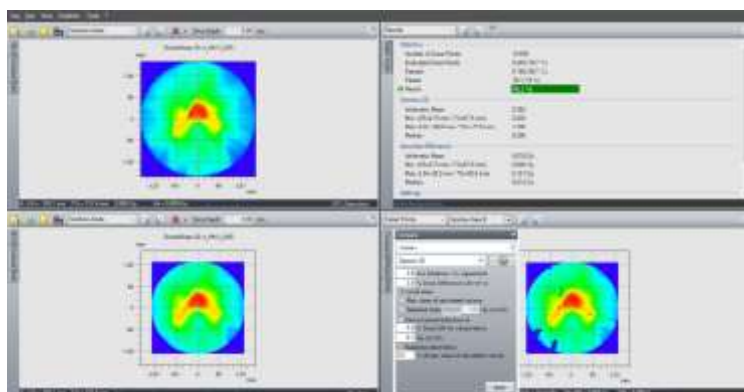


Figure 3. The interface of evaluation gamma analysis 3%/3 mm with VeriSoft for PTW Octavius 4D 1500.

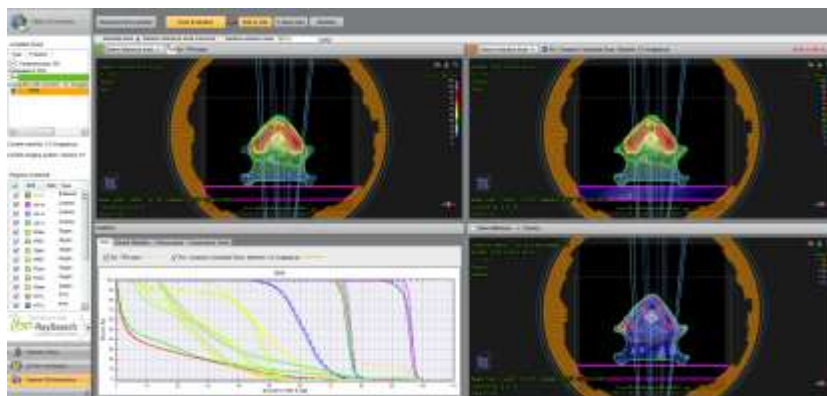


Figure 4. The interface of evaluation gamma analysis 3%/3 mm with Compass for Dolphin – IBA Dosimetry.

Table 1 Gamma analysis results obtained using, EPID, Octavius 4D and Dolphin dosimetry tools.

Patient	EPID		Octavius 4D		Dolphin	
	2%/2 mm [%]	3%/3 mm [%]	2%/2 mm [%]	3%/3 mm [%]	2%/2 mm [%]	3%/3 mm [%]
1	97,7	100	93,9	99,7	94,7	99,9
2	97,3	100	92,9	99,1	95,4	100
3	92,9	99,5	89,3	97,7	90,6	98,9
4	96,1	99,8	92,6	98,7	93,9	99,6
5	95,8	100	92	99,3	95,3	100
6	94,4	99,4	90,2	97,5	91	98,6
7	92,5	99,4	88,8	97,9	91,7	98,7
8	97	100	93,4	98,9	95,8	99,7
9	94,1	99,5	89,6	98,1	92,5	99
10	93,2	99,4	88,3	97,1	91,1	98,6
Mean	95.1	99.7	91.1	98.4	93.2	99.3

4. CONCLUSION

The gamma evaluation method is typically used to verify the actual dose distribution that will be delivered to the patient when a VMAT treatment is to be performed. QA results are acceptable when they achieve a passing rate higher than 95%, based on a 3% tolerance for dose difference and a 3 mm tolerance for distance to an agreement. In this study, the result of the gamma index obtained by EPID, Octavius 4D and Dolphin was examined. This report provides all three suggested standards are efficient detectors for a patient-specific QA and can be implemented at the clinical level to evaluate the acceptability of VMAT plans, specifically in the busy centre of radiation oncology.

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MOLECULAR DOCKING STUDY OF SELECTED NUSBIARYLINS AS POTENTIAL NONCOVALENT INHIBITORS OF SEVERE ACUTE RESPIRATORY SYNDROME CORONAVIRUS 2 MAIN PROTEASE

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ABSTRACT:

Given the fact that coronavirus pandemic is a major public health concern nowadays, there is the constant need to develop the new effective drugs against severe acute respiratory syndrome coronavirus 2. Computer-aided drug design is a time-saving efficient tool that can quickly identify new promising compounds. Biaryl compounds targeting N-utilisation substances, called “nusbiarylins” represent a group of new ribosomal RNA synthesis inhibitors with potential antibacterial activity. In this paper, we wanted to evaluate the potential of these antibacterial compounds to inhibit severe acute respiratory syndrome coronavirus 2 viral replication. The aim of this in silico study was to estimate antiviral potential of seven newly designed nusbiarylin derivatives (1-7) based on inhibition of severe acute respiratory syndrome coronavirus 2 main protease. AutoDock Vina software was used for the binding analysis of designed compounds into the active site of the severe acute respiratory syndrome coronavirus 2 main protease (PDB ID: 5RGX). Analysis of binding poses revealed that benzamide derivative 1 achieved the lowest free binding energy value of -7.1 kcal/mol, while mercaptobenzoate derivative 4 formed the highest number of significant binding interactions (six). Based on number, type of key binding interactions and docking scores, we can conclude that compounds 1 and 4 demonstrated the highest binding affinity for the target enzyme and therefore possess the best antiviral potential against severe acute respiratory syndrome coronavirus 2.

Keywords: coronavirus 2 main protease, nusbiarylins, molecular docking, AutoDock Vina, binding analysis

1. INTRODUCTION

Computer-aided drug design (CADD) represents the fundamental *in silico* approach in the identification of promising active compounds. Molecular docking methodology, within structure-based virtual screening is an efficient tool in the rapid binding potential evaluation of a large number of synthetic, naturally occurred and hypothetical designed compounds, when the structure of the target protein is known [1,2].

In December 2019, a novel coronavirus has spread to more than 200 countries in the world, wherefore World Health Organization (WHO) declared a global pandemic, titled the virus as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and the viral disease as Coronavirus Disease 2019 (COVID-19) [3]. According to WHO, on 26 April, 2023, there were 764,474,387 confirmed cases of COVID-19, including nearly seven million fatal outcomes [4].

SARS-CoV-2 therapeutic drug targets include the envelope spike (S) protein, envelope (E) protein, membrane (M) protein, nucleoprotein (N), replicase polyprotein, main protease, and papain-like protease [5]. The chymotrypsin-like cysteine protease (3CL^{Pro}) or main protease of the SARS-CoV-2 (M^{Pro}), cleaves the viral polypeptides to generate various non-structural proteins that are essential for viral replication. M^{Pro} consists of three domains: domain I (residues 8-101), domain II (residues 102-184), and domain III (residues 201-303). Domain II and III connecting region is labeled as a long loop (residues 185-200) [6].

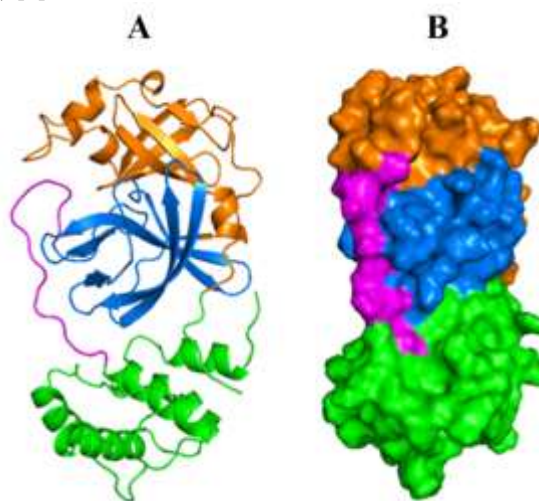


Fig. 1. SARS-CoV-2 M^{Pro} protein backbone with constituent domains. Domain I is colored brown, domain II blue, domain III green, and connecting region is colored pink.
B) Surface presentation of the enzyme with domains.

Current COVID-19 treatments including antivirals such as molnupiravir, ritonavir-boosted nirmatrelvir, and remdesivir, interleukin-1 receptor antagonist, anakinra, as well as monoclonal antibodies such as tixagevimab/cilgavimab, regdanvimab, casirivimab/imdevimab, and sotrovimab [7].

Nusbiarylins got their name based on biaryl structure (Figure 2) and substances from the group of Nus (N-utilization substances) proteins which are their biological targets. In a recent study, it was observed that compounds from this group demonstrated antibacterial activity against clinically significant strains of bacteria, including Methicillin-Resistant *Staphylococcus aureus* (MRSA). It is believed that nusbiarylins inhibit the synthesis of bacterial ribosomal ribonucleic acid, whereby RNA polymerase and various transcription factors play a key role in this process. Given the fact that formation of the NusB-NusE heterodimer is the first necessary step in the formation of the rRNA transcription complex, scientists hypothesized that molecules inhibit the formation of this heterodimer also exert antibacterial activity [8,9]. In a line with that, we wanted to estimate the ability of selected nusbiarylins to interact with the active site of the SARS-CoV-2 M^{pro}, and thus evaluate their antiviral potential against this virus.

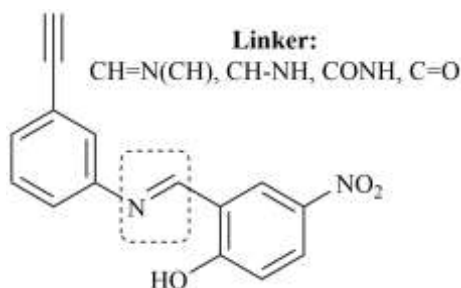


Fig. 2. General structure of nusbiarylins

The aim of this *in silico* study was to estimate antiviral potential of seven newly designed nusbiarylin derivatives (**1-7**) based on inhibition of SARS-CoV-2 M^{pro}.

2. MATERIALS AND METHODS

2.1. Designed compounds

In this *in silico* study we designed the seven nusbiarylin derivatives, which structural formulas are presented in the Figure 3.

2.2. Ligand preparation

Energy optimization of compounds's conformations was performed in Chem3D Ultra 7.0 software [10], using AM1 semi-empirical method. Subsequently, pdb files of tested molecules were converted to the mol2 format in the Mercury 3.10.2 software [11], and finally prepared for molecular docking in AutoDockTools 1.5.6 [12], where rotatable bonds were defined and Gasteiger charges were added.

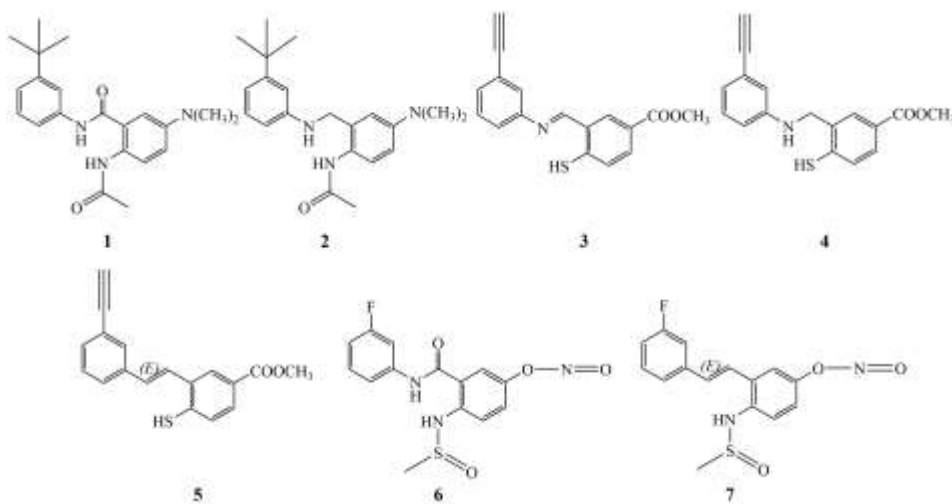


Fig. 3. Chemical structures of designed nusbiarylin derivatives

2.3. Selection and preparation of receptors

Crystal structure of SARS-CoV-2 M^{pro} (PDB ID: 5RGX) in complex with co-crystallized ligand 2-(3-cyanophenyl)-N-(4-methylpyridin-3-yl)acetamide (PDB ID: UGP) was obtained from the Protein Data Bank [13]. BIOVIA Discovery Studio Visualizer [14] was utilized to remove dimethyl sulfoxide and water molecules. All docking calculations were performed on chain A of target protein where the binding site of co-crystallized ligand is located. AutoDockTools 1.5.6. was employed to prepare the protein for molecular docking by assigning non-polar and polar hydrogen atoms and converting protein structure into pdbqt format. Based on the UGP coordinates in the 5RGX crystal structure (x = 9.674, y = -0.342, and z = 20.841), a grid box of 28, 24, and 24 points in x-, y-, and z-direction, respectively, with grid spacing of 0.375 Å was defined and centered on the co-crystallized ligand.

2.4. Molecular docking protocol

Molecular docking study was performed in AutoDock Vina software [15], whereby nine binding poses were generated for the each investigated molecule. The semi-

flexible docking protocol was executed, in which protein coordinates were rigid, while ligands' conformations were flexible. For the purpose of molecular docking protocol validation, co-crystallized ligand was removed from its native crystal structure and re-docked it, afterwards the calculation of root-mean-square deviation (RMSD) value was performed. Molecular docking simulation is properly conducted if calculated RMSD value is less than 2.0 Å for the best-docked binding pose.

3. RESULTS AND DISCUSSION

As we mentioned above, RMSD value was calculated to confirm the validity of performed molecular docking study. By overlapping the native and re-docked conformers of co-crystallized ligand, RMSD value of 1.3922 Å (Figure 4) was obtained, indicating that molecular docking methodology was properly conducted.



Fig.4. Overlapping of native (green) and re-docked binding pose (magenta) of UGP in active site of SARS-CoV-2 M^{pro}.

In this *in silico* study selected nusbiarylin derivatives were modelled into the active site of SARS-CoV-2 M^{pro}. Within molecular docking analysis, the analogy between the binding mode of co-crystallized ligand UGP and tested compounds were determined based on a number and type of key non-covalent interactions, as well as docking scores of ligand's best-docked binding poses. In the interpretation of molecular docking results we consider the key binding interaction as those contacts achieved by the co-crystallized ligand in the binding site of the target protein. The molecular fitting of UGP into the active sites of SARS-CoV-2 M^{pro} revealed the following types of non-covalent interactions: conventional hydrogen bonds (His163 and Glu166), C-H hydrogen bonds (His164 and Asp187), π - π interaction (His41), hydrophobic interactions (Met49, Phe140, Leu141, Asn142, Met165) and single Van der Waals force (Gln189) (Figure 5).

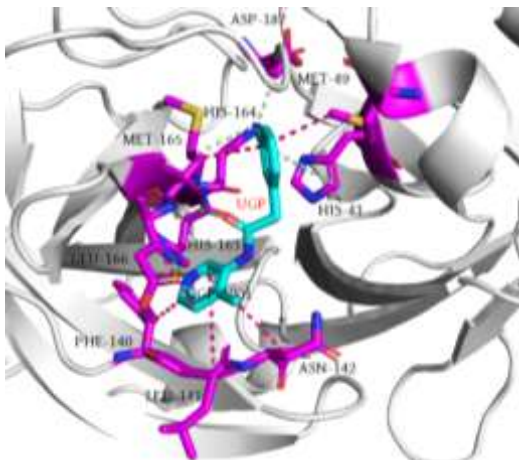


Fig. 5. Molecular docking of UGP into the SARS-CoV-2 M^{pro}. The conventional hydrogen bonds (green dotted lines), C-H hydrogen bonds (pale green dotted lines), and hydrophobic interactions (hot pink dotted lines) are shown. Key binding interactions fromed by best-docked conformations of investigated compounds are presented in Table 1.

Table 1. Key binding interactions formed by tested compounds

Compound	Hydrogen bonds	C-H hydrogen bonds	Hydrophobic interactions				π -S	π -cation	π -anion	Halogen interaction
			π - π	π -alkyl	π - σ	alkyl				
1	His41 His164	/	/	/	/	/	Met49	/	/	/
2	His164	Glu166	His41	/	/	/	Met49			/
3	Asn142	/	His41	His41	/	Met49 Met165	/	/	/	
4	His41 Asn142 His164	/	/	/	/	/	Met49	His41	Glu166	/
5	Asn142	/	His41	His41	/	Met49 Met165	/	/	/	/
6	Asn142	/	His41	/	Met49	/	Met165	/	/	His164
7	Asn142	/	His41		Met49	/	Met165	/	/	His164

Concerning the number of key binding interactions, it was observed that mercaptobenzoate derivative **4** formed the highest number of significant binding interactions (six), compounds **1** and **2** formed three and four significant interactions, while compounds **3**, **5**, **6** and **7** established five key interactions. Considering polar non-covalent interactions, compound **2** singled out by formation of a single C-H hydrogen bond with residue Glu166, while compound **4** achieved even three conventional hydrogen bonds with the corresponding residues. It is interesting to note that the electrostatic contacts play a significant role in the interaction of derivative **4** with the active site of the protein (Figure 6).

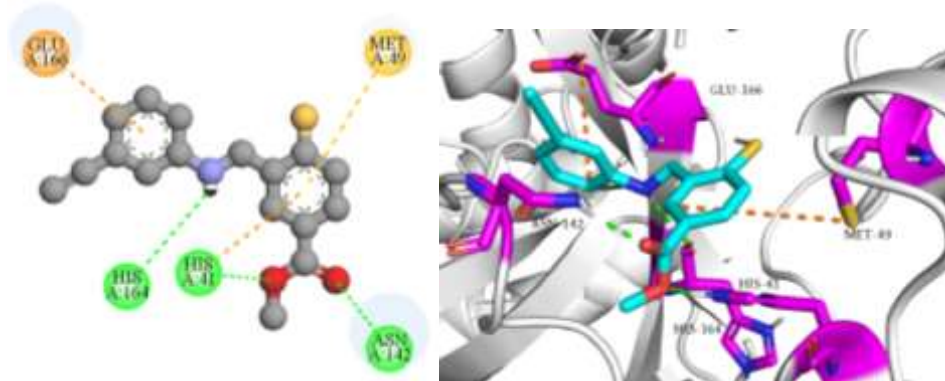


Fig. 6. Designed compound **4** modeled into the active site of the SARS-CoV-2 M^{pro}. (A) Two-dimensional and (B) three-dimensional representation of key binding interactions formed by compound **4**. Hydrogen bonds (green dotted lines), and electrostatic interactions (orange dotted lines) are shown.

None of the tested compounds formed conventional hydrogen bonds observed during molecular fitting of co-crystallized ligand. On the other hand, compounds **3** and **5** established the highest number of hydrophobic interactions – four each.

Lower value of free binding energy indicates stronger interaction of the tested compound and protein, thereby stronger inhibition. The binding energies of tested compounds (**1-7**) were -7.1, -6.7, -6.2, -6.5, -6.1, -6.5, and -6.8 kcal/mol, respectively. Benzamide derivative **1** demonstrated the highest binding affinity towards target protein as evident from the free binding energy value of -7.1 kcal/mol. Its molecular docking into the structure of SARS-CoV-2 M^{pro} was presented in the Figure 7.

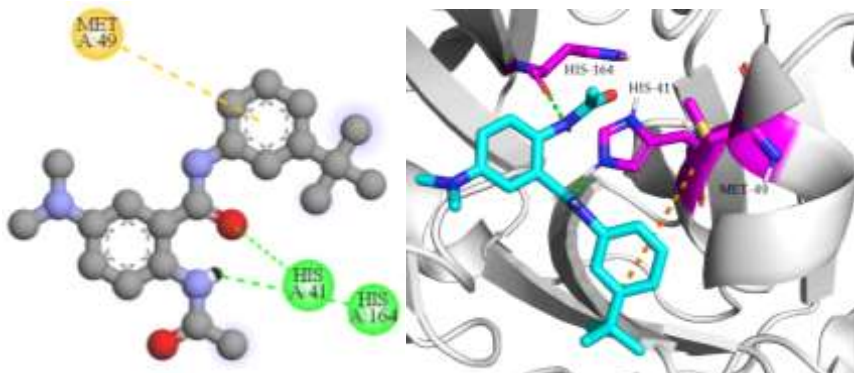


Fig. 7. Designed compound **1** modeled into the active site of the SARS-CoV-2 M^{pro}. (A) Two-dimensional and (B) three-dimensional representation of key binding interactions formed by compound **1**. Hydrogen bonds (green dotted lines), and electrostatic interactions (orange dotted lines) are shown.

If we compare the binding affinity of our compounds with the binding affinity published in previous studies, contradictory conclusions can be made. Oseltamivir, ritonavir, and ribavirin bound to the same target protein with free binding energy values of -7.3, -6.5, and -5.4 kcal/mol, respectively, indicating a comparable binding affinity of these molecules compared to tested compounds [16]. Azithromycin [17] exhibited free binding energy value of -6.3 kcal/mol, which was again comparable to the values obtained for our compounds. On the other hand, free binding energy value of -7.9 kcal/mol was observed throughout simvastatin interaction with the SARS-CoV-2 M^{pro}, which was lower compared to our tested compounds [18].

Considering all binding parameters data, it can be noticed that compound **1** exhibited the lowest value of free binding energy, while compound **4** formed the highest number of key binding interactions with protein. The binding orientation of these two compounds with respect to binding mode of UGP in the active site of SARS-CoV-2 M^{pro} is shown in Figure 8.

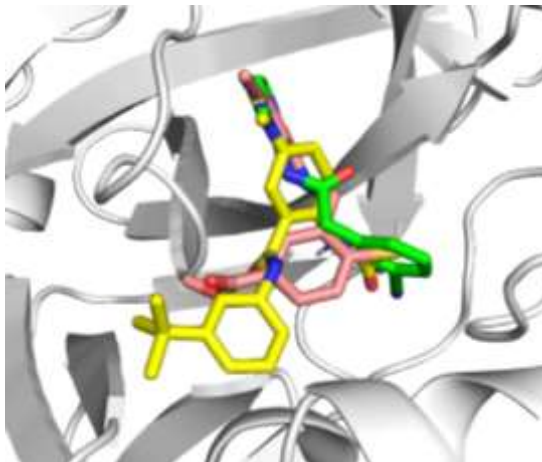


Fig. 8. Mutual binding orientation of UGP (colored green) and the best-docked conformations of compounds **1** (colored yellow) and **4** (colored red) in the active site of the SARS-CoV-2 M^{pro}

3. CONCLUSION

Based on binding assessment criteria, we can conclude that compounds **1** and **4** demonstrated the highest binding affinity for the target enzyme and therefore possess the best antiviral potential against SARS-CoV-2. In a line with that, derivatives **1** and **4** can be underlined as the best *in silico* hits for the inhibition of SARS-CoV-2 replication and represent the most promising molecules for further *in vitro* and *in vivo* investigation of their antiviral potential.

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ARYLALKANOIC ACID DERIVATIVES OF NSAIDS AS POTENTIAL INHIBITORS OF MICROGLIAL ACTIVATION IN NEUROINFLAMMATION – MOLECULAR DOCKING STUDY

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ABSTRACT:

Neuroinflammation and excessive activation of microglial cells leads to the progression of different neurodegenerative diseases. The binding of lipopolysaccharide to the TLR4 (Toll-like Receptor 4)/MD-2 (Myeloid Differentiation factor 2) complex leads to activation of the nuclear transcription factor κ B (NF- κ B), whereby microglial cells secrete proinflammatory cytokines such as IL-1 β , IL-6 and TNF- α . Based on aforementioned, inhibition of the TLR4 signaling pathway represents a good strategy in preventing the occurrence of neuroinflammation, and therefore the development of neurodegenerative diseases. The aim of the conducted in silico research was to determine inhibitory potential of six arylalkanoic acid derivatives of non-steroidal anti-inflammatory drugs (1-6), previously designed by our research group, against the TLR4/MD-2 complex. We used AutoDock Vina software for semi-flexible docking protocol to analyze binding affinity of design compounds to the binding site of TLR4/MD-2 complex (PDB ID: 3VQ2). The binding analysis of tested compounds was performed according three main criteria: number, type of significant interactions and free binding energy value. Compound 4 (2,3-dihydropyrrole amide of fenoprofen) formed the most stable ligand-protein complex with a free binding energy value of -8.7 kcal/mol. Compound 6 (piperidine amide of naproxen) achieved the highest number of significant interactions with the target protein (eleven). Based on obtained results, it can be concluded that compounds 4 and 6 have the best potential to prevent the occurrence of neuroinflammation, and thus potentially prevent the development of neurodegenerative diseases.

Keywords: *neuroinflammation, TLR4/MD-2 complex, molecular docking, AutoDock Vina*

1. INTRODUCTION

Neuroinflammation is usually defined as an inflammatory response of brain tissue or meninges. Cytokines, chemokines, reactive oxygen species, and secondary messengers are the most responsible for the development of the inflammatory neurological process. Microglia, astrocytes, endothelial cells or peripheral cells of the immune system can produce mentioned inflammatory mediators [1]. The main receptors involved in the immune response to the mentioned proinflammatory stimuli are Toll-like receptors (TLR) that can be expressed on the surface of cells or on endosomes. These transmembrane proteins recognize different molecules such as lipopolysaccharide (LPS), zymosan, peptidoglycan, and flagellin, which are released through infectious agents [2]. Secreted LPS interacts with the TLR4/MD-2 (Myeloid Differentiation factor 2) complex located on the surface of microglial cells. Namely, recognition of LPS by the TLR4 receptor system is followed by a series of sequential steps in which the signal is transmitted to the TLR4/MD-2 complex, initiating a signaling cascade that leads to the production of proinflammatory cytokines and interferons caused by activated nuclear factor- κ B (NF- κ B) [3]. Over-activated microglial cells have been identified as the main cause of chronic neuroinflammation. Chronic neuroinflammation may lead to chronic neurodegenerative diseases, such as Alzheimer's disease (AD) and Parkinson's disease (PD) [4].

TLR4 is the first member of the TLR family discovered in humans and is the most studied of all its members. TLR4 is expressed on astrocytes, microglia and neurons in the brain and has a key role in neuroinflammation by recognizing exogenous and endogenous ligands. Amyloid β binds to TLR4 on the surface of microglia and astrocytes to trigger the release of proinflammatory factors [5]. In animal models of neuroinflammation, it has been shown that TLR4 activation can enhance the clearance of amyloid plaques through glial cell phagocytosis. Inhibition of TLRs can be achieved in two ways, by blocking ligand binding to the receptor and by inhibiting intracellular signaling pathways to prevent signal transduction [6]. To date, various drugs such as TAK-242 and eritoran have been developed with the pharmacological potential to prevent the progression of neuroinflammation by inhibiting TLR4 [7,8]. LPS cannot directly bind to TLR4 and requires the presence of the TLR4/MD-2 complex for its binding. MD-2 binds to the extracellular domain of the TLR4 receptor and as such is required for LPS recognition [9]. The crystal structure of the TLR4/MD-2/LPS complex is shown in Figure 1.

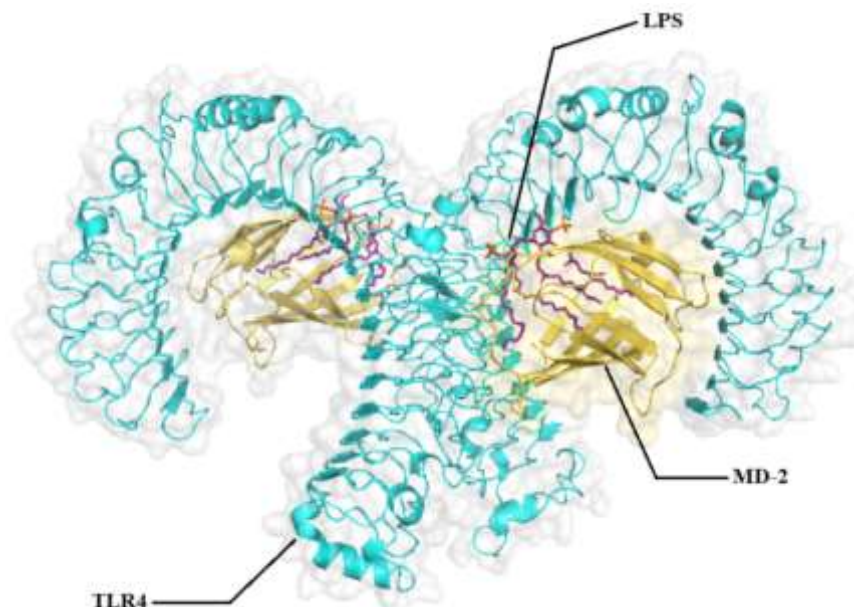


Fig. 1. X-ray structure of the TLR4/MD-2 dimer in complex with LPSs (PDB ID: 3VQ2)

The aim of this *in silico* study was to determine neuroprotective potential of six arylalkanoic acid derivatives of non-steroidal anti-inflammatory drugs (NSAIDs) according to their affinity against the TLR4/MD-2 complex.

2. MATERIALS AND METHODS

2.1. Designed compounds

Arylalkanoic acid derivatives of NSAIDs (compounds **1-6**) are molecules designed and tested in this study (Figure 2). Neuroprotective potential of these compounds were examined based on molecular docking and molecular dynamics studies in our previously published article where we estimated their binding affinity against mPGES-2 (microsomal prostaglandin E synthase-2) and FLAP (5-lipoxygenase activating protein) as well as stability of formed target protein-ligand complexes [10].

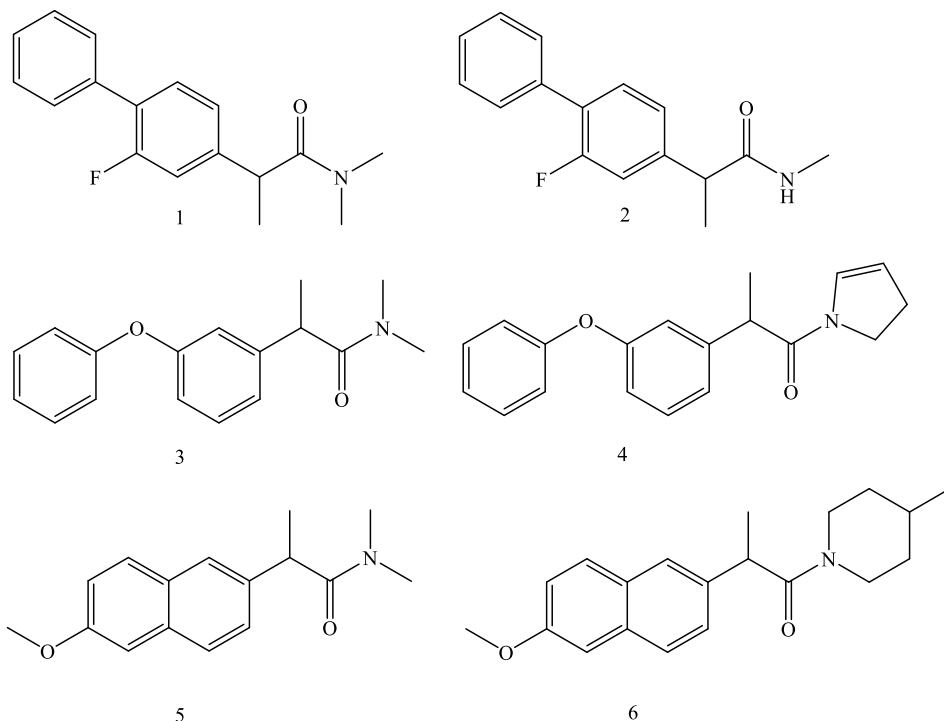


Fig. 2. Chemical structures of designed compounds

2.2. Ligand preparation

Geometry of designed compounds was optimized using AM1 semi-empirical quantum chemical methods in Chem3D Ultra 7.0 software [11]. Thereafter, these molecules were imported and converted to the mol2 format in the Mercury 3.10.2 software [12]. AutoDockTools 1.5.6. was used to add Gasteiger charges, set rotatable bonds and save selected molecules in pdbqt format [13].

2.3. Selection and preparation of receptors

Crystal structure of TLR4/MD-2 dimer in complex with LPS (PDB ID: 3VQ2) was downloaded from the Protein Data Bank [14]. BIOVIA Discovery Studio Visualizer v. 17.2.0.16349 [15] was used to remove the co-crystallized ligands, water molecules and unnecessary receptor chains. Based on the location of the co-crystallized ligand, we selected chain C to perform a molecular docking study. AutoDockTools 1.5.6. was used to prepare the protein for AutoDock Vina [16] by assigning hydrogens and converting protein structure to pdbqt format. Based on the location coordinates of the co-crystallized

ligand LPS in the 3VQ2 crystal structure, which were set to $x = -22.401$, $y = -14.423$, and $z = 22.646$, a grid box of 30, 30, and 52 points in x-, y-, and z-direction, respectively, with grid spacing of 0.375 Å was built and centered on the co-crystallized ligand.

2.4. Molecular docking

Molecular docking calculations were performed in AutoDock Vina software and nine poses were generated for the each tested compound. In this semi-flexible docking simulation, target protein was kept as rigid, while docked ligands were flexible. For the docking validation, co-crystallized ligand was extracted and redocked into the active sites of the target protein and root-mean-square deviation (RMSD) value was calculated. *In silico* prediction is considered valid if the RMSD value is less than 2.0 Å for the best scored conformation.

3. RESULTS AND DISCUSSION

In this *in silico* study, we tested six selected ligands (**1-6**) with adequate BBB (Blood-Brain Barrier) permeability predicted in our previously published study [10]. The main physicochemical characteristics of these molecules are presented in Table 1. Selected ligands were docked into the active site of TLR4/MD-2 dimer. Non-covalent interactions of designed compounds with amino acid residues of LPS binding site and docking scores of ligand's best conformation were determined. Number of key binding interactions, type of key binding interactions, and free binding energy were three main criteria based on which the binding affinity of the tested compounds was evaluated. The term key binding interaction refers to those contacts formed by the co-crystallized ligand in the binding site of the receptor.

Table 1. Physicochemical characteristics of tested compounds

Ligand number	Molecular formula	Molecular weight (g/mol)	LogP	TPSA (Å ²)
1	C ₁₇ H ₁₈ FNO	271.33	4.09	20.31
2	C ₁₆ H ₁₆ FNO	257.30	3.91	29.10
3	C ₁₇ H ₁₉ NO ₂	269.34	3.42	29.54
4	C ₂₀ H ₂₁ NO	291.39	5.23	29.54
5	C ₁₆ H ₁₉ NO ₂	257.33	3.27	29.54
6	C ₂₀ H ₂₅ NO ₂	311.42	4.56	29.54

To evaluate the validity of molecular docking protocol we redocked co-crystallized ligand into the active site of target protein in Discovery Studio Visualizer. The degree of overlap between the two conformations of the co-crystallized ligand is quantified as an RMSD value that has to be less than 2 Å for the molecular docking study

to be considered valid. Based on the fact that the calculated RMSD value was less than 2 Å, we can conclude that the conducted *in silico* study was valid.

Results of molecular docking analysis showed that co-crystallized ligand bound to the active site of target protein with higher binding energy (-6.5 kcal/mol) in comparison to all tested compound. The mentioned fact indicates that analyzed compounds formed more stable complexes with TLR4/MD-2 dimer than LPS. Among the tested compounds, the highest binding affinity was shown by compound **4** with a free binding energy value of -8.7 kcal/mol. The model of docking compound **4** into the active site of the target protein is shown in Figure 3. Only one more molecule achieved a free binding energy value lower than -8 kcal/mol and that was compound **6** (-8.3 kcal/mol). The above results showed that these two compounds formed the most stable complexes when binding to the target protein. Yahaya and co-workers showed that the natural product vitexin binds to the LPS binding site with a higher free binding energy value (-4.35 kcal/mol) compared to all tested compounds [17].

The second criterion for evaluation of the inhibitory potential of the tested molecules was the number of key interactions that compound formed into the binding site of the target protein. The main characteristic of all tested compounds was that no molecule formed any hydrogen bond, as one of the strongest non-covalent interactions. As presented in Table 2, the highest number of key binding interactions (11) with the target protein was achieved by compound **6**. Hydrophobic interactions were formed with residues Val61, Leu94, Ile117, and Phe 151, while residues Ile32, Ile46, Ile52, Leu54, Phe76, Phe147, and Ile153 established Van der Waals forces with mentioned molecule (Figure 4). On the other hand, LPS as co-crystallized ligand formed several hydrogen bonds. Namely, double hydrogen interaction is formed with residue Ser120, while Lys263, Glu122, Lys360, and Ser413 residues that achieve single hydrogen bonds with LPS.

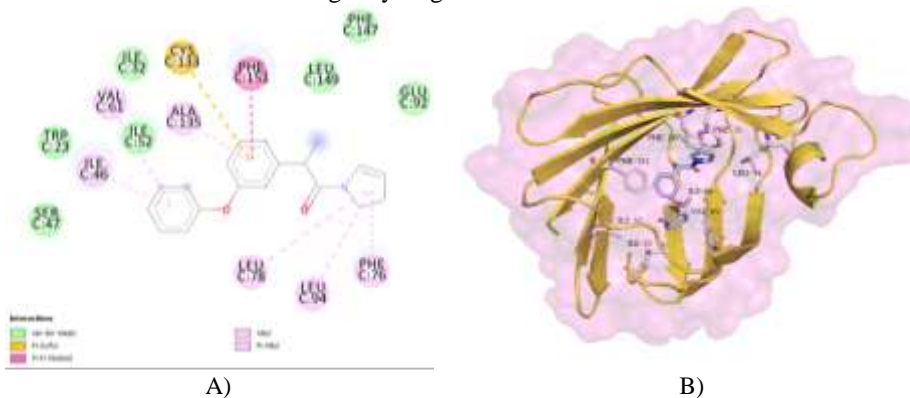


Fig. 3. Molecular docking of compound **4** into the active site of TLR4/MD-2 complex

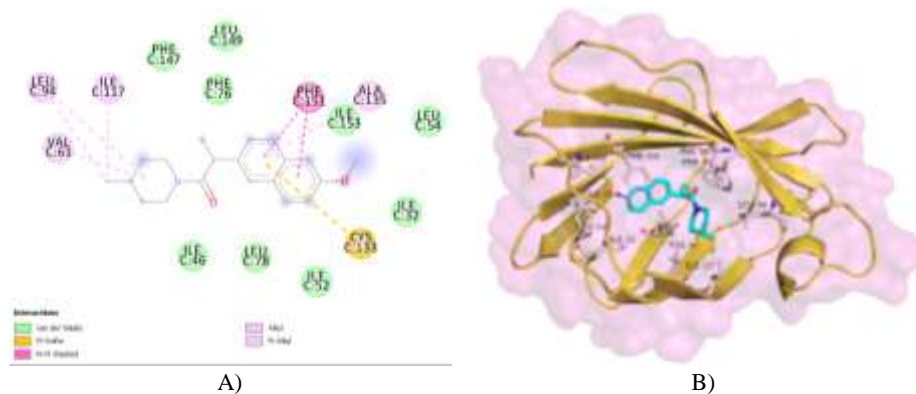


Fig. 4. Molecular docking of compound **6** into the active site of TLR4/MD-2 complex

Table 2. Molecular docking parameters of the tested compounds

Ligand number	Van der Waals forces	Hydrophobic interactions				Docking score (kcal/mol)
		$\pi-\pi$	$\pi-\sigma$	π -alkyl	alkyl	
1	Ile46 Phe126 Tyr131	Phe151	Leu54	Ile153 Ile32 Ile52	/	-7.5
2	Ile52 Val61 Phe126 Tyr131 Phe151	/	Ile153 Leu54	Ile32	/	-7.4
3	Ile32 Ile52 Val61 Phe147	Phe151	Phe76	Ile46	/	-7.4
4	Ile32 Ile52 Phe147	Phe151	/	Ile46 Val61 Phe76	Leu94	-8.7
5	Ile46 Ile52 Leu54 Val61 Phe76 Leu94 Ile153 Phe147	Phe 151	/	Ile32	/	-6.9

6	Ile32 Ile46 Ile52 Leu54 Phe76 Phe147 Ile153	Phe 151	/	/	Val61 Leu94 Ile117	-8.3
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3. CONCLUSION

In silico determination of neuroprotective potential of six arylalkanoic acid derivatives NSAIDs based on inhibition ability against TLR4/MD-2 complex showed that all analyzed molecules formed more stable complex with target protein in comparison to co-crystal LPS. Among the analyzed compounds, derivatives **4** and **6** were singled out as a potential drug candidates on which further studies of potential neuroprotective drugs can be based.

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EVALUATION OF THE BINDING BEHAVIOR OF NUDT5 INHIBITORS WITH ESTROGEN RECEPTORS: MOLECULAR DOCKING STUDY

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ABSTRACT:

The enzyme NUDT5 (nucleotide diphosphate hydrolase type 5) catalyzes the reaction of converting adenosine diphosphate into adenosine triphosphate. NUDT5 is a constitutive regulator of tumor drivers and may play an important role in breast cancer. Recent studies indicate that increased expression of NUDT5 in breast cancer patients is associated with a worse prognosis and occurrence of relapse and metastasis.

In this paper, virtual screening was conducted using a potent inhibitor of NUDT5 hormone signaling as searching query in the Swiss Similarity web tool. Compounds with more than 50% structural similarity in comparison to searching query were selected. The criteria used for the further selection of compounds were: toxicological predicted characteristics, drug-likeness properties, and substrate or non-substrate for P-glycoprotein. Using the mentioned parameters, we selected 6 compounds that were included in further analysis. The aim of this research was to investigate the binding mode of selected compounds to estrogen receptor using the molecular docking methodology and then determine the number, type of the key binding interactions, and free binding energy value. Focused semi-flexible molecular docking was performed using the AutoDock Vina software. The three-dimensional crystal structure of estrogen receptor was downloaded from the Protein Data Bank (PDB ID: 3ERT). The highest number of interactions were hydrophobic type, whereby all compounds formed contacts with Ala350A and Leu525A. The presence of hydrogen bond interactions with Glu353A and Arg394A were particularly significant. These polar interactions contribute to the higher binding affinity of tested compounds to estrogen receptors.

Keywords: molecular docking, NUDT5, estrogen receptor, breast cancer

1. INTRODUCTION

Breast cancer is the most common type of malignant disease in women. It is estimated that 1 in 8 women will develop breast cancer during their lifetime, while the probability of the disease increases with age. In developed countries of the world, compared to undeveloped ones, the frequency of breast cancer is slightly higher, but due to early diagnosis and optimal treatment, the death rate is lower [1, 2]. The basis of a malignant disease is genetic changes, acquired or hereditary. The key genetic changes are the activation of proto-oncogenes into oncogenes and the inactivation of tumor-suppressor genes [3, 4]. Breast cancer therapy includes several forms of treatment, surgical, radiotherapy, chemotherapy, hormone therapy, and targeted therapy. Hormonal therapy is indicated for cancers with increased estrogen or progesterone receptor expression. The presence of these receptors shows that cancer cell growth depends on estrogen and/or progesterone. Estrogens are hormones that are primarily synthesized in the ovary, and they perform their action through estrogen receptors ER α и ER β . These receptors act as ligand-activated transcription factors. The basic mechanism of action involves the binding of estrogen to receptors in the nucleus, after which the receptors dimerize and bind to specific elements found in the promoters of target genes. Hormone binding induces a conformational change within the ligand binding domain, and this conformational change allows coactivator proteins to be activated [5-8].

Computer screening of compounds is the gold standard for the discovery of biologically active molecules [9]. The development of computer technology and a lot of available data on a large number of therapeutic targets, has led to the increasing use of *in silico* approaches [10]. The most commonly applied virtual screening method is molecular docking. Molecular docking is a methodology used to study the behavior of ligands during binding to target proteins. Molecular docking determines the interactions that a small molecule achieves with the target macromolecule, the binding affinity, and the stability of the formed complex, providing information that is the basis for rational drug development. The main goal of molecular docking is to understand and predict the ligand binding site within the target protein, with optimized conformation and the lowest Gibbs free energy of binding (ΔG) [11-13].

The enzyme NUDT5 (nucleotide diphosphate hydrolase type 5) catalyzes the reaction of converting adenosine diphosphate into adenosine triphosphate. NUDT5 is known to be a constitutive regulator of tumor drivers and a biomarker for cancer stratification, as well as a target for drug discovery to treat aggressive types of cancer and metastases. Also, NUDT5 is associated with hormone-dependent gene regulation as well as proliferation in breast cancer cells [14].

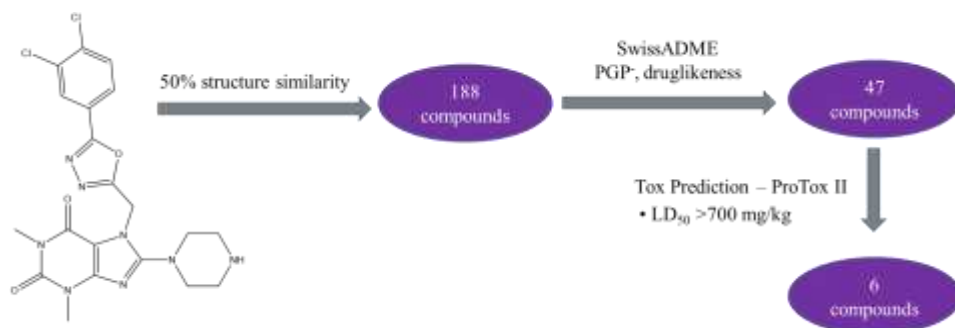
The aim of this *in silico* study was the selection of compounds, using ligand-based virtual screening. NUDT5 inhibitor was used as searching query to select compounds with potential for steroid receptors inhibition and thus a possible cytostatic effect. To determine the primary binding site and interactions between tested compounds and the active binding site of the target protein was used molecular docking method.

2. MATERIALS AND METHODS

2.1 Virtual screening

Since NUDT5 is associated with gene expression and cell proliferation in breast cancer tissue, a compound that inhibits this enzyme was used as searching query for virtual screening in this research. Namely, by searching the crystal structures in the Protein Data Bank, the structure of the NUDT5 inhibitor (5NWH) was selected, which IUPAC name is 7-[[5-(3,4-dichlorophenyl)-1,3,4-oxadiazol-2-yl]methyl]-1,3-dimethyl-8-piperazin-1-yl-purine-2,6 diones. By analyzing the similarity with the searching query in the Swiss Similarity program [15], a virtual screening was carried out and in this way compounds with more than 50% structural similarity were selected. A total of 188 compounds were thus obtained. In the next step, the druglikeness parameters were checked for all previously obtained compounds and it was examined whether the compounds are substrates for P-glycoprotein. Lipinski [16], Ghose [17], Weber [18], Egan [19], and Muegge [20] filters were used within the druglikeness rules.

In this way, 47 compounds that fully meet the druglikeness rules and are not substrates for P-glycoprotein were selected. By checking the toxicological characteristics in the ProTox-II-Prediction of TOXicity of chemicals virtual lab, compounds which LD₅₀ (Lethal dose 50 - the dose of a substance that leads to death in 50% of the examined population) values were greater than 700 mg/kg were selected. Using virtual screening with the above-mentioned parameters, 6 compounds were selected and included in further analysis (Scheme 1).



Scheme 1. Virtual screening diagram

The structures of the compounds obtained by virtual screening are shown in Figure 1.

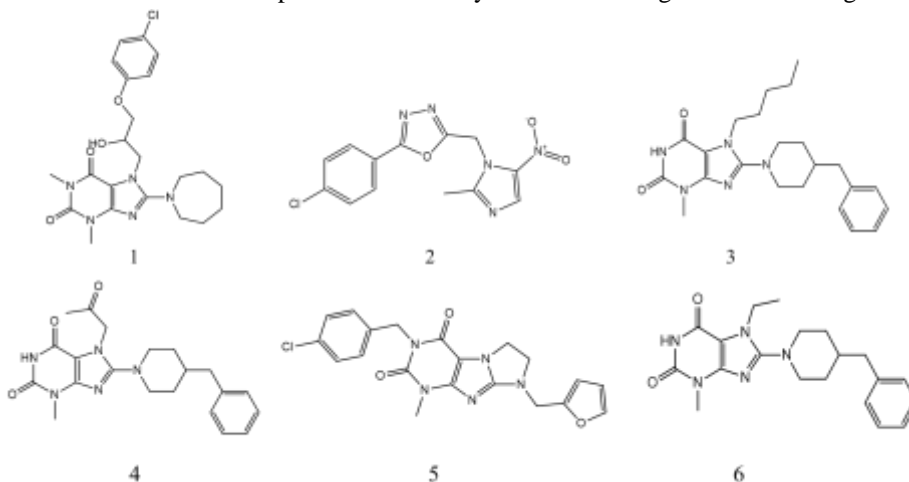


Fig. 1. The chemical structures of the tested compounds

2.2 Docking methodology

Energy optimization of the tested compounds was carried out using the program Chem3D Ultra 7.0.[21] with the purpose of ligands preparation for molecular docking simulations. The crystal structure of the human estrogen receptor was used as the target molecule. The estrogen receptor, which belongs to the group of nuclear receptors, is of human origin, and is found in a complex with 4-hydroxytamoxifen as a co-crystallized ligand (resolution 1.90 Å). The crystal structure of the human estrogen receptor, (PDB ID: 3ERT) was downloaded from the Protein Data Bank. The preparation of the target molecule for docking was performed in the Discovery Studio Visualizer 17.2.0.16349 [22], by removing the present water molecules.

The molecular docking method involves a series of attempts to bind the tested compound in different spatial orientations to a certain part of the target molecule, with the task of predicting the most likely interaction as well as binding affinity and related biological action. Focused semi-flexible molecular docking protocol was performed using the AutoDockVina software [23]. The search area was set as a grid box. Based on the position of the co-crystallized ligand, a search area was defined with a grid box size of 30 x 28 x 32 points and a spacing of 0.375 Å. After molecular docking, each of the designed compounds had 9 different spatial orientations, whereby the binding energy was calculated and binding interactions were determined for each of them. The best fitted conformation of the tested compound was visualized using Discovery Studio Visualizer and PyMol 2.4.1. [24]. Root Mean Square Deviation (RMSD) value was calculated to check the accuracy of the molecular docking.

3. RESULTS AND DISCUSSION

In this *in silico* study compounds were selected by ligand-based virtual screening using NUDT5 inhibitor as searching query. Six compounds were selected and the interactions between the active binding site of estrogen receptors are investigated by molecular docking simulations.

After the molecular docking, in order to check the accuracy of the results, we performed a validation of procedure. The validation procedure involves comparing the native and docked orientation of the co-crystallized ligand (4-hydroxytamoxifen). The result is expressed through the RMSD value. If the obtained values are less than 2 Å, this indicates the validity of the process itself. As the obtained parameter has a value of 1.1204 Å, it is considered that the molecular docking simulation was properly performed (Figure 2).

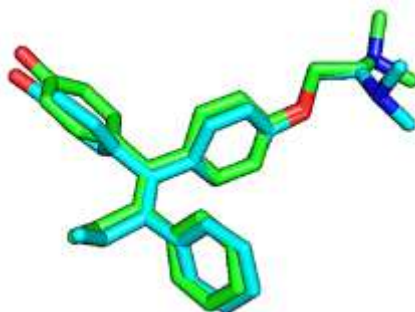


Fig. 2. Molecular overlapping of the crystallographic (green) and redocked conformation (cyan) of 4-hydroxytamoxifen

The inhibitory potency of tested compounds was estimated based on the thermodynamical parameter, the free energy of binding. Also, as part of the molecular docking simulations, non-covalent interactions of residues that are crucial for binding to estrogen receptor were identified. Crucial binding residues are defined as those that interact with co-crystallized ligand during its molecular fitting in the active site of receptors. Molecular docking parameters of tested compounds during molecular fitting into the active sites of estrogen receptors are given in Table 1.

The Gibbs free binding energy shows the stability of the protein-ligand complex, and determines the binding affinity of the ligand for the target molecule. The binding free energy values of all six tested compounds are negative, on the basis of which it can be observed that all compounds spontaneously bind to estrogen receptors. By comparing the values of the binding energy of the co-crystallized ligand with the values of the tested compounds, it is observed that the binding free energies of the selected compounds are higher than the binding energy of the co-crystallized ligand, however this difference is not significant. In a line with that, it can be concluded that the binding to the target molecules will take place in a similar way, as is the case with a co-crystallized ligand.

Ligand	Van der Waals forces	Hydrophobic interaction	Hydrogen bond	Other interactions	Gibbs free energy of binding (kcal/mol)	
					Ligand	Co-crystallized ligand
1	/	Ala350A (<i>alkyl</i>) Trp383A (π - <i>alkyl</i>) Leu525A (<i>alkyl</i>)	/	Leu525A (<i>amide</i> - π)	-7,9	-9,8
2	/	Leu346A (π - <i>alkyl</i> , <i>alkyl</i>) Ala350A (π - <i>alkyl</i>) Phe404A (π - <i>alkyl</i>) Leu525A (π - <i>alkyl</i>)	Gly521A (<i>CH</i>)	Asp351A (π - <i>anion</i>) Met421A (π - <i>sulfur</i>)	-7,5	-9,8
3	Met343A Leu387A Met421A	Leu346A (π - <i>alkyl</i>) Ala350A (π - <i>alkyl</i> , <i>alkyl</i>) Leu525A (<i>alkyl</i>)	Leu346A (<i>CH</i>) Glu353A (<i>CH</i>) Arg394A (<i>conventional</i>)	/	-8,2	-9,8
4	/	Leu346A (π - <i>alkyl</i>) Ala350A (π - <i>alkyl</i> , <i>alkyl</i>) Trp383A (π - π) Leu525A (<i>alkyl</i>)	Leu346A (<i>CH</i>) Glu353A (<i>CH</i>) Arg394A (<i>conventional</i>)	Asp351A (π - <i>anion</i>)	-8,9	-9,8
5	/	Ala350A (π - <i>alkyl</i>) Trp383A (π - σ , π - π) Leu384A (<i>alkyl</i>) Leu525A (π - σ , π - <i>alkyl</i>)	/	Met343A (π - <i>sulfur</i>)	-8,3	-9,8
6	/	Leu346A (<i>alkyl</i> , π - <i>alkyl</i>) Ala350A (<i>alkyl</i> , π - <i>alkyl</i>) Trp383A (π - π) Met421A (<i>alkyl</i>) Leu525A (<i>alkyl</i>)	Leu346A (<i>CH</i>) Glu353A (<i>CH</i>) Arg394A (<i>conventional</i>)	Asp351A (π - <i>anion</i>)	-8,6	-9,8

Table 1. Molecular docking parameters of the tested compounds

The potential biological activity, in addition to the Gibbs free energy of binding, is influenced by the number and type of significant interactions that the investigated compounds establish with the residues of the estrogen receptor active site. The largest number of formed interactions between the tested compounds and the estrogen receptor are hydrophobic nature, with all compounds forming interactions with Ala350A and Leu525A. Alanine 350A establishes π -alkyl interactions with the aromatic rings of the compounds, while alkyl-alkyl interactions are formed with saturated rings (azepane in

compound 1, piperidine in compounds 3,4 and 6). In the study by Grande et al., the molecular docking of homoisoflavone derivatives into the structure of the estrogen receptor was investigated, whereby the obtained results emphasize the specific influence of hydrophobic interactions with Ala350A and Leu525A [25]. The remaining hydrophobic interactions were formed with Leu346, Trp383A, Leu384A, Phe404A. Due to the great structural similarity between compounds 3, 4 and 6, leucine 346A accomplishes a π -alkyl interaction with purine-2,6-dione, and in the case of compound 2 the same type of interaction is formed with imidazole. The importance of the presence of substituted purine-2,6-dione, in addition to the formation of hydrophobic interactions, is reflected in the formation of conventional hydrogen (Arg394A) and CH-type hydrogen interactions (Leu346A, Glu353A, Gly521A). In compounds 3, 4 and 6, leucine 346A and glutamic acid 353A form CH hydrogen interactions with the methyl group attached to the nitrogen atom, while arginine 394A forms a conventional hydrogen bond with the oxygen atom of purine-2,6-dione. The presence of hydrogen interactions with Glu353A and Arg394A is particularly significant, which contribute to a higher binding affinity for estrogen receptors, and thus to a stronger cytostatic effect. Molecular docking analysis revealed that tested compound 6 had the highest affinity for estrogen receptors, indicating that this compound has the potential for anticancer activity. This compound forms the largest number of interactions with key amino acid residues and has the most favourable binding free energy (Figure 3 and 4). In addition to hydrophobic interactions, the complex compound 6-target protein was also stabilized by the formation of hydrogen bonds, both conventional and CH type.

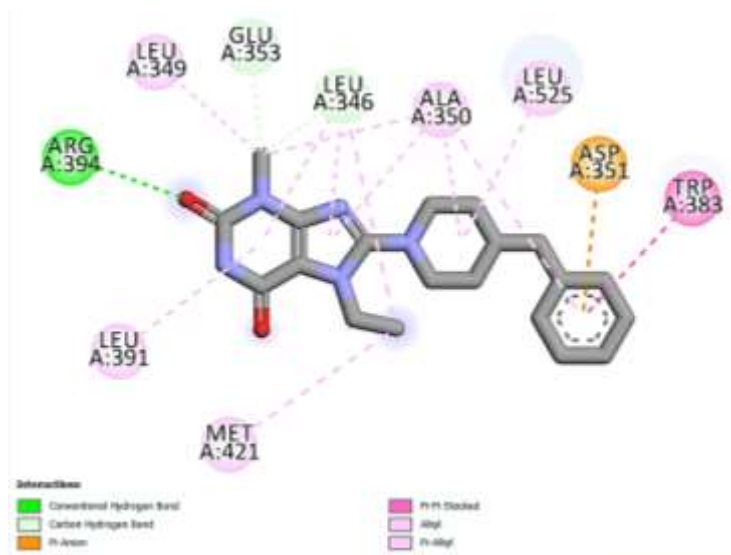


Fig. 3. Two-dimensional representation of the interaction between compound **6** and estrogen receptor

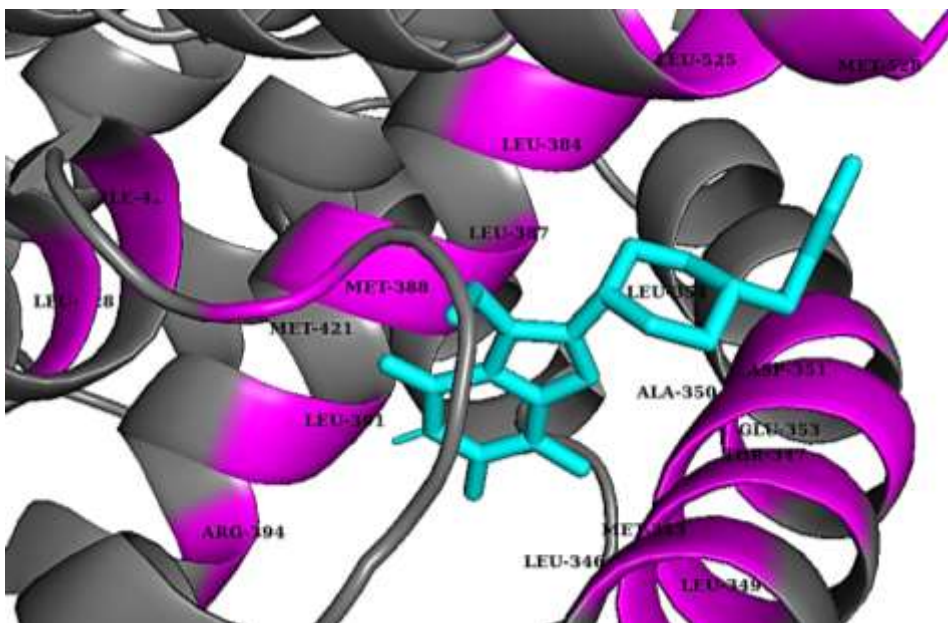


Fig. 4. Three-dimensional representation of the interaction between compound **6** and residues involved in active site of estrogen receptor

Certain cellular signals initiated by the activation of estrogen and progesterone receptors are responsible for the initiation and progression of hormone-dependent breast cancer. Recent studies have shown that, as an estrogen cofactor, adenosine triphosphate plays an important role in the effect of estrogen [26, 27]. NUDT5 is a key factor for the production of adenosine triphosphate and thus is involved in the pathogenesis of breast cancer. Overexpression of the NUDT5 gene is associated with poor prognosis, increased risk of recurrence and metastasis. All these facts points to the importance of finding compounds that will achieve the desired cytostatic effect by inhibiting estrogen and progesterone receptors.

4. CONCLUSION

In hormone-dependent breast cancer, excessive expression of estrogen and progesterone receptors has been observed, so one of the therapeutic strategies involves the use of drugs that inhibit these receptors. In this study, the ability of six tested compounds to form complexes with the estrogen receptor was investigated. The obtained results confirm that the selected compounds are complementary with the binding site and interact

with a large number of key amino acid residues, with the dominant presence of hydrophobic and hydrogen interactions. Compound 6 showed the highest inhibitory potential for estrogen receptors, so this *in silico* study can be considered as a starting point for further experimental research.

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ISTRAŽIVANJE PRAVILNE PRIMENE ANTIBIOTIKA U STOMATOLOGIJI

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SAŽETAK:

Izbor antibiotika se zasniva na principu “najbolje pretpostavke“, uz poznavanje infektivnog oboljenja, najverovatnijeg uzročnika i njegovog uobičajenog profila osetljivosti na antibiotike. Ovakva empirijska antibiotska terapija se najčešće primenjuje u stomatologiji jer je većina infekcija uzrokovana sa više uzročnika, u ovim infekcijama najčešće su uključene anaerobne Gram-negativne bakterije i prilikom uzimanja uzoraka teško je izbeći kontaminaciju uzorka sa kolonizujućom mikroflorom. Potrebno je pridržavati se osnovnih principa pravilne primene antibiotika. Potrebno je utvrditi da li je oboljenje infektivne etiologije, i ako jeste pre primene antibiotika uzeti uzorak za mikrobiološki pregled. Više faktora može da utiče na izbor antibiotika: istorija bolesti, alergijske reakcije, toksični efekti leka i prethodne antimikrobne terapije. Dozu je potrebno odrediti unapred, pre primene, da bi se postigla dovoljna koncentracija antibiotika na mestu infekcije. Pri tome je potrebno voditi računa o postojećim oštećenjima organa. Način primene antibiotika zavisi od težine oboljenja pa se kod teških infekcija bira parenteralni, intravenski put primene. Sve češće se zapažaju interakcije antibiotika sa drugim lekovima, zbog uvođenja novih lekova u kliničku praksu, pa je neophodno i ovaj faktor uzeti u obzir prilikom određivanja antimikrobne terapije. Odstupanja od ovih principa mogu dovesti do raznih nepravilnosti i neželjenih reakcija u terapiji. Preterana empirijska upotreba antibiotika dovela je do enormnog razvoja rezistencije bakterija na ove agense pa je danas sužen izbor terapijskih mogućnosti za lečenje mnogih infekcija i moraju se koristiti često manje efikasni agensi.

Cljučne riječi: stomatologija, antimikrobna terapija, rezistencija

1. UVOD

U stomatologiji se koriste antibakterijski, antivirusni i antifungalni antimikrobni agensi. Antibiotici ili antimikrobni agensi su jedinjenja koja selektivno inhibiraju ili ubijaju mikroorganizme. Koriste se kada imuni sistem domaćina nije dovoljno snažan da savlada mikroorganizme koji su prouzrokovali infekciju. Antibiotici su hemijski agensi koji mogu da potpuno unište patogene mikroorganizme ili da zaustave njihov rast ili razmnožavanje, bez pricinjavanja značajnije štete organizmu domaćina. Mogu biti štetni ako se nepravilno koriste. Preterana empirijska upotreba antibiotika dovela je do enormnog razvoja rezistencije bakterija na ove agense. To je dovelo do toga da je sužen izbor terapijskih mogućnosti za lečenje mnogih infekcija, pa se moraju koristiti često manje efikasni agensi. Smrtnost od takvih infekcija je povećana. U današnje vreme se javljaju i sojevi bakterija koje su rezistentne na skoro sve ili čak na sve raspoložive antibiotike (multirezistentni, panrzententni i ekstenzivno rezistentni sojevi).

Svi antimikrobni agensi ispoljavaju selektivno toksično delovanje tako što ispoljavaju značajan letalni ili toksični efekat na mikroorganizme, a da pri tome nemaju značajno toksično delovanje na čoveka.

Mogu ispoljavati neželjena dejstva na čoveka što znači da ih treba primenjivati racionalno i samo kada je potrebno. Antibiotici se dele prema načinu delovanja na baktericidne i bakteriostatične. Najčešće indikacije za upotrebu antibiotika u stomatologiji su:

- Dentogene infekcije sa težom lokalnom i opštom kliničkom slikom, praćene poremećajem opšteg zdravstvenog stanja, kada je prisutna i upala regionalnih limfnih žlezda;
- Kada se dijagnostikuje veoma brz tok bolesti, pa pretil opasnost od širenja infekcije iz oralne sredine u susedne prostore;
- Kod posebno osetljive grupe pacijenata na infekcije, tj. kod imunokompromitovanih pacijenata;
- Kod upale viličnih kostiju - osteomijelitisa, kao i kod akutne upale sinusa;
- Kod infekcija srednje trećine lica i veoma opasne upale poda usne duplje-Ludvigove angine (Angina Ludovici).

Posebna grupa bolesnika kod kojih je veoma važna preventivna primena antibiotika su pacijenti sa mogućnošću pojave bakterijskog endokarditisa. U tu grupu spadaju pacijenti koji imaju veštačke zaliske, pacijenti sa prethodno preležanim endokarditisom, urođenim srčanim manama sa cijanozom i pacijenti sa transplantiranim srcem.

2. OSNOVNI PRINCIPI ANTIMIKROBNE TERAPIJE

Izbor antibiotika se zasniva na principu “najbolje pretpostavke” (“best guess”), uz poznavanje infektivnog oboljenja, najverovatnijeg uzročnika i njegovog uobičajenog profila osetljivosti na antibiotike. Ovakva terapija se označava kao empirijska antibiotska terapija. Terapiju kod koje znamo, na osnovu mikrobiološkog ispitivanja, koji je uzročnik

infekcije i njegovu osjetljivost na antibiotike, nazivamo etiološka ili racionalna antibiotska terapija. U većini situacija u stomatologiji se primenjuje empirijska antibiotska terapija zato što je većina infekcija uzrokovana sa više uzročnika (polimikrobne infekcije), zato što su u ovim infekcijama najčešće uključene anaerobne Gram-negativne bakterije (djagnostika je skupa i dugotrajna, 10-14 dana), i što je prilikom uzimanja uzoraka teško izbeći kontaminaciju uzorka sa kolonizujućom mikroflorom. Kada se radi o infekcijama koje ugrožavaju život bolesnika (Ludwig-ova angina), o hroničnim infekcijama (osteomijelitis vilice), ili se sumnja na specifične infekcije (tuberkuloza), uvek treba da se uzme jedan ili više uzoraka za mikrobiološku dijagnostiku, pre primene doze antibiotika. Pored slanja uzorka na histopatološko ispitivanje, mora se poslati uzorak i na mikrobiološku dijagnostiku. Nakon uzimanja uzorka za mikrobiološki pregled, kod infekcija koje ugrožavaju život pacijenta, primenjuje se intravenska, kombinovana antibiotska terapija širokog spektra, u visokim dozama. Nakon dobijanja rezultata sa mikrobiološkog ispitivanja i kada se utvrdi uzrok infekcije, na osnovu krajnje kliničke procene može se preći na ciljanu etiološku antibiotsku terapiju. Ovaj pristup u antibiotskoj terapiji se zove de-eskalaciona antibiotska terapija.

Indikacije za primenu antibiotika su kada je prisutno jedno ili više od sledećih stanja: postojanje opštih simptoma akutne infekcije (povišena telesna temperatura, malaksalost), infekcije koje se šire u međufascijalne prostore bez jasne lokalizacije, ako hronična infekcija perzistira uprkos drenaži i debridmana, kod infekcije u medicinski kompromitovanih pacijenata, u slučajevima osteomijelitisa, bakterijskog sijaloadenitisa, kod nekih oboljenja parodontijuma (nekrozna oboljenja parodontijuma).

2.1. Principi prepisivanja antibiotika

Pre nego što se napiše antibiotik potrebno je utvrditi da li je oboljenje infektivne etiologije. Ukoliko ne postoje znaci i dokazi, antibiotike ne treba primenjivati. Jedan od primera pogrešne primene kada se izoluje mikroorganizam ili mikroorganizmi bez dokaza o postojanju infektivnog oboljenja (inflamacija-kolonizacija). Ponekad je, ipak, potrebno primeniti antibiotik u slučaju antibiotske profilakse bez obzira što ne postoje znaci infekcije.

Uzorci za mikrobiološka ispitivanja

Neophodno je pre bilo kakve primene antibiotika uzeti uzorak za mikrobiološki pregled. Tako se neće kompromitovati dijagnostika i tako će se dobiti raniji rezultati mikrobiološkog ispitivanja. Pomoću uzorka će se tačno znati koji antibiotik treba primenjivati. Ukoliko je pogrešan uzorak ili se uzorak ne uzme, terapija će biti pogrešna.

Početak antibiotske terapije

U principu, terapija antibioticima ne počinje dok se ne dobiju rezultati mikrobiološkog ispitivanja (blage ili hronične infekcije, na primer aktinomikoza). U slučaju infekcija, koje ugrožavaju život pacijenta (Ludwig-ova angina, sepsa, meningitis), bez obzira što rezultati ispitivanja nisu gotovi, terapiju treba otpočeti tog trenutka bez odlaganja.

Koji antibiotik treba primeniti?

Postoji više faktora koji utiču na izbor antibiotika. U obzir se uzimaju anamneza (istorija bolesti), naročito alergijske reakcije, toksični efekti leka i prethodne antimikrobne terapije. Uz to, na uzor utiču i neželjena dejstva leka i samo funkcionisanje leka pri primeni.

Doza antibiotika

Dozu je potrebno odrediti unapred, pre primene, da bi se postigla dovoljna koncentracija antibiotika na mestu infekcije. Postiže se određivanjem adekvatne doze. Potrebno je voditi računa o postojećim oštećenjima organa jer mogu nastati oštećenja bubrega, sluha i jetre, pogotovu ako je doza antibiotika previsoka.

Dužina trajanja antibiotske terapije

Ne može se precizno odrediti tačno trajanje terapije. Antibiotici se bore sa patogenim mikroorganizmima (“kupuju vreme”), dok oragnizam ne bude u stanju da se izbori sa ostatkom. Idealno bi bilo primenjivati antibiotik toliko dugo dok imuni sistem sam ne bude mogao da eliminiše preostale patogene mikroorganizme. Danas se favorizuju kraći terapijski režimi jer se pacijenti bolje pridržavaju istih, jer su efikasni, jer dovode do manje rezistencije mikroflore na sam lek i zbog neželjenih dejstava kao što je dijareja.

Put primene antibiotika

Način primene antibiotika zavisi od težine oboljenja. Kod teških infekcija se bira parenteralni, intravenski put primene. Prelazi se na peroralnu upotrebu tek kada dođe do značajnijeg poboljšanja kliničke slike.

Odabir antibiotika na osnovu njegove farmakokinetike

Antibiotik mora postići odgovarajuću koncentraciju na mestu infekcije. Na primeru hroničnog osteomijelitisa, lek mora prodrati kroz kost (Klindamicin-dobro prodire kroz koštano tkivo), a kod meningitisa u likvor.

Putevi izlučivanja antibiotika iz organizma

Ako kod pacijenta postoji problem sa funkcijom jetre ili je oštećena, ne smeju se primenjivati antibiotici (eritromicin estolat) koji se metabolišu u jetri. A kod pacijenata sa oštećenom funkcijom bubrega treba izbegavati primenu nefrotoksičnih lekova (aminoglikozidi, vankomicin).

Interakcije antibiotika sa drugim lekovima

Sve se češće zapažaju interakcije antibiotika sa drugim lekovima, prevashodno zbog uvođenja novih lekova u kliničku praksu. Interakcije su normalna pojava. Kliničari treba da poznaju pozitivne i neželjene posledice tih interakcija tokom terapije. Penicilin i eritromicin značajno smanjuju dejstvo kontraceptiva. Apsorpcija tetraciklina se smanjuje ukoliko se u isto vreme primenjuju cink oksid, antacidi ili preparati gvožđa. Disulfiram fenobarbitol fenitoin smanjuje efekat metronidazola. Ovo su samo neki od primera gde ukoliko se pogreši sa terapijom, može doći do neželjenih posledica.

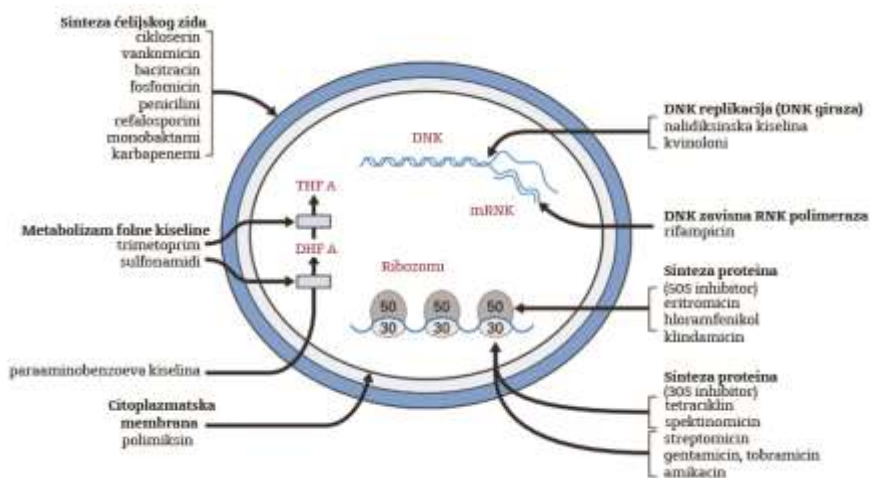
Ovi principi su uslov pravilne primene antibiotika i potrebno je i poželjno pridržavati ih se. Svako odstupanje dovodi do raznih nepravilnosti i neželjenih reakcija u terapiji.

2.2. Uzroci neuspeha terapije sa antibioticima

Prvi klinički znaci delovanja leka se obično primećuju u prvih 48 sati od početka primene. Ukoliko nemamo vidnog napretka u terapiji određenog antibiotika, znači da je nepravilno

upotrebljen ili da neki od faktora utiče na sam uspeh lečenja. Postoje mnogi uzroci za neuspeh antibiotske terapije. Faktori su sledeći:

- nepostojanje ili neodgovarajuća drenaža gnoja i debridman devitalizovanog tkiva;
- odstupanje od pravilne primene antibiotske terapije kao što je izbor antibiotika;
- rezistencija mikroflore, premala ili previsoka doza antibiotika i greške pri interakciji sa drugim lekovima;
- prisustvo stranih tela koja predstavljaju leglo i pogodno mesto za nastavak i širenje infekcije, kao što su intravenski kateter, a u stomatologiji najčešće inficiran zub;
- oštećen imuni sistem pacijenta, pri upotrebi imunosupresivnih lekova ili ukoliko je pacijent zaražen HIV-om;
- nesavesno pridržavanje propisane terapije ili primene;
- prilikom postojanja oboljenja koje nije infektivne etiologije (upala drugog porekla) ili prisustvo neuobičajene (retke) bolesti;
- loša prokrvljenost na mestu infekcije; ali je usna duplja dobro vaskularizovana.



Slika 1 - Način delovanja najčešćih antimikrobnih agenasa, TFT, tetrahidrofolna kiselina, DHF, dihidrofolna kiselina, PABA, paraminobenzoeva kiselina (11)

3. ANTIBIOTICI KOJI SE NAJČEŠĆE KORISTE U STOMATOLOGIJI

3.1. Penicilini

Bez obzira na dugogodišnju primenu i moguću rezistenciju mikroorganizama kod pacijenata, prirodni penicilin G je još uvek najefikasniji antibiotik u terapiji infekcija uzrokovanih senzitivnim sojevima.

Penicilini se dele na pet klasa:

1. Prirodni penicilini- penicilin G i penicilin V;
2. Penicilinaza- rezistentni penicilini (metecilin, nafcilin, izoksazolil penicilini-ciljano se primenjuju kod lečenja stafilokoknih infekcija);
3. Aminopenicilini- ampicilin i amoksicilin (pored širokog spektra delovanja, deluju i ciljano na enterobakterije);
4. Karboksipenicilini- praktično se ne primenjuju u stomatologiji (karbenicilin);
5. Acil ureidopenicilini - retko se primenjuju u stomatologiji (u kliničkoj praksi se koristi piperacilin).

Ako se penicilin pravilno upotrebljava i pridržava principa upotrebe antibiotika, smanjiće se broj neželjenih situacija ili ih neće ni biti. Pored grešaka koje mogu da se načine postoje i faktori na koje ne možemo uticati. Jedan od ozbiljnijih faktora su urođene alergijske reakcije na penicilin (iako se pravilno uzme anamneza, pacijent ne zna da je alergičan). U tim situacijama pored alergijskih simptoma kao što su kožni osip, otoci, svrab, može nastati i anafilaktički šok. Anafilaktički šok koji bez brze i adekvatne antišok terapije, može biti sa letalnim krajem (srećom su ti slučajevi veoma retki). Takođe od neželjenih dejstava se pojavljuju dijareja i povišena telesna temperatura. Jedan od primera nepravilne upotrebe penicilina G je davanje previsoke doze (obično >30 miliona jedinica na dan,) koja uzrokuje miokloničke grčeve i napade zbog toksičnog delovanja na CNS. Pored navedenih primera, postoji još patoloških dejstava na druge organe zbog loše primene.

3.1.1. Penicilin G- benzilpenicilin

Primenjuje se najčešće intravenski, a ređe intramuskularno. Daje se na 4 - 6 sati, ali kod teških infekcija se smanjuje vreme, pa se daje na svaka 2-3 sata. Terapiju penicilinom G ne treba ukršati sa primenom hloramfenikola, makrolida, sulfonamida i tetraciklina jer mogu da oslabe baktericidno dejstvo penicilina. Za odrasle, uobičajena doza penicilina G je 0,6 grama intramuskularno ili intravenski na svakih 4 - 6 sati. Za ozbiljnije infekcije poput meningitisa mogu se dati veće doze; za odrasle 1,2 - 1,8 grama, na svakih 4 sata, veće doze nisu neophodne. Kristalni penicilin G se daje intravenski kontinuirano (infuzija) ili u intermitentnim injekcijama ili infuzijama. Primenjuje se u niskim dozama od 600.000 do 1.200.000 IU (IU- international unit) intramuskularno, dnevno. Visoke doze su jednake ili veće od 20 miliona IU (=12 grama) intravenski, dnevno, na svaka 4 sata. Kod urgentnog stanja teških infekcija, prva injekcija se može dati intravenski da bi se brzo postigla koncentracija penicilina G u serumu. Dalje se nastavlja sa kontinuiranom infuzijom ili intravenskim intermitentnim injekcijama. U stomatologiji se ovaj penicilin upotrebljava kod gangrenoznog stomatitisa, kod gnojnih orofacijalnih dentogenih infekcija (Ludwig-ova angina), i drugih oboljenja medijufacijalnih, retrofaringealnih,

lateralno faringealnih prostora, rinogenih infekcija i drugih. Prokain penicilin G je vodena suspenzija za intramuskularnu primenu. Kod pneumonije, na primer, se u kasnijem stadijumu terapije može primeniti umesto kristalnog penicilina. Uobičajena doza za odrasle je 1,0 grama jednom ili dva puta u toku 24 sata. Nikada se ne sme primeniti intravenski.

3.1.2. Penicilin V- Fenoksimetilpenicilin

Sličan je penicilinu G. Za razliku od njega, otporan je na želudačnu kiselinu, pa se lako apsorbuje iz gastrointestinalnog trakta. Postoji u vidu kapsula ili tableta, a za decu u vidu sirupa. Normalna doza za odrasle je 250 – 500 mg na 6, 8 ili 12 sati. Potrebno je dati na prazan želudac, minimum 1 sat pre jela. Za teže infekcije može se primeniti veća doza. Preporučuje se upotreba kod blagih infekcija ili kod nastavka lečenja težih infekcija nakon što su postignuti odgovarajući klinički rezultati.

3.1.3. Aminopenicilini: ampicilin i amoksisicilin

Slični su, ali se razlikuju u pogledu bioraspoloživosti i farmakokinetičkih osobina. Da bi se proširio spektar delovanja, kombinuju se sa inhibitorima beta-laktamaza. U većini zemalja se više primenjuje amoksisicilin umesto ampicilina jer se bolje apsorbuje iz gastrointestinalnog trakta (90% > 40%).

Ampicilin- Normalna peroralna doza za odrasle je 500 mg, na svakih 6 sati. Ampicilin u obliku natrijumove soli se može primenjivati i intramuskularno ili intravenski. Kod teških oboljenja odraslih osoba, neophodne su nekad visoke parenteralne doze (1-2 g/6-8 sati). Slično se daje kao i penicilin G. Intramuskularno se daje na svakih 4-6 sati. Bolje je davati intravenski jer su intramuskularne bolne pa ih treba izbegavati. Najveća doza koja može da se primenjuje je 2 g na svaka 4 sata.

Amoksisicilin - Nalazi se u kapsulama (250 mg, 500 mg i 1000 mg), rastvorljivim tabletama (3 grama), oralnoj suspenziji (5 ml sadrži 125 ili 250 mg) i bočicama sa natrijum-amoksisicilinom (250, 500 ili 1000 mg) za parenteralnu primenu. Normalna peroralna doza za odrasle je 250-500 mg, na 6 ili 8 sati. Na-amoksisicilin je pogodan za intramuskularnu i intravensku primenu.

Ako su infekcije blage, onda se primenjuju doze kao kod peroralne primene. Za odrasle je doza Na-amoksicilina 1-2 g, na svakih 4-6 sati. Takođe, daje se intravenski slično kao penicilin G. Doze amoksicilina za peroralnu primenu u Evropi su diskutabilne i ne mogu se tačno utvrditi. Intravenski se obično primenjuje u dozama 500 mg do 2 g, četiri puta dnevno, dok je maksimalna doza 6 puta dnevno po 2 grama.

3.1.4. Antistafilokokni penicilini

Većina stafilokoka je rezistentna na peniciline (oko 95%). Stafilokokne infekcije možemo lečiti putem kombinacije penicilina sa inhibitorima beta-laktamaza (amoksisicilin/klavulanat, ampicilin/sulbaktam, piperacilin/tazobaktam), kao i sa antistafilokoknim penicilinima. Meticilin-rezistentni stafilokoki (MRSA) su mikroorganizmi koji su rezistentni na sve beta-laktamske antibiotike. Jedini koji mogu da deluju na njih su antistafilokokni cefalosporini (ceftarolin). U grupu antistafilokoknih

penicilina spadaju izoksazoil-penicilini (kloksacilin, flukloksacilin, dikloksacilin) i nafcilin. Izoksazoil-penicilini stabilno reaguju na kiseline i apsorbuju se iz gastrointestinalnog trakta. Oni su pravi izbor u terapiji stafilokoknih infekcija, sem ukoliko se ne radi o sojevima koji su rezistentni na meticilin (MRSA). Kloksacilin se primenjuje peroralno 500 mg na 6 sati, ili intravenski. Kloksacilin se primenjuje peroralno 500 mg na 6 sati, ili intravenski u dozi od 1 g na svakih 6 sati. Visoke doze su 1 g na 6 sati peroralno i intravenski 2 g na 4 sata. Flukloksacilin se primenjuje u standardnoj dozi od 1 g na 8 sati peroralno ili intravenski 2 g na svakih 6 sati. Visoke doze flukloksacilina su 1 g peroralno na 6 sati i 2 g intravenski na svaka 4 sata.

Postoje dve grupe klinički značajnih inhibitora beta-laktamaza (BL). To su klavulanska kiselina i sulfoni penicilične kiseline (sulbaktam i tazobaktam). Inhibitori BL sami po sebi imaju malo direktno antibakterijsko dejstvo ali uprkos tome mogu inhibirati neke bakterije pri visokim koncentracijama. Amoksicilin/klavulanska kiselina (amoksiklav ili augmentin) predstavlja kombinaciju amoksicilina i inhibitora beta-laktamaza klavulanska kiselina, u obliku kalijumove soli. Klavulanska kiselina ima slabo antimikrobno dejstvo. Njena klinička uloga se ogleda u tome što moćno inhibira BL. Klavulanska kiselina koju sadrži amoksiklav ili augmentin je odgovorna za dijareju kao i za gastro-intestinalne poremećaje (nauzeja, povraćanje). Da bi ti poremećaji bili ređi daju se, kod doziranja dva puta dnevno, manje doze klavulanske kiseline. Uzimanje leka sa hranom utiče takođe na težinu poremećaja. Pošto prolaze kroz placentu ovu kombinaciju leka treba izbegavati davati trudnicama koje su u kasnoj trudnoći i ženama sa visokim rizikom od prevremenog porođaja. Njena primena se povezuje sa neonatalnim nekrotizujućim enterokolitisom. Pacijenti koji dožive alergijsku reakciju (anafilaktički šok), bar 50% je reakcija na klavulanat. Hepatotoksičnost se takođe pripisuje klavulanatu iako je pojava hepatotoksičnosti odložena, oštećenje jetre je blago, a insuficijencija retka.

Amoksiklav se u različitim zemljama drugačije primenjuje. Za peroralnu upotrebu se nalazi u tabletama od 375 mg (250 mg amoksicilina plus 125 mg klavulanske kiseline), 625 mg (500/125 mg) i 1000 mg (875/125 mg). U novije vreme se primenjuje formulacija sa produženim oslobađanjem klavulanske kiseline (1000/62,5 mg). Za blage infekcije se daje 375 mg na svakih 8 sati, a za teže infekcije 625 mg na 6-8 sati. Kad je potrebna veća peroralna doza, uz 500 mg amoksicilina se dodaje 625 mg amoksiklava na 6 sati. Postoje razne formulacije leka, ali bitno je samo to da postoji fiksna količina klavulanske kiseline od 125 mg koja omogućava dovoljnu koncentraciju u tkivima za inaktivaciju beta-laktamaza. Veća doza 125 mg je nepoželjna. Kod intravenske primene se daje doza amoksiklava od 1,2 g (1 g amoksiklava i 0,2 g klavulanske kis.) na svakih 8 sati. U sporim intravenskim injekcijama u toku 3-4 minuta i više. Visoka doza od 2 g amoksiklava plus 0,2 g klavulanske kiseline se daje intravenski na 8 sati. Voditi računa kod pacijenata koji imaju oštećenu funkciju jetre, a doze podešavati ako pacijent ima insuficijenciju bubrega. Kod dojilja se primenjuje oprezno.

Ampicilin/sulbaktam je kombinacija ampicilin natrijuma i inhibitora BL. Deluje slično amoksiklavu na Gram-pozitivne, Gram-negativne i anaerobne bakterije. Razmera ampicilina u sulbaktama je 2:1. Parenteralno se primenjuje kao spora intravenska infuzija koja se daje u toku 10-15 minuta. Može se primeniti i duboka intramuskularna injekcija.

Preporučena doza je od 1,5 g (1 g ampicilina plus 0,5 g sulbaktama) do 3 g (2/1 g). na svakih 6 sati. EUCAST, 2018. g. preporučuje dozu od 3 g na 8 sati, a kod težih infekcija na svakih 6 sati. Kod velikog broja pacijenata (43-100%) sa infektivnom mononukleozom koji primaju ampicillin dolazi do pojave osipa kože. Ako dođe do insuficijencije jetre, onda nije potrebno podešavanje doza, ali kod insuficijencije bubrega jeste. Kontraindikacije za primenu su preosetljivost na peniciline (alergijska reakcija), gastrointestinalna oboljenja kao što je kolitis i oštećenje bubrega. Kod dojlja se treba pažljivo koristiti.

3.2. Cefalosporini

Cefalosporini su beta-laktamski antibiotici čiji je mehanizam delovanja identičan mehanizmu penicilina. Većina deluje na Gram-pozitivne bakterije (izuzev enterokoka) i Gram-negativne bakterije. Njihov spektar delovanja zavisi od generacije cefalosporina. Dele se na 4 generacije i u svakoj generaciji na one koje se primenjuju peroralno i one koje primenjuju parenteralno. U prvu generaciju spadaju cefaleksin i cefadroksil koji se primenjuju peroralno, i cefazolin i cefalotin koji se primenjuju parenteralno. Najbolje deluju na *S. aureus* (ukoliko nedostaje tip rezistencije na meticilin). Svi deluju na *Streptococcus spp.* Drugoj generaciji pripadaju cefalosporini koji imaju proširen spektar delovanja u odnosu na cefalosporine prve generacije tako što deluju bolje na Gram-negativne bakterije. Cefoksitin i cefotetan (pripadnici druge gen.) spadaju u antianaerobne cefalosporine jer od svih deluju najbolje na anaerobne bakterije. Zbog toga imaju veliku primenu u stomatologiji. Cefalosporini treće generacije imaju proširen spektar delovanja na Gram-negativne bakterije. Jedini predstavnik četvrte generacije koji se primenjuje u kliničkoj praksi je cefepim.

Većina cefalosporina koji se primenjuju peroralno se mogu uzimati bez hrane. Ako postoji insuficijencija bubrega, doza se podešava. Dobro prodiru u tkiva i telesne tečnosti. Unakrsna reakcija preosetljivosti sa penicilinom se javlja kod cefalosporina u 3-10% slučajeva. Takođe mogu ispoljiti i sopstvenu specifičnu alergijsku reakciju. Najčešće neželjene reakcije su dijareja, reakcije preosetljivosti u vidu osipa na koži, Stives-Džonsonov sindrom, erythema multiforme, toksična epidermalna nekroliza, povišena telesna temperatura, serumska bolest. Kod primene treće generacije je povećan rizik od kolitisa koji uzrokuje *C. difficile* i kolonizacije sa vankomicin-rezistentnim enterokokima. Najčešće se koriste u terapiji infekcija kože i mekih tkiva. Cefalosporini prve i druge generacije primenjuju u lečenju nekomplikovanih infekcija bolesti kože i mekih tkiva uzrokovanih stafilokokima i streptokokima.

3.2.1. Metronidazol

Spada u grupu imidazole. Od svih drugih antibiotika on najbolje deluje na anaerobne bakterije i dobro prodiro u tkiva, uključujući i CNS. Upotrebljava se kod infekcija uzrokovanih anaerobnim bakterijama, *Helicobacter pylori* infekcija, Chron-ove bolesti i u hirurškoj profilaksi. U toku terapije se nikako ne sme konzumirati alkohol. U prva tri meseca trudnoće ne treba koristiti ovaj lek. Slabo deluje na anaerobne nesporogene Gram-pozitivne bacile (*Actinomyces spp*, *Lactobacillus spp*) kao i na anaerobne streptokoke iz

usne duplje. U mešanim infekcijama (aerobna i anaerobna), obično se dodaje penicilin metronidazolu da bi delovao na aerobe i Gram-pozitivne anaerobe usne duplje (streptokoki). Nisu uobičajena neželjena dejstva zbog toga što se dobro podnosi. Najozbiljnije neželjeno dejstvo mogu doživeti pacijenti koji imaju poremećaje CNS-a jer primaju produženu terapiju sa povećanom dozom. Naravno, čim se jave neurološki simptomi kao što su ataksija, dizarija, periferna neuropatija, glavobolja, vertigo, konfuzija, depresija, odmah se prestaje sa terapijom. Mogu se pojaviti i nauzeja i epigastrični bol, a ređe povraćanje, dijareja, konstipacija, pankreatitis i hepatitis. Tokom sistemске primene se može javiti i metalni ukus u usnoj duplji kao i obloženost jezika, glossitis, stomatitis, suva usta sa pojavom kandidoze. Što se tiče genitourinarnog trakta javlja se taman urin, ređe cystitis i smanjen libido. Za teške infekcije se preporučuje intravenska primena. Dobro se apsorbuje peroralno pa se zbog toga može preći na takvu primenu kad stanje pacijenta to omogućava. Može se dozirati na 8, 12 ili 24 sata. Za anaerobne infekcije se daje intravenski u dozi od 7,5 mg/kg (oko 500 mg na 6 sati, ne prelazeći dnevnu dozu od 4 g). Takođe se najviše može davati u dozi 15 mg/kg na 12 sati. Ukoliko je život pacijenta ugrožen, daje se doza 500 mg na 6 sati. Peroralne doze EUCAST 2018.g. preporučuje 400 mg na 8 sati ili intravenske 400 mg na 8 sati, dok su visoke doze per os 500 mg/8h i intravenske 500 mg/8h. Kod oslabljene funkcije jetre treba podesiti dozu.

Veoma je koristan u terapiji oboljenja parodonticijuma (periodontalne bolesti). Tu se daje lek lokalno i sistemski uporedo sa hirurškim tretmanom. Lek je izbora kod nekroznih oboljenja parodonticijuma. Kod dentoalveolarnih infekcija se koristi uporedo sa penicilinom ili sam. Čak se i smatra da doprinosi lečenju hiperplazije gingive indukovane ciklosporinom.

3.3. MLSb Funkcionalna grupa antibiotika (makrolidi, linkozamidi, streptogramini)

Prototip klase makrolida je eritromicin. Pored njega, postoje na osnovu makrocikličnog prstena, azitromicin i klaritromicin (imaju značajnu prednost u odnosu na eritromicin u pogledu farmakokinetike, neželjenih dejstava i proširenog spektra delovanja). Prilikom peroralne upotrebe eritromicin se brzo inaktivira pomoću želudačne kiseline, dok su azitromicin i klaritromicin stabilni i imuni. Apsorpcija azitromicina i eritromicina se smanjuje do 50% ukoliko se uzimaju zajedno sa hranom. Bolja je distribucija u tkivima nego u serumu (10 do 100 puta veća u nekim tkivima u odnosu na serum). Oko 90% klindamicina se apsorbuje tokom peroralne upotrebe, a hrana ne ometa apsorpciju. Dobro se raspoređuje u kosti, pluća, žuč, a slabo prodire u likvor.

Neželjena dejstva kod upotrebe eritromicina su relativno mala. Može dovesti do anoreksije, nauzeje i povraćanja jer aktivira receptore u crevima i aktivira nekoordiniranu peristaltiku. Mogu se javiti i dijareja i grčevi u abdomenu. Tromboflebitis se izbegava tokom intravenskih infuzija razređenjem u većoj zapremini i sporijom infuzijom. Reakcije preosetljivosti mogu biti u vidu osipa, temperature i eozinofilije. Postoje mogućnosti nastanka holestatskog hepatitisa, ređe pseudomembranoznog kolitisa i superinfekcija *Candida* spp i Gram-negativnim bakterijama. Istovremenom primenom eritromicina i terfenadina se potencijalno javlja aritmija. Produženje QT intervala- ovim mehanizmom

se povećava rizik od ventrikularne tahikardije i srčanog zastoja. Interakcije sa drugim lekovima mogu predstavljati ozbiljan problem kod primene makrolida. Makrolidi ometaju metabolizam drugih supstrata i tako stvaraju rizik od njihovog nagomilavanja i toksičnog dejstva. Najmanji rizik je kod primene azitromicina. Primenom klindamicina može se u 20% slučajeva javiti dijareja. Druga neuobičajena neželjena dejstva su osip i temperatura.

3.3.1. Eritromicin

Sličan je penicilinu, ali nije identičan. Eritromicin je lek izbora u stomatologiji ukoliko je pacijent alergičan na penicilin. Ipak, ne koristi se uvek kao lek izbora jer ne deluje baš striktno na Gram-negativne bacile. Uglavnom deluje na Gram-pozitivne koke, neke Gram-negativne bakterije. Ukoliko se koristi dugo može ispoljiti hepatotoksično delovanje. Postoji više vrsta formulacija eritromicina i za svaku je doziranje različito. Većina peroralnih preparata se daje 1 sat pre jela jer hrana utiče na apsorpciju. Pretežno se daje peroralno. Doza zavisi od indikacija, a maksimalna doza je 4 g na dan nezavisno od formulacije, podeljeno u četiri jednake doze. Konvencionalna peroralna doza esterskih formulacija je 250 mg/6h za estolat i stearate, a 400 mg/6h za etilsukcinat. Formulacije sa postepenim oslobađanjem se mogu davati na 8, 12 ili 24h do ukupno 1000 mg/dan; za teške infekcije 4 4/24h. Za lečenje teških infekcija se primenjuje intravenski kao eritromicin laktobionat.

3.3.2. Azitromicin

Bolji je od eritromicina prilikom delovanja na neke Gram-negativne bakterije i ima bolja farmakokinetička svojstva. Značajno se nakuplja unutar ćelija. Takođe pokazuje i antiinflamatorno delovanje posebno kod bolesnika sa cističnom fibrozom. Slabo deluje u kiseljoj sredini. Uglavnom se primenjuje peroralno. Za većinu indikacija za odrasle se daje doza od 500 mg jednom dnevno prvog dana, a tokom narednih 4 dana se daje doza po 250 mg. Može se dati i jedna doza od 500 mg jednom dnevno tokom tri dana. Ovakvo kratko doziranje je moguće zbog farmakokinetike azitromicina i njegove perzistencije i koncentracije u tkivima. Za neka specifična oboljenja se primenjuje poseban način doziranja (gonoreja- singl doza od 2 g). Pored peroralne primene, može se primeniti intravenski. Ne preporučuje se podešavanje doza kod insuficijencije bubrega, a treba biti oprezan kod terapije pacijenata sa insuficijencijom jetre.

3.3.3. Klindamicin

Spektar delovanja je sličan spektru delovanja eritromicina (sa kojim nekada ispoljava unakrsnu rezistenciju), i benzil penicilina. Dobro deluje na Gram – negativne, struktno anaerobne bacile iz usne duplje. Takođe deluje na Gram – pozitivne aerobne bakterije, mnoge anaerobne i protozoa. Klindamicin postoji u različitim formama. Može se primenjivati peroralno, intramuskularno ili intravenski. Klindamicin hidrohlorid (jedna od formi) se primenjuje per os. Estar klindamicin palmitate hidrohlorid, primenjuje se kao suspenzija za decu i odrasle, koji ne mogu gutati kapsule. Doziranje je slično kao kod klindamicin hidrohlorida. Slabo se rastvara u rastvorima pri neutralnom pH i suviše je iritabilan za parenteralnu primenu, pa se estar klindamicin fosfat koristi za

intramuskularnu, intravensku i lokalnu primenu. Kod odraslih osoba se daje u dozama od 600-900 mg, na osam sati intravenski, ili peroralno u dozama od 300-450 mg, na šest sati. Intramuskularne doze za odrasle su 600-2400 mg/dan u dve do četiri podeljene jednake doze, u zavisnosti od težine infekcije. Radi intravenske primene klindamicin fosfat se mora razrediti u infuzionom rastvoru i u zavisnosti od količine rastvora davati u infuziji u toku 20 do 45 minuta. EUCAST 2018.g. preporučuje peroralnu primenu od 300 mg na 12 sati do 600 mg na 8 sati i parenteralnu primenu, doza od 300 mg na 6 sati do 1200 mg na 12 sati. Za infekcije koje ugrožavaju život, intravenski se primenjuje doza do 4800 mg na dan. Kod insuficijencije bubrega i jetre, nije potrebno podešavanje doze. Pažljivo se koristi kod dojilja, a rizik od primene u trudnoći svrtava se u kategoriju B. Da bi izbegli iritaciju ezofagusa, uzima se kapsula sa dosta vode. Koristi se u terapiji apscesa u različitim delovima tela, u tečnost apscesa ispoljava dobro delovanje u njoj. Ima dobar uticaj na imunološki sistem. Preporučuje se u hirurškoj profilaksi za čiste hirurške procedure, posebno za alergične na beta-laktame. Ukoliko se rade hirurške procedure u predelu glave i vrata ili hirurške intervencije gde postoje već prisutne inficirane rane, takođe se preporučuje primena klindamicina.

3.4. Tetraciklini

Tetraciklin je otkriven 1957. godine. Novi tetraciklini, doksicilin i minociklin se više koriste u kliničkoj praksi, zato što imaju veću bioraspoloživost i lipofilnost, što im proširuje spektar delovanja i povećava efikasnost. Tetraciklini se koriste uglavnom peroralno, ali se doksicilin i minociklin primenjuju i intravenski. Primena tetraciklina za vreme razvoja zuba (poslednja polovina trudnoće, novorođenačko doba i detinjstvo do navršenih 8 godina), može uzrokovati trajnu prebojenost zuba – tetraciklinski zubi, koje karakteriše žuto-sivo-braon prebojenost. Nekompletno se resorbuju iz gastrointestinalnog trakta, ali je apsorpcija bolja na prazan stomak. Hrana manje kompromituje apsorpciju doksicilina i minociklina. Kod pacijenata sa oštećenom funkcijom jetre tetracikline treba izbegavati, ili koristiti oprezno i smanjenim dozama. Pri oštećenju bubrega produženo je poluvreme eliminacije tetraciklina, osim doksicilina; zato se doksicilin smatra tetraciklinom izbora za ekstrarenalne infekcije kod oštećenja funkcije bubrega. Prolaze kroz placentu i ugrađuje se u kosti i zube fetusa. U velikim koncentracijama se izlučuju u mleku i zato se ne preporučuju trudnicama i dojiljama. Minociklin pri fiziološkom pH postiže relativno visoke koncentracije u salivi i suzama.

Imaju iritativne efekte na gornji deo gastrointestinalnog trakta (ezofagealne ulceracije, nauzeja, povraćaje, epigastrični bol). Ako se produži primena tetraciklina može da izazove oštećenje crevne flore i onda može dovesti do dijareje i pseudomembranoznog kolitisa. Reakcije preosetljivosti su neuobičajene i ispoljavaju se kao urtikarija i anafilaksija. Postoje ukrštene preosetljivosti između pojedinih tetraciklina. Fotosenzitivnost se ispoljava u vidu eritemskog osipa na područjima koja su izložena sunčevim zracima, i može se javiti kod primene bilo kog tetraciklina (pacijenti ne trebaju da se sunčaju dok primaju tetracikline). Ometaju rast kostiju, dovode do specifične prebojenosti zuba i hiperplazije gledji. Zbog toga se primena izbegava u toku trudnoće, kao i kod dece uzrasta

do 8 godina. Minociklin izaziva vrtoglavicu, a benignu intrakranijalnu hipertenziju (pseudotumor cerebri), izazivaju minociklin i drugi tetraciklini.

3.4.1. Tetraciklin hidrohlorid

Smatra se zastarelim antibiotikom ali se još uvek primenjuje u zemljama u razvoju. Postoji u kapsulama od 250 i 500 mg, za peroralnu primenu, koje se daju na 6 sati. Intravenski se dozira 0,5 do 1 gram na 12 sati. Indikacije su mu slične indikacijama doksiciklina.

3.4.2. Doksiciklin

Doksiciklin je tetraciklin druge generacije sa povećanom bioraspoloživošću i penetracijom u tkiva, sa širokim spektrom delovanja. Najčešće se daje peroralno, ali postoje i intravenske formulacije. Ima produženo poluvreme eliminacije. Zbog razvoja rezistencije i otkrića baktericidnijih antibiotika, danas ima uglavnom ograničenu primenu. Uobičajena doza za odrasle je 100 mg/12 h, koju treba uzeti sa bar 100 ml vode. Pri intravenskoj primeni se daje prva doza od 200 mg a zatim po 100 mg/12 sati. Svaku dozu treba rastvoriti u 500 ili 1000 ml glukoza- fiziološkog rastvora i dati kao sporu infuziju u toku jednog sata. Kod oštećenja funkcija jetre i bubrega nije potrebno podešavanje doza. Tokom trudnoće primena je bezbedna i svrtava se u kategoriju D. Ne preporučuje se dojiljama. U lokalnom lečenju paradontopatije koristi se kao dodatak u osnovnoj terapiji, u suboptimalnoj dozi.

3.4.3. Minociklin

Spektar delovanja mu je uglavnom isti kao kod tetraciklina i doksiciklina, ali se od njih razlikuje u pogledu farmakokinetike. Najčešći oblik primene je peroralni. Nalazi se u obliku kapsula ili obloženih tableta od 50 do 100 mg, i kao prašak za suspenziju. Za terapiju paradontopatija i akni nalazi se u obliku mikrogranula, odnosno, kapsula sa produženim oslobađanjem za lokalnu primenu. Postoje i parenteralne formulacije. Odraslim osobama se daje peroralno prva doza zasićenja od 200 mg, a posle doze održavanja od 100 mg na 12 sati. Svaka doza se rastvara u 500 ili 1000 ml rastvora glukoze ili fiziološkog rastvora za sporu infuziju u toku jednog sata. Ne daje se deci ispod 8 godina zbog trajnog prebojavanja zuba. Deci starijoj od 8 godina, daje se početna doza od 4 mg/kg, peroralno kao početna doza, a potom 2 mg po kg, na 12 sati. Kontraindikacije su iste kao kod doksiciklina. Minociklin u formi mikrogranula se primenjuje kao dodatak hirurškom tretmanu paradontopatija, i pokazao je značajno poboljšanje u odnosu na to kada je korišćena samo hirurška terapija.

3.5. Fluorokvinoloni

Preporučuju se za lečenje antraksa, infekcija kože i mekih tkiva koje uzrokuju Gram-negativne anaerobne bakterije. Ciprofloksacin se intravenski primenjuje u dozi od 400 mg na 12 sati, dok se za infekcije koje je uzrokovao *P. aeruginosa* daju doze od 400 mg na 8 sati. Peroralno se daju doze od 500 ili 700 mg na 12 sati. Levofloksacin se daje u dozama od 250, 500 ili 750 mg peroralno ili intravenski na 24 sata. Za većinu infekcija se prednost daje dozi od 750 mg. Moksifloksacin ima jedini antianaerobne dejstvo, pa je interesantan

za primenu u stomatologiji. Ključan za terapiju multirezistentne i ekstenzivno rezistentne tuberkuloze. Primenjuje se u dozama od 400 mg peroralno ili intravenski na 24 sata. Ukoliko je pacijent patološki gojazan, potrebne se povećane doze.

3.6. Antibiotici koji se uglavnom primenjuju u terapiji infekcija uzrokovanih multirezistentnim bakterijama

Sistemske i komplikovane, obično bolničke infekcije koje su uzrokovane rezistentnim bakterijama se leče antibioticima koji su prethodno odobreni od strane specijaliste, infektologa. Ti antibiotici se ređe koriste i njihova primena je uglavnom ograničena. U tu grupu spadaju vankomicin, ceftarolin, linezolid, daptomicin, karbapenemi i drugi.

3.6.1. Vankomicin

Vankomicin je glikopeptidni antibiotik čiji spektar delovanja obuhvata samo Gram-pozitivne bakterije. To je lek izbora za pacijente koji su alergični na penicilin, za infekcije uzrokovane Gram-pozitivnim bakterijama i parenteralnu terapiju infekcija koje uzrokuje MRSA (meticilin-rezistentni *Staphylococcus aureus*). Intravenska doza je 0,5 g na 6 sati ili 1 g na 12 sati. Pored ovog doziranja, može se primeniti i kontinuirana infuzija od 2 g na 24 sata.

3.6.2. Linezolid

Jedini antibiotik u kliničkoj praksi iz grupe oksazolidinona. Može se koristiti za lečenje komplikovanih infekcija kože i mekih tkiva koje uzrokuje MRSA i drugi Gram-pozitivni multi-rezistentni patogeni. Primenjuje se u dozama od 600 mg na 12 sati. Terapija počinje intravenski, ali zbog dobre biorasploživosti se može nakon toga preći na peroralnu upotrebu.

3.6.3. Daptomicin

Mehanizam delovanja nije utvrđen, ali deluje baktericidno na Gram-pozitivne bakterije. Daje se u dozama od 250 mg do 500 mg, intravenski na 24 sata. Kod dece se ne primenjuje.

3.6.4. Karbapenemi

Imaju širok spektar, deluju na anaerobne, na Gram-negativne i na Gram-pozitivne bakterije. Zbog toga su korisni u lečenju raznih infekcija koje uzrokuju multirezistentne bakterije, posebno u bolnicama, kod pacijenata koji su prethodno lečeni drugim antibioticima širokog spektra.

4. PRIMERI PRIMENE ANTIBIOTIKA U STOMATOLOGIJI

Navešćemo dva primera upotrebe antibiotika u terapiji čestih oboljenja u stomatologiji. Prvi primer je formiranje apscesa različitih porekla, koja mogu biti od inficiranog korena zuba, inficiranog impaktiranog zuba, nelečena trauma, itd. Kod svih tih situacija dominira stafilokokna i streptokokna kultura. Tim mikroorganizmima se pridružuju i anaerobne kulture, ali je dominantna aerobna infekcija. Posledica neblagovremeno lečenog apscesa

na donjoj vilici je teška infekcija poda usne duplje (Ludwigova angina) koja prodire do mediastinuma i ugrožava život. U terapiji apscesa, pored hirurškog zahvata koji podrazumeva inciziju („Ubi pus, ibi evacuatio“), neophodna je i antibiotska terapija. Suvereni antibiotici u lečenju apscesa su penicilinski preparati, naravno ukoliko pacijent nije alergičan na penicilin. Ako postoji reakcija na penicilin, onda se primenjuju antibiotici širokog spektra uz antibiotike za anaerobnu floru uz dodatak doze antibiotika koji deluju na anaerobne mikroorganizme, jer one mogu dovesti do ozbiljnih komplikacija.

Drugi primer je nekrozno oboljenje parodontijuma. Terapija podrazumeva početni lokalni debridman (uklanjanje nekrotičnog tkiva) i savete za održavanje oralne higijene uz primenu rastvora hlorheksidina. Od antibiotika se preporučuju metronidazol (lek izbora) u dozi od 500 mg na 8 sati per os ili intravenski kod teških formi. Alternativa može biti amoksicilin/klavulanat 500 mg per os na 8 sati, ili klindamicin 450 mg per os na 6 sati i klindamicin kod teških formi intravenski 600 mg na 6-8 sati.

5. REŽIMI ANTIMIKROBNE TERAPIJE

Terapijski režimi su prikazani u sledećim tabelama:

Tabela 1. Režimi antimikrobne terapije nedentogenih infekcija (3)

Klinički entitet	Najčešći uzročnici infekcije	Antimikrobni režim
Gangrenozni stomatitis (noma)	<i>Fusobacterium nucleatum</i> , <i>Borrelia vincentii</i> , <i>Prevotella melaninogenica</i> , drugi anaerobi usne duplje	Penicillin G, 2-4 MU iv na 4-6 h <i>plus</i> metronidazol, 500 mg <i>per os</i> ili iv na 8 h ili
		Ampicilin-sulbaktam, 1,5-3 g iv na 6-8 h ili
		Amoksicilin-klavulanat, 625 mg <i>per os</i> na 8 h ili
		Klindamicin, 450 mg <i>per os</i> na 6-8 h ili 600 mg iv na 6-8 h
Teški mukozitis kod imunokompromitovanih bolesnika	Streptokoki grupe viridans i drugi streptokoki, <i>Bacteroides</i> spp, <i>Peptostreptococcus</i> spp, i drugi anaerobi usne duplje, fakultativni Gram-negativni bacili (enterobakterije)	Lokalno hlorheksidin (0,1%) rastvor za ispiranje usta tri puta dnevno <i>plus</i> jedno od sledećih:
		Cefotaksim, 2 g iv na 6 h ili
		Piperacilin-tazobaktam, 3,375 g iv na 6 h ili
		Imipenem, 500 mg iv na 6 h ili

		Meropenem, 1 g iv na 8 h
Sijalaodenitis i gnojni parotitis*	<i>Staphylococcus aureus</i> , <i>streptokoki viridans</i> grupe i drugi <i>streptokoki</i> , <i>Bacteroides spp</i> , <i>Peptostreptococcus spp</i> , drugi anaerobi usne duplje	Kloksacilin, 1 -2 g iv na 6 h <i>ili</i>
		Flukloksacilin, 1-2 g iv na 6h <i>ili</i>
		Vankomicin, 1 g iv na 12 h <i>plus</i> jedno od sledećih
		Metronidazol, 500 mg iv na 6 h <i>ili</i>
		Klindamicin, 600 mg iv na 6 h

MU= million jedinica; IV= intravenski; *=preporučuje se mikrobiološka dijagnostika

Tabela 2. Inicijalni režimi empirijske antimikrobne terapije gnojnih infekcija glave i vrata (3)

Vrsta infekcije	Najčešći uzročnici	Režim antimikrobne terapije
Gnojne orofacijalne dentogene infekcije, (uključujući Ludwig-ovu anginu (**))	Streptokoki grupe viridans i drugi streptokoki, <i>Peptostreptococcus spp</i> , <i>Bacteroides spp</i> , drugi anaerobi usne duplje	Penicilin G, 2-4 MU na 4-6 h PLUS metronidazol, 500 mg iv na 6 h <i>ili</i>
		Ampicilin-sulbaktam, 3 g iv 4-6 h <i>ili</i>
		Klindamicin, 600 mg iv na 6 h <i>ili</i>
		Cefoksitin, 1-2 g iv na 6 h
Infekcije lateralnog faringealnog ili retrofaringealnog prostora		
Dentogene (**)	Streptokoki viridans grupe, <i>Staphylococcus spp</i> , <i>Peptostreptococcus spp</i> , <i>Bacteroides spp</i> , drugi anaerobi usne duplje	Penicilin G, 2-4 MU na 4-6 h PLUS metronidazol, 500 mg iv na 6 h <i>ili</i>
		Ampicilin-sulbaktam, 3 g iv 4-6 h <i>ili</i>
		Klindamicin, 600 mg iv na 6 h
Rinogene (***)	<i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i> , streptokoki viridans grupe i drugi	Jedan od sledećih režima: 1) Penicilin G, 2 [^] 1 MU na 4-6 h, <i>ili</i> Levofloksacin, 500 mg iv na 24 h, <i>ili</i> Ciprofloksacin 750 mg iv na 12 h <i>Plus</i>

	streptokoki, <i>Bacteroides</i> spp, <i>Peptostreptococcus</i> spp, drugi anaerobi usne duplje	Metronidazol, 500 mg iv na 6 h <i>ili</i> Klindamicin, 600 mg iv na 6 h 2) Moksifloksacin, 400 mg iv na 24 h
Otogene	Isti uzročnici kao kod rinogenih infekcija	Terapijski režimi isti kao kod rinogenih infekcija
Cervikofacijalna aktinomikoza	<i>Actinomyces israelii</i> , <i>Arachnia propionica</i> , <i>Aggregatibacter</i> <i>actinomycetemcomitans</i>	Penicilin G, 24 MU na 4-6 h <i>ili</i> Doksicilin, 200 mg per os <i>ili</i> iv na 12 h <i>ili</i> Klindamicin, 450 mg per os na 6h <i>ili</i> 600 mg iv na 6h
Ujed čoveka ili životinje	<i>S. pyogenes</i> , <i>S. atireus</i> , <i>Eikenella corrodens</i> , anaerobi usne duplje, <i>Pasteurella multocida</i>	1) Ampicilin-sulbaktam 3 g iv na 4-6 h <i>ili</i> 2) Amoksicilin-klavulanat, 500 mg <i>per os</i> na 8h <i>ili</i> 3) Moksifloksacin, 400 mg iv <i>ili</i> <i>per os</i> na 24 h
Maksilofacijalna trauma, posthirurške infekcije rana	<i>S. aureus</i> , <i>S. pvogenes</i> , <i>Peptostreptococcus</i> spp, drugi anaerobi usne duplje, <i>Pseudomonas</i> <i>aeruginosa</i> , enterobakterije	Kloksacilin, 1 g iv na 6 h <i>ili</i> Flukloksacilin 2 g iv na 6h, <i>ili</i> Vankomicin, 1 g iv na 12 h plus jedno od sledećih 1) Piperacilin-tazobaktam 3,375 g iv na 6 h <i>ili</i> 2) Meropenem 1 g iv na 8 h <i>ili</i> 3) Moksifloksacin 400 mg iv <i>ili</i> <i>per os</i> na 24 h <i>ili</i> 4) Tigeciklin 100 mg iv prva doza, a potom 50 mg iv na 12 h
Gnojni jugularni tromboflebitis (Lemierre-ov smdrom)	<i>Fusobacterium</i> necrophorum, uzročnici kao kod dentogenih infekcija međufascijalnih prostora	Isti terapijski režimi kao kod dentogenih infekcija međufascijalnih prostora
Gnojna tromboza sinus kavernozusa	Isti uzročnici kao kod dentogenih, rinogenih i otogenih međufascijalnih infekcija	Terapijski režimi kao kod dentogenih (*), rinogenih (**) i otogenih (***) infekcija međufascijalnih prostora
		Klindamicin 600 mg iv na 6 h <i>ili</i>

Osteomijelitis mandibule	Isti uzročnici kao kod dentogenih (*) infekcija međufascijalnih prostora	Moksifloksacin 400 mgper os <i>ili</i> iv na 24 h
Osteomijelitis poreklom iz infekcija prevertebralnog prostora	<i>Staphilococcus aureus</i> , fakultativni Gram-negativni bacili	Kloksacilin. 1 g iv na 6 h <i>ili</i> flukloksacilin, 2 g iv na 6h <i>ili</i> vankomicin, 1 g iv na 12 h PLUS Tobramicin. 1,7 grama/kg iv na 8 h <i>ili</i> ciprofloksacin, 400 mg iv na 12 h

Tabela 3. Režimi antimikrobne terapije dentogenih infekcija (3)

Klinički entitet	Najčešći uzročnici infekcije	Antimikrobni režim
Prevenција supragingivalnog zubnog plaka i zubnog karijesa	<i>Streptococcus mutans</i> , drugi streptokoki, <i>Actinomyces</i> spp	Zubne paste i rastvori za ispiranje usta sa fluoridom (Na-fluorid 1,1% ili kalaj fluorid 0,4%) 2-3 puta dnevno sa ili bez
		Lakovi koji sadrže fluorid (Na-fluorid 5%) 3-4 puta godišnje sa ili bez
		Hlorheksidin, 0,12% rastvor za ispiranje usta
Nekrozna oboljenja parodonticijuma	<i>Prevotella intermedia</i> , <i>Fusobacterium</i> spp, <i>Tannerella forsythia</i> , <i>Treponema denticola</i> , druge oralne spirohete	Metronidazol 500 mg per os <i>ili</i> iv na 8 h <i>ili</i>
		Ampicilin/sulbaktam, 1,5-3 g iv na 6 h <i>ili</i>
		Amoksicilin/klavulanat, 625 mg <i>per os</i> na 8 h <i>ili</i>
		Klindamicin, 450 mg <i>per os</i> na 6 h ili 600 mg iv na 6-8 h
Rano-nastupajuća "agresivna" ili "lokalizovana juvenilna" parodontopatija (periodontitis)	<i>Aggregatibacter actinomycetemcomitans</i> , <i>Porphyromonas gingivalis</i> , <i>Treponema denticola</i> , <i>Prevotella intermedia</i>	Doksiciklin 100-200 mg <i>per os</i> <i>ili</i> iv na 12 h (samo pacijentima starosti > 8 godina starosti) <i>ili</i>
		Metronidazol, 500 mg <i>per os</i> ili iv na 8 h

”Uznappedovala” ili parodontopatija odraslih	<i>Treponema denticola</i> , druge oralne spirohete, crno-pigmentujući anaerobi (<i>Porphyromonas gingivalis</i> i <i>Prevotella melaninogenica</i>), <i>Tannerella forsythia</i>	Lokalna primena globula minociklina (Arestin) ili
		Lokalna primena doksiciklina hiklata, gel sa produženim oslobađanjem (Atridox)

Tabela 4. Režimi doziranja cefalosporina (3)

Generičko ime	Put primene	Doze za odrasle
Cefaleksin	PO	0,25-1 g na 6 h (maksimalno 4 g dnevno)
Cefadroksil	PO	0,5-1 g na 12 h
Cefaclor	PO	0,25-1 g na 8 h
Cefiksim	PO	400 mg na 12 h ili na 24 h
Cefazolin	IV/IM	1-2 g na 8 h
Cefoksitin	IV/IM	1-2 g na 6-8h
Cefuroksim	IV/IM	0,75 g na 8 h do 1,5 g na 8 h
Cefotaksim	IV	1 g na 8-12 h do 2 g na 6 h
Ceftriakson	IV ili IM u 1% lidokainu	1-2 g na 24 h
Ceftarolin		600 mg na 12 h u toku 1 h do 600 mg na 8 h u toku 2 h

PO = per os; IV = intravenski; IM = intramuskularno; g = gram

6. REZISTENCIJA BAKTERIJA NA ANTIBIOTIKE

Rezistencija bakterija na antibiotike je globalni problem. Nastaje i širi se zbog njihove preterane upotrebe i zloupotrebe u medicini, veterini, poljoprivredi i proizvodnji hrane. Mnoge bakterije imaju urođenu rezistenciju na antibiotike. Međutim, bakterije mogu da steknu rezistenciju tokom svog života, najčešće putem plazmida. Prilikom konjugacije plazmida koji nose gene rezistencije mogu preći iz jedne bakterije u drugu. Za razvoj klona rezistentnih bakterija potrebno je da prodje neko vreme pod preteranom upotrebom antibiotika i antiseptika kada se eliminišu osetljive bakterije na primenjeni antibiotik, a zaostanu otporne bakterije i nastave da žive i razmnožavaju se.

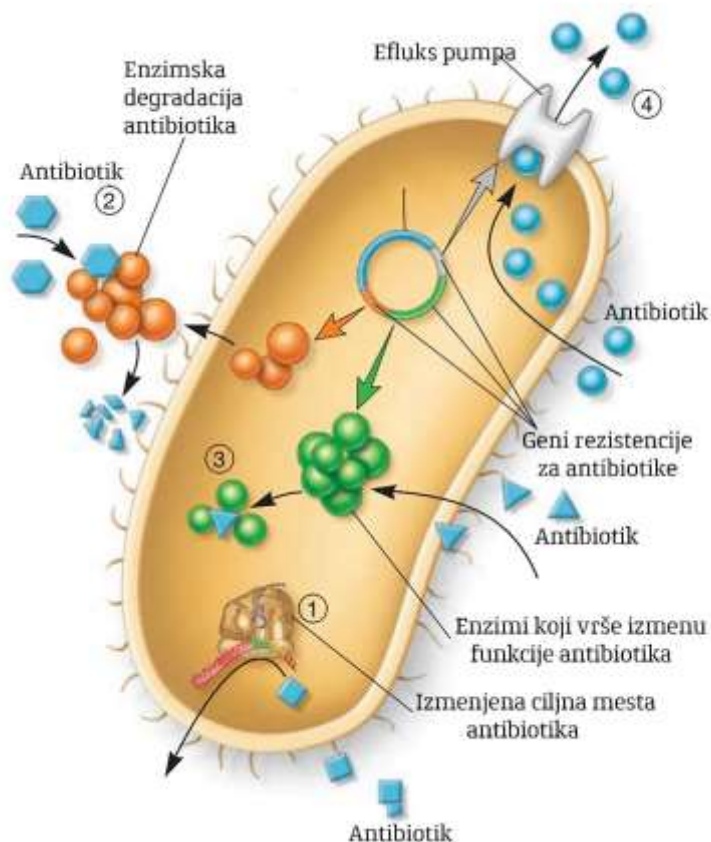
Vrlo često pacijenti koji su uzimali veliku količinu antibiotika imaju izmenjenu crevnu floru, sa smanjenim brojem bakterija koje su bile osetljive na date antibiotike i povećanim brojem multirezistentnih bakterija. Najčešće ovakvu situaciju vidamo kod teških bolnički

lečenih pacijenata, iako se sve češće i kod ambulantno lečenih pacijenata izoluju uzročnici infekcije rezistentni na više grupa antibiotika. Da bi se ovo suzbilo, bolnice i druge ustanove gde se sprovodi zdravstvena delatnost treba da imaju protokole za lečenje infekcija.

Protokol treba da uputi kada se upotrebljavaju antibiotici prvog ili drugog reda, a kada mogu rezervni antibiotici. Rezervni antibiotici treba da se štede jer predstavljaju poslednju meru odbrane od infekcije. Takođe protokoli treba da odrede i dozu i dužinu terapije za određenu infekciju. Infekcije izazvane multirezistentnim bakterijama komplikuju lečenje bolesnika i produžavaju boravak u bolnici. Dovode do povećanja mortaliteta, morbiditeta i povećavaju troškove lečenja. Značajan je javno zdravstveni problem u bogatim zemljama, a naročito u siromašnim zemljama.

U Evropi se prate bakterije od velikog epidemiološkog značaja kao što su: *meticilin rezistentni Staphylococcus aureus (MRSA)*, vankomicin rezistentni enterokok (VRE), enterobakterije (*Escherichia coli* i *Klebsiella pneumoniae*) rezistentne na 3. generaciju cefalosporina i karbapeneme, *Pseudomonas aeruginosa*, *Acinetobacter baumannii* rezistentni na karbapeneme i *Streptococcus pneumoniae* rezistentan na penicilin.

Rezistencija bakterija se najbrže širi među Gram-negativnim bakterijama iste vrste, najčešće putem plazmida. Međutim, prelaz plazmida sa jedne bakterije na drugu se može dešavati između Gram-negativnih bakterija različitih vrsta. Nakon završenog procesa konjugacije bakterija primaoc osetljiva je na antibiotike. Rezistentna bakterija (donor) oslobađa plazmid na kome se nalazi gen za rezistenciju na jedan ili više antibiotika (zeleni prsten). Plazmid preuzima bakterija primaoc i na taj način i ona postaje rezistentna na iste antibiotike. Bakterije su razvile veći broj različitih mehanizama kojima stiču rezistentnost. Najvažniji su: enzimska destrukcija ili inaktivacija leka, izmena ciljnog enzima, izmena propustljivosti ćelijskih ovojnica, izmena strukture ribozoma, izmena metaboličkog puta.



Slika 6- Prikaz mehanizma rezistencije bakterija (11)

6. ZAKLJUČAK

Antibiotici gube efikasnost i dejstvo brzinom koja se još pre par godina nije mogla predvideti. U budućnosti se možemo suočiti sa povratkom u „preantibiotsku eru“. Zbog limitiranih terapijskih mogućnosti obična bakterijska infekcija može se završiti smrtnim ishodom.

Stoga nas ta situacija obavezuje na pravilnu primenu antibiotika i eventualno stvaranje protokola o upotrebi antibiotika.

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RESEARCH ON THE CORRECT USE OF ANTIBIOTICS IN DENTISTRY

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ABSTRACT: *Antibiotics are chosen on a "best guess" basis, with knowledge of the infectious disease, the most likely pathogen and its usual antibiotic susceptibility profile. This type of empirical antibiotic therapy is used in most situations in dentistry because most infections are caused by multiple pathogens, anaerobic gramme-negative bacteria are most commonly involved in these infections, and it's difficult to avoid contamination of the specimen with the colonising microflora when taking samples. It's important to follow the basic principles of the correct use of antibiotics. It must be determined whether the disease has an infectious cause and if so, a sample must be taken for microbiological examination before antibiotics are administered. Several factors may influence the choice of antibiotic: medical history, allergic reactions, toxic effects of the drug and previous antimicrobial therapy. Existing organ damage must be taken into account. The way antibiotics are administered depends on the severity of the disease. For example, the parenteral, intravenous route of administration is chosen for severe infections. Interactions of antibiotics with other drugs are becoming more common due to the introduction of new drugs into clinical practise, so this factor must be considered when determining antimicrobial therapy. The over-empirical use of antibiotics has led to a tremendous development of bacterial resistance to these agents, so that today the choice of therapeutic options for the treatment of many infections is limited to less effective agents.*

Keywords: dentistry, antimicrobial therapy, resistance

RESISTANCE OF BACTERIAL ISOLATES FROM URINE CULTURES TO ANTIBIOTICS

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ABSTRACT: *Because of their frequency, the necessary use of antibiotics and the increased costs of treatment, bacterial infections of the urinary tract represent a current and one of the most prevalent problems in modern medicine. The aim of this work was to show the main causes of bacterial infections of the urinary tract and their resistance to various antibiotics used in the treatment of these diseases. Through the bacteriological examination of urine cultures in the period from January to December during 2022, patients with the presence of bacterial infections were registered in the territory of Šabac. The presence of bacteria was determined in urine culture, using standard microbiological methods. In order to test resistance to antibiotics, the disk diffusion method was used. In the observed period, 23,586 patients with urinary infections were registered. Of these, the largest number of isolates is Escherichia coli (59.51%), Klebsiella spp. (14.11%), Enterococcus spp. (8.97%) and Proteus spp. (7.32%). The species Stenotrophomonas maltophilia (0.04%) had the lowest representation in the urine culture. Considering that uropathogenic representatives of bacteria have the ability to develop resistance to antibiotics, it is recommended that the therapy of these infections be carried out on the basis of an antibiogram. The drugs of first choice in the treatment of infections caused by Escherichia coli are colistin, tigecycline and nitroxoline, while the majority of isolates showed resistance to ampicillin and amoxicillin. In Klebsiella spp. all isolates showed the appropriate percentage of resistance to the tested antibiotics, and ciprofloxacin and trimethoprim sulfonamide proved to be the most effective.*

Keywords: *urine culture, bacterial infections, antibiotics, antibiotic resistance*

1. INTRODUCTION

Bacterial infections mean diseases or conditions caused by the reproduction of bacteria or the action of their toxins in the blood, skin, gastrointestinal tract, lungs or some other place in the patient's body. The types of bacterial infections can be different and include: urinary tract infections, bloodstream infections, skin, throat, nose, ear or sinus infections, bacterial pneumonia, food poisoning, some sexually transmitted infections, etc. Thanks to

the ability of toxins to penetrate tissues and cells and damage organs, bacterial infections in patients can cause numerous pathological changes or even lead to death. Urinary tract infections (UTIs) are known as one of the most common bacterial infections in the world (Azab I et al. 2021). They include infections of the urethra, bladder, ureters and kidneys (Barber et al., 2013). They are considered a significant cause of morbidity in infant boys and elderly men and women of all ages, causing serious consequences including recurrent infections, pyelonephritis with sepsis, kidney damage in young children, and premature birth (Flores-Mireles et al., 2015).

Clinically, urinary tract infections are categorized as uncomplicated or complicated. Uncomplicated UTIs typically affect individuals who are otherwise healthy and have no structural or neurological abnormalities of the urinary tract (Hooton, 2012; Nielubowicz and Mobley, 2010) these infections are differentiated into lower UTIs (cystitis) and upper UTIs (pyelonephritis) (Hooton, 2012, Hannan et al., 2012). Several risk factors are associated with cystitis, including female gender, previous UTI, sexual activity, vaginal infection, diabetes, obesity, and genetic susceptibility (Hannan et al., 2012). Complicated UTIs are defined as UTIs associated with factors that compromise the urinary tract or host defenses, including urinary obstruction, urinary retention caused by neurologic disease, immunosuppression, renal failure, kidney transplantation, pregnancy, and the presence of foreign bodies such as stones, indwelling catheters, or other drainage devices (Lichtenberger and Hooton 2008; Levison and Kaye, 2013).

Pathogens that are most often encountered as causes of urinary tract infections are well known and described in the literature (Amdeker et al., 2011; Abraham & Miao 2015). According to Azahrani et al., (2020), the most common uropathogenic species isolated from urine cultures are: *Escherichia coli* (37.82%), *Klebsiella pneumoniae* (19.20%), *Enterococcus faecalis* (10.89%) and *Pseudomonas spp.* (6.59%).

Due to various unknowns in diagnosis and therapy, urinary tract infections represent a challenge for medical staff and especially for hospital epidemiologists who, thanks to their knowledge of epidemiology, should propose quality prevention measures.

Early diagnosis and the choice of an adequate antibiotic are of crucial importance in the treatment of these infections. The choice of antibiotics should primarily depend on the knowledge of the bacteria causing the disease and their sensitivity to antibiotics [Shaifali, Al-Mijalli,]. Antibiotics are antimicrobial substances that inhibit the development of microorganisms in such a way that they can prevent the synthesis of cell wall components (beta-lactam antibiotics, glycopeptides, bacitracin), act on the cytoplasmic membrane (polymyxins), prevent protein synthesis (aminoglycosides, tetracyclines, glycyclcyclines, chloramphenicol, macrolides and others) or prevent the synthesis of nucleic acids (quinolones, metronidazole and others) (Dujmić Ilić). Acting on the cell wall actually affects the synthesis of peptidoglycan precursors or the assembly of precursors in the cell wall and the formation of the peptidoglycan layer. Since human cells do not possess peptidoglycan, it is possible to achieve selective toxicity to a large extent by using this group of antibiotics. The most important antibiotics found in this group are beta-lactam antibiotics and glycopeptides (4). Beta-lactam antibiotics are the most commonly used antibiotics for the treatment of bacterial infections due to their low toxicity, high

bactericidal properties and a wide spectrum of action (Brkić, 2021). In recent years, the resistance of bacteria to antibiotics has increased significantly, forcing doctors to have a limited choice of drugs [Houghton 2012]. The third generation cephalosporins are the gold standard in the treatment of bacterial infections.

The aim of this study was to determine different representatives of bacteria that cause urinary tract infections and examine their antibiotic resistance, in the territory of the city of Šabac, during a one-year period.

2. MATERIAL AND METHODS

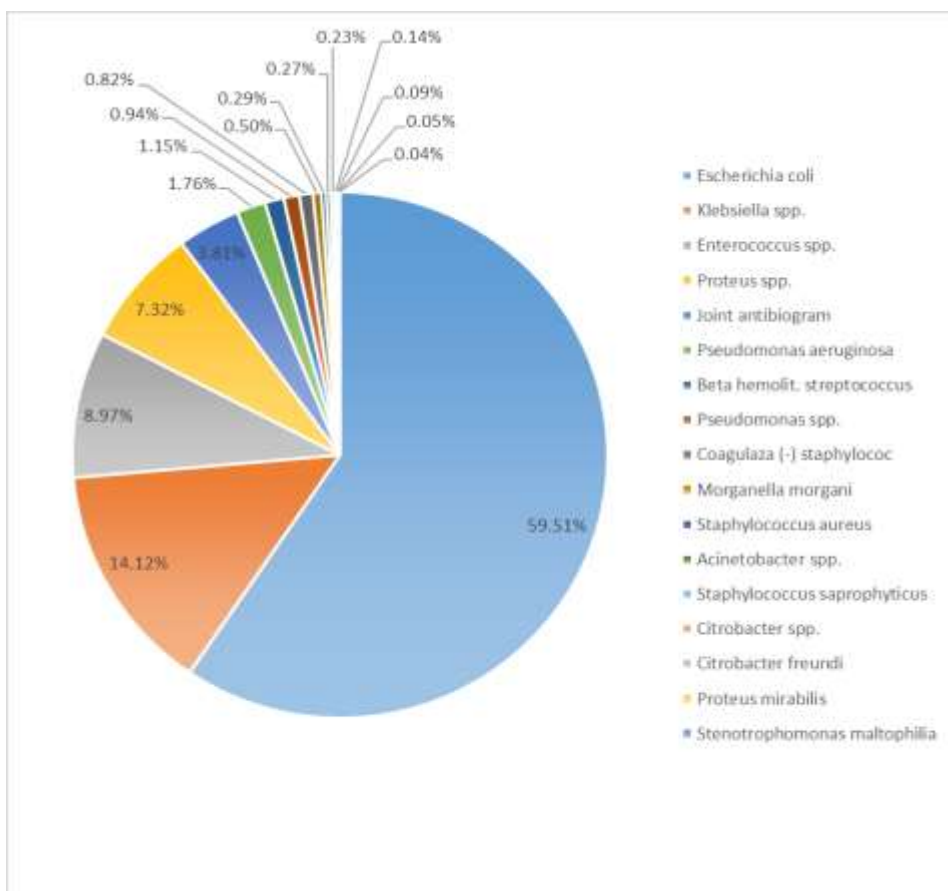
The research was conducted by collecting the results (from January to December 2022.) of microbiological analyses, which included the isolation and identification of bacterial pathogens of urinary infections and the determination of their sensitivity to antibiotics using the antibiogram method. The analysis was performed in the Zdravlje Health Microbiology Laboratory in Šabac based on instructions from the primary level health care institution. The research included bacterial isolates that were isolated using standard microbiological methods from urine cultures. Antibiotic susceptibility testing was performed using the disk-diffusion method on Mueller-Hinton agar (antibiogram method). The inoculum is prepared by diluting an 18-24-hour pure bacterial culture in a saline solution. The suspension is vortexed and then the density of the suspension is adjusted by comparison with the 0.5 McFarland standard for turbidity. After that, the inoculum is sown on the surface of the substrate and then antibiogram tablets or discs are placed on the surface using a dispenser or sterile tweezers. Growth inhibition zones were read according to the recommendations of Eucast (European Committee on Antimicrobial Susceptibility Testing). Susceptibility to: penicillin G, ampicillin, amoxicillin, amoxicillin-clavulonic acid, cephalexin, cefazolin, cefaclor, ceftriaxone, tetracycline, tigecycline, erythromycin, clindamycin, gentamicin, amikacin, tobramycin, ofloxacin, ciprofloxacin, levofloxacin, trimethoprim-sulfonamide, cefprozil was tested. , cefuroxime, cefadroxil nitrofurantoin, ampicillin sulfbactam, meropenem, fosfomycin, colistin, piperacillin, imipenem, ceftazidime, piperacillin-tazobactam, vancomycin and aztreonam. The obtained results were processed using descriptive statistics of the Microsoft Excel program.

3. RESULTS AND DISCUSSION

The research included 23,586 patients with urinary infections, in a period of twelve months, during 2022.

Based on the data shown in Graph 1, it can be seen that the most frequently isolated pathogens from urine cultures are: *Enterococcus spp.* (8.97%), *Escherichia coli* (59.51%) and *Klebsiella spp.* (14.12%) and *Proteus spp.* (7.32%). Our results are comparable to the results of the study by Djordjević et al., (2016) who analyzed the frequency of outpatient urinary tract infections. The most frequently isolated causative agents of urinary infections among them were *E. coli* (56.6%), followed by *Klebsiella spp.* (16.2%), *Enterococcus spp.* (5.3%) and *Pseudomonas aeruginosa* (3.7%). Similar results on the presence of bacteria

in urine cultures were published by Lazarevic et al. 2022, based on which the bacterium *E. coli* was more often isolated in women (82.7%), while *P. aeruginosa* was more present in men (76.1%).



Graph 1. Percentage participation of certain causative agents of urinary infections

Klebsiella spp. and *Enterococcus spp.* occurred almost equally in both sexes (Lazarević et al., 2022). And the results of Marković et al., 2007, show that *E.coli*, as the most common causative agent, was represented by 53.24% in urine samples, while *Klebsiella pneumoniae* was isolated from 7.71% of urine samples. According to Alzahrani et al (2020), the occurrence of uropathogenic infections is much more frequent in the summer than in the winter, with *E.coli* and *Enterococcus faecalis* being the predominant isolates.

The high percentage of *E.coli* in the urine culture can be explained by the fact that this bacterium generally belongs to the normal flora of the human colon, from where it can very easily colonize the urinary tract. Other pathogens that can be found in urine, although present in smaller percentages, play a significant role in urinary infections due to their pathogenicity and high resistance to antibiotics.

By testing the sensitivity of *Escherichia coli* isolates from urine samples, the results shown in Table 1 were obtained.

Escherichia coli isolates showed high sensitivity to the antibiotics colistin, tigecycline and nitrofurantoin (100%), as well as to fosfomycin (99.42%), nitrofurantoin (98.43%), amikacin (98.06%), imipenem (96, 43%), piperacillin-tazobactam (96.29%), meropenem (96.43%) and ertapenem (96%). Our findings are in accordance with the reports of other researchers who, by analyzing the sensitivity of *E. coli*, observed a high sensitivity to a wide range of antibiotics such as meropenem, piperacillin, ceftazidime, levofloxacin, tigecycline and colistin (Alzahrani et al., 2020).

Table 1. Susceptibility of *Escherichia coli* isolates to antibiotics

Antibiotic	Total tested	Resistant (Number / %)	Sensitive (Number / %)	Intermediate (Number / %)
Ampicillin	1037	568 / 54,77	469 / 45,23	0
Amoxicillin	937	474 / 50,59	463 / 49,41	0
Amoxicillin-clavulanic acid	1035	152 / 14,69	880 / 85,02	3 / 0,29
Piperacillin	2	1 / 50	1 / 50	0
Imipenem	28	1 / 3,57	27 / 96,43	0
Piperacillin-tazobactam	27	1 / 3,71	26 / 96,29	0
Meropenem	28	1 / 3,57	27 / 96,43	0
Ertapenem	25	1 / 4	24 / 96	0
Cephalexin	1032	141 / 13,67	805 / 78	86 / 8,33
Ceftiaxone	1037	113 / 10,89	921 / 88,81	3 / 0,29
Ceftazidime	47	27 / 57,45	19 / 40,42	1 / 2,13
Cefixime	1037	115 / 11,09	922 / 88,91	0
Cefepime	27	3 / 11,11	19 / 70,37	5 / 1,85
Gentamicin	1023	139 / 13,59	876 / 85,63	8 / 0,78
Amikacin	1033	19 / 1,84	1013 / 98,06	1 / 0,1
Tobramycin	19	10 / 52,63	8 / 42,11	1 / 5,26
Fosfomycin	861	4 / 0,46	856 / 99,42	1 / 0,12
Nitroxsoline	848	0	848 / 100	0
Nitrofurantoin	1017	12 / 1,18	1001 / 98,43	4 / 0,39
Ofloxacin	725	195 / 26,89	529 / 72,97	1 / 0,14

Ciprofloxacin	919	249 / 27,09	667 / 72,58	3 / 0,33
Levofloxacin	136	84 / 61,76	52 / 38,24	0
Trimethoprim-sulfonamide	1024	344 / 33,59	679 / 66,31	0
Cefotaksime	47	28 / 59,57	18 / 38,30	1 / 2,13
Cefuroksime	27	17 / 62,96	10 / 0,37	0
Tigecycline	16	0	16 / 100	0
Trimethoprim	4	3 / 75	1 / 25	0
Ampicillin sulfbactam	18	14 / 77,77	4 / 22,22	0
Colistin	11	0	11 / 100	0
Aztreonam	8	1 / 12,50	4 / 50	3 / 37,50
Total	14035 /100%	2717 /19,36	11196 /79,77	122 / 0,87

Colistin is a polymyxin, a polypeptide bactericidal antibiotic with a broad spectrum of action against Gram-negative bacteria, including species of *Acinetobacter spp.*, *Pseudomonas aeruginosa*, *Klebsiella spp.* and *Enterobacter spp.* (Bilandžić et al., 2018). The mechanism of antimicrobial activity of colistin is binding to lipopolysaccharides and phospholipids in the outer cell membrane of Gram-negative bacteria. They competitively displace divalent cations from the phosphate groups of membrane lipids, which leads to disruption of the outer cell membrane, leakage of intracellular contents and death of bacteria (Singhal et al., 2022).

Tigecycline is a unique glycylcycline class of semisynthetic antimicrobial agents developed for the treatment of polymicrobial infections caused by multidrug-resistant Gram-positive and Gram-negative pathogens. Tigecycline evades the main tetracycline resistance genetic mechanisms, such as tetracycline-specific efflux pump acquisition and ribosomal protection, via the addition of a glycyamide moiety to the 9-position of minocycline. Tigecycline is chemically (4S,4aS,5aR,12aS)-9-[2-(tertbutylamino)acetamido]-4,7-bis (dimethylamino)-1,4,4a,5,5a,6,11,12a-octahydro-3,10,12,12a-tetrahydroxy-1,11-dioxo-2-naphthacene-carboxamides.

Compared with other tetracyclines, tigecycline's extended, wide-range antibiotic activity is due to a main backbone of minocycline with an N-alkyl-glycyamido side chain addition to the C9 carbon of the "D" tetracycline ring (Yaghoubi et al., 2021).

Nitroxoline is a urinary antibacterial agent active against susceptible gram-positive and gram-negative organisms commonly found in urinary tract infection (Hof and Juretschke, 2019). It is a hydroxyquinoline derivative, more precisely a 5-nitro-8-hydroxy-quinoline, used for treatment of acute and recurrent/chronic UTIs. Its antimicrobial efficacy is based on the ability to chelate divalent cations (Pelletier, 1995). Although it has been in clinical use for many years, no increase in resistance has been observed for *Escherichia coli*, the most frequent uropathogen. Subinhibitory nitroxoline concentrations inhibit the bacterial adhesion of *E. coli* to human bladder epithelial cells through reduction of the number of

adhesins and reduce biofilm mass synthesis and viable cell counts of *Pseudomonas aeruginosa* (Sobke et al., 2012).

Our results show that the highest percentage of *Escherichia coli* isolates show resistance to the antibiotic ampicillin sulfbactam (77.77%) and cefuroxime (62.96%). In the literature, you can find a large number of data on the resistance of these pathogenic bacteria to antibiotics (Brkić 2021; Lazarević et al., 2022). The results of Alzahrani et al., (2020) showed that *Escherichia coli* showed high resistance to ampicillin (88.46%), cephalexin (95.45%), cefoxitin (72.73%), trimethoprim sulfomethoxazole (57.01%) and norfloxacin (52.83%).

Amoxicillin is a common antibiotic that's in the same class of antibiotics as penicillin. It works by preventing the cell wall of bacteria from forming, which makes it so they cannot reproduce and keeps it from growing (Ronald et al., 2007). Clavulanate potassium is an ingredient that is added that makes the antibiotic more effective against bacteria that are resistant to amoxicillin alone. Amoxicillin clavulanate was markedly inferior to ciprofloxacin in clinical and microbiological cure rates. Increasing fluoroquinolone resistance in many pathogens causing health care-associated and community acquired infections has raised concerns about the future usefulness of this potent and frequently prescribed class of antibiotics (Hooton et al., 2005).

Ampicillin belongs to beta-lactam antibiotics, and penicillin derivative antibiotic recommended for UTI therapy. Ampicillin has the action of inhibiting the synthesis of bacterial cell walls (Shah et al., 2018). The use of ampicillin is very extensive for Gram-negative and positive bacteria which causes a high level of resistance. Molecularly, the mechanism of antibiotic resistance of ampicillin is carried by the plasmid. These plasmids of resistance will be lost in the bacterial population if they have not been used for years. Due to its low resistance, ciprofloxacin is used as a standard reference, and often compared with other antibiotics. Ciprofloxacin is a quinolone antibiotic, although more susceptible than ampicillin, but it has some side effects, particularly not safe for pregnant women, babies and children (Rosana et al., 2019). Therefore, it is necessary to examine all factors, conditions, effects, properties, as well as side effects for choosing the appropriate antibiotic for urinary infections.

Results of testing the susceptibility of isolates of *Klebsiella spp.* from urine samples are shown in Table 2.

Table 2. Susceptibility of isolates of *Klebsiella spp.* to antibiotics

Antibiotic	Total tested	Resistant (Number / %)	Sensitive (Number / %)	Intermediate (Number / %)
Ampicillin	209	209 / 100	0	0
Amoxicillin	176	176 / 100	0	0
Amoxicillin-clavulanic acid	208	107 / 51,44	99 / 47,60	2 / 0,96
Piperacillin	2	1 / 50	1 / 50	0

Imipenem	83	5 / 6,02	68 / 81,93	10 / 12,05
Piperacillin-tazobactam	80	28 / 3,5	43 / 53,75	9 / 11,25
Meropenem	81	22 / 27,16	57 / 70,37	2 / 0,25
Ertapenem	79	27 / 34,18	50 / 63,29	2 / 2,53
Cephalexin	206	104 / 50,48	92 / 44,67	10 / 4,85
Ceftriaxson	209	99 / 47,36	110 / 52,64	0
Ceftazimid	101	79 / 78,22	22 / 21,78	0
Cefiksim	209	100 / 47,85	109 / 52,15	0
Cefepim	83	55 / 66,27	19 / 22,89	9 / 10,84
Gentamicin	206	88 / 4,26	117 / 56,79	1 / 0,05
Amikacin	209	50 / 23,92	155 / 74,16	4 / 1,91
Tobramicin	66	53 / 80,30	8 / 12,12	5 / 7,58
Fosfomicin	58	8 / 13,79	45 / 77,58	5 / 8,62
Nitroxsolin	26	1 / 3,85	24 / 92,31	1 / 3,85
Nitrofurantoin	15	7 / 46,67	8 / 53,33	0
Ofloxacin	156	52 / 33,33	103 / 66,03	1 / 0,64
Ciprofloxacin	205	62 / 30,24	139 / 67,80	4 / 1,96
Levofloxacin	108	53 / 49,07	50 / 46,30	5 / 4,63
Trimethoprim-sulfonamid	205	93 / 45,37	111 / 54,14	1 / 0,49
Cefotaksim	98	79 / 80,61	19 / 19,39	0
Cefuroksim	64	53 / 82,81	11 / 17,19	0
Tigeciklin	68	0	65 / 95,59	3 / 4,41
Ampicillin sulfbactam	67	65 / 97,01	2 / 2,99	0
Colistin	36	0	34 / 94,44	2 / 5,56
Aztreonam	17	13 / 76,47	4 / 23,53	0
Total	3330 / 100	1689 / 50,72	1565 / 46,70	76 / 2,58

Isolates of *Klebsiella* spp. showed high sensitivity to the antibiotics tigecycline (95.59%), colistin (94.44%), nitroxoline (92.31%), imipenem (81.93%) and fosfomicin (77.58%). All tested isolates of *Klebsiella* spp. showed resistance to antibiotics ampicillin and amoxicillin (100%), while high resistance was also observed to cefuroxime (82.81%), tobramycin (80.30%) and cefotaxime (80.61%).

The problem of bacterial resistance to antibiotics used in UTI is growing at a rapid rate, and therefore new treatment strategies are needed. To be able to therapeutically intervene in the host-pathogen interaction in the urinary tract, a better understanding of antibiotic susceptibility and resistance is needed.

4. CONCLUSION

In the territory of Šabac, during 2022, 23,586 urine samples were positive for uropathogenic microorganisms. *Escherichia coli* (59.51%), *Klebsiella spp.* (14.11%), *Enterococcus spp.* (8.97%) and *Proteus spp.* (7.32%) have the largest share among isolated uropathogenic representatives. The most reliable way of defining the correct antibiotic therapy is precisely the isolation and identification of the cause of the rash, and then testing the sensitivity of the specific isolate using the antibiogram method.

In the treatment of infections caused by bacteria *E. coli* and *Klebsiella spp.* in the highest percentage, colistin, tigecycline and nitroxoline can be used.

Resistance to antibiotics has been known since their use and is a growing problem worldwide. In this study, a high rate of *E. coli* and *Klebsiella spp.* isolates were resistant to ampicillin.

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***EKONOMIJA, MENADŽMENT, TURIZAM I
HOTELIJERSTVO***

***ECONOMY, MANAGEMENT, TOURISM AND
HOSPITALITY***

ON THE QUESTION OF THE ESSENCE OF OUTSOURCING SERVICES IN THE CONDITIONS OF A STABLE BALANCED REGIONAL DEVELOPMENT

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ABSTRACT: This study is devoted to the study of the theoretical aspects of outsourcing services, by analyzing the modern definition of the concept of "outsourcing" and its classification features, as a result of which it is concluded that it is necessary to highlight its forms, which were studied in the article, and the importance of outsourcing services for sustainable balanced development of the region is substantiated. The definition of the concept of "outsourcing" has been further developed, which is distinguished by an emphasis on the transfer from one business entity to another of a number of management functions or business processes on the basis of a concluded agreement in order to optimize performance.

Keywords: outsourcing; outsourcing services; market of outsourcing services; types of outsourcing; forms of outsourcing; development of the region.

1. INTRODUCTION

Modern trends in the development of the world and regional economies are characterized by a fairly high degree of competition between economic entities. This is due to fleeting changes in the organizational structure of world production, the development of transnational relations, investment policy, the formation of multinational companies, close information ties and the development of the digital economy.

Obviously, the foregoing forces enterprises to use more progressive organizational forms of doing business, which, in turn, would create sustainable competitive advantages, and at the same time make their activities more flexible and capable of quickly and painlessly adapting to the ever-changing conditions of economic development in the context of digitalization. . One of these organizational forms of doing business is outsourcing, as one of the universal tools for increasing the competitiveness of an enterprise by reducing costs and rationally organizing production and management activities.

In world practice, the market for outsourcing services used in business activities is an element of sustainable balanced development of the region, and, accordingly, allows

us to talk about its importance for the development of the economy (especially in the context of its active digitalization).

2. OTHER TOPICS

Among the publications of interest for substantiating the theoretical foundations of outsourcing services, the works of B.A. Anikina are of interest. and Ruda I.L. [2], Ivlev A. [3], Anderson E. and Trinkle B. [4], Mykalo A.I. [5], Bravara J. and Morgan R. [6], Mikhailova D.M. [7].

In addition, it is impossible to ignore publications that consider the classification features of outsourcing services (we are talking, first of all, about the studies of Brin P.V. and Prokhorenko O.V. [13], Mykalo A.I. [14], Gorova K. O. [15], Vorobieva K. Yu. [17]).

Given the significant contribution of scientists to the issues under study, the issue of generalizing experience and forming a unified scientific approach to the definition of the concept of "outsourcing services" and, accordingly, their classification features remains unresolved. The debatability of individual publications requires further research and development in the direction of improving the theoretical foundations of outsourcing services. For this purpose, modern definitions of the concept of "outsourcing" and its classification features were analyzed, as a result of which it was concluded that it is necessary to highlight its forms, which were studied in the work.

2.1 Study of the theoretical aspects of outsourcing services and substantiation of their importance for sustainable balanced development of the region.

It should be emphasized that the concept of "outsourcing" has been used in world practice for more than 30 years, but today there is no single generally accepted definition of it. The concept of outsourcing is of English origin and is translated as "use of external resources" or "external sources". It should be noted that until recently this word was not in the lexicon of any country in the world and it appeared only in the early nineties of the last century.

So, in the modern economic dictionary, outsourcing is interpreted as "... the transfer of traditional non-key functions of the organization ... to external performers ..." [1]. This definition is already "classic" for most modern economic dictionaries, which reduce outsourcing services to the transfer of management functions or individual business processes to third parties to obtain an economic or social effect.

In turn, the publications of individual domestic and foreign scientists introduce ambiguity into the issues under study, thereby forming vectors for further scientific discussions. So, for example, Anikin B.A., Ruda I.L. outsourcing is understood as "... the performance of certain functions (production, service, information ...) or business processes by an external organization that has the necessary resources for this on the basis of a long-term agreement" [2, p. fourteen].

At the same time, Ivlev A. focuses on organizational decisions on the configuration of business systems, the management of which is transferred to third-party enterprises and

organizations [3, p. 9]. Developing to a certain extent the position of A. Ivlev, a number of other scientists [4; 5; 6; 7-9] reduces outsourcing to:

- paid services for the transfer of certain management functions, which are legally fixed [4];
- tools for increasing competitiveness through the development of competencies available at the enterprise for the implementation of key business processes [5];
- partnerships between enterprises, the emergence of which is due to an agreement on the mutual use of property, funds and other resources [6];
- a business process, the implementation of which by third parties contributes to cost savings [7-9].

Zagorodniy A.G. adheres to a similar position. paying attention not only to the transfer of certain functions of the enterprise to third-party organizations, but also to the obligation to guarantee the proper quality of their performance by an outsourcing company [10, p. 87].

The multidimensionality of the researched issues is given by the publication of Manoilenko O.V., in which the author logically substantiates the need and importance of outsourcing services both for improving management functions and for developing own mechanisms for increasing competitiveness, maximizing financial results, developing human resources, and forming strategic guidelines for activities. In addition, the author separately emphasizes the relevance of outsourcing services for enterprises in various sectors of the economy (from the service sector to heavy industry) [11].

It is worth noting that the development of economic sectors, including in the regions of Donbass, takes place in conditions that are characterized by low competitiveness in the domestic market due to technological imperfection of equipment, moral and physical depreciation of fixed capital. That is why there is a need for structural transformations in the economy, which should be aimed at developing the existing intellectual potential in the service sector to increase the competitiveness of the region. This becomes possible due to the development of the outsourcing services market, to which Nikishenko E.V. pays special attention. The scientist focuses on the fact that outsourcing is associated only with "... delegation of non-core business processes..." [12, p. 83] to specialized firms to improve their efficiency and create "...unique competitive advantages..." [12, p. 83].

The results of a critical analysis of the foregoing suggest that outsourcing, primarily as an economic category, is multifaceted, while most scientists reveal it only from one side. Based on this, we tend to believe that outsourcing is appropriate to understand the transfer from one business entity to another of a number of management functions or business processes on the basis of a concluded agreement in order to optimize performance.

Obviously, the optimization of performance results predetermines the existence of various types of outsourcing, depending on certain classification features. Thus, most scientists rightly insist on a multi-level classification of outsourcing, taking into account a set of homogeneous features. Here it is appropriate to cite the opinion of Brin P.V. and Prokhorenko O.V., who identify many features of the classification of outsourcing

services: “... depending on the form of contractual relations; depending on the period of the contractual relationship; depending on the intended purpose...” [13, p. 84].

In turn, Mykalo A.I. proposes to classify outsourcing according to six classification criteria: “by the purpose of introducing outsourcing, by the degree of attraction of the resources of the customer company, by the nature and ratio of functions transferred to outsourcing, by the number of performers, by the home country of the service provider company, by the period of provision of services” [14, p. 221]. O.V. Manoilenko adheres to a similar position. [11] adding a number of other classification features that are different in name, but similar in essence (for example, by geographical feature, by scope).

Given the above and taking into account the results of our own reasoning, we come to the conclusion that there is no single approach to the classification of outsourcing: there are many classification features, each scientist in his research supplements the existing ones with new ones, offering his own vision of the problem under study. The information presented in Table 1 confirms the legitimacy of the conclusion made.

Table 1 - Classification features of outsourcing
 (compiled by the authors based on [15-20])

Classification features	The authors)
<u>Depending on the number of participants in the provision of services:</u> <ul style="list-style-type: none"> – direct outsourcing; – indirect outsourcing. <u>Depending on the affiliation of the outsourcer and the customer enterprise:</u> <ul style="list-style-type: none"> – independent outsourcing; – outsourcing with the allocation of a division of the enterprise; – outsourcing for the purpose of further consolidation. 	K.A. Gorova [15, p. 15]
<u>Depending on the areas and types of activities, business processes:</u> <ul style="list-style-type: none"> – outsourcing of business processes; – technological services; 	Yu.N. Gribova, E.V. Bogoviz [16, p. 45]
<ul style="list-style-type: none"> – outsourcing of production/industrial processes; – outsourcing of cognitive processes and knowledge; 	K.Yu. Vorobyov [17, p. 53]
<ul style="list-style-type: none"> – outsourcing of maintenance of corporate computer networks; – outsourcing of payroll; – outsourcing of financial operations and transactions; – recruiting outsourcing, etc.; 	O.Yu. Ryzhak [18, p. 62]
<ul style="list-style-type: none"> – operational; – functional; – resource outsourcing; 	A.A. Sainchuk [19, p. 52]

Classification features	The authors)
<ul style="list-style-type: none"> – outsourcing of information technologies, – outsourcing of business processes, – outsourcing of accounting services – outsourcing of office printing, – outsourcing of personnel processes (outstaffing). 	I.V. Yatskevich [20, p. 201]

According to Table 1, at present, in the special economic literature, the classification of outsourcing is the most popular, depending on the directions and types of activities, the feasibility of which may be the subject of scientific discussions. Thus, in the modern conditions of the development of the economy of the Donetsk People's Republic, consulting firms provide the following types of outsourcing services: accounting, legal support of activities, recruitment, marketing research and product sales.

Considering the foregoing, we conclude that it is logically justified in the current realities of the development of the economy of the domestic region to consider its forms of implementation in the classification of outsourcing, rather than types and areas of activity. So, in the course of the study, the following forms of outsourcing were identified:

- 1) managerial outsourcing (associated with the implementation of management functions);
- 2) operational outsourcing (affects the implementation of business processes);
- 3) related outsourcing (accounting, technical support).

Management outsourcing involves the professional management of an enterprise or its individual business processes. It should be noted that the main function of management outsourcing is a competent professional assessment of the resources of the enterprise, the external environment in which it operates. In addition, an important task is to search for possible growth prospects, on the basis of which the main strategic directions for the development of the enterprise are developed and then implemented, bringing it to a completely new competitive level. At the same time, the outsourcer performing the functions of managerial outsourcing must be a professional in the field of management (management), have an entrepreneurial mindset, promote the development of social responsibility, and also use modern information technologies in management.

The essence of operational outsourcing, which directly affects the implementation of business processes, is the transfer of business processes to an outsourcing (consulting) company in order to reduce costs and form competitive pricing and, as a result, obtain the maximum possible profit. At the same time, the company has the opportunity to focus on the development of new products or services, increase, for example, the flexibility of the working week, which is especially important during the coronavirus pandemic.

Associated outsourcing involves the transfer of ancillary activities of the enterprise to professionals in a particular industry, in particular, accounting, legal support in order to focus on core activities and optimize its efficiency.

It should be noted that the sphere of outsourcing services in the Donetsk People's Republic in modern realities is not considered as a priority area of socio-economic

development. This gives grounds to assert that government agencies do not fully pay attention to the role and importance of the outsourcing services market for the sustainable balanced development of the region.

The development of the outsourcing services market in the Donetsk People's Republic, along with an increase in investment attractiveness, will lead to: an increase in the financial performance of enterprises and organizations; improving the quality of human capital; diversification of business activities; development of economic relations between enterprises and organizations of different sectors of the economy. However, this requires the solution of a complex of interrelated tasks:

- formation of favorable conditions for entrepreneurial activities in the field of outsourcing services;
- creation of an appropriate legislative framework for the regulation of the outsourcing services market;
- improvement of already functioning mechanisms for the provision of outsourcing services;
- development of public-private partnership in the field of outsourcing services.

3. CONCLUSION

In the course of the study, modern definitions of the concept of "outsourcing" were analyzed and its author's definition was proposed: the transfer from one business entity to another of a number of management functions or business processes on the basis of a concluded agreement in order to optimize performance. The article studies the classification features of outsourcing, as a result of which it is concluded that it is necessary to single out its forms that are of paramount importance for sustainable balanced regional development. Proceeding from this, the forms of outsourcing (managerial, operational, accompanying) have been identified, to the study of which further prospective studies should be directed.

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TRAVEL ADVERTISING IN THE BALKAN POSTERS AND DIGITAL MEDIA

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ABSTRACT:

We present the results of stylistic analysis of the Balkan travel poster and digital media. New tools for creating shapes and images, and new tools and operations for colour-tonal resolution of objects have appeared. A fundamentally new type of communication has acquired its own meanings and images. The subject of the study is advertising of cruises XX – II decade of XXI century and visualization of the tourist product in web resources. The value of scientific work lies in the theoretical generalization of the development of water travel advertising from the standpoint of visual aesthetics. The authors emphasize that travel ads should have regional imagery, attractiveness, concise and clear disclosure of the characteristics of the tourist service, original composition, non-standard perspective, contrast and harmonious colouring, ensuring the functionality of each appeal. Electronic advertising (website, animation project, commercial, web banner, presentation) is the result of the implementation of creative, technological, and organizational components of design activities to meet public information needs. The obtained scientific results deepen the idea of graphics, generalize its communicative and art-aesthetic aspects, allow the identification of new factors at the conceptual and prognostic level, and provide insight into the current state of cruise tourism ads, including its possible combination with cultural, environmental, recreational, religious, or gastronomic, and the use of the aesthetic potential of nature will promote the development of creative thinking of professionals, and improve the visual info space.

Keywords: *cruise tourism ads, travel poster, web banner, digital media, visualization.*

1. INTRODUCTION

At the end of 20th century, the interest in textuality changed with a new interest in visualization. Since language could not offer complete explanation of the reality, cultural philosophers increasingly emphasized the power of visual expression in art, science, and, in fact, in everyday life, where the media and communication are considered as important determinants. Appropriately, visuality requires a comprehensive analysis to integrate the methodology of cultural theory and history to interdisciplinary research. The relationship between visuality and cross-cultural communication opens up another complex area of media research with poster as one of its components.

Poster can tell much more about the age than other documents. Poster involves an instant perception of information, expressive means and deliberate layout. Cultural heritage of poster can be observed in various contexts: image, axiological, economic, semantic, and creative – as an exchange of images and symbols. Communicative approach, in our opinion, is the most appropriate for the analysis of poster stylistics within the historical framework, while cross-cultural approach adapts advertising to another cultural environment in accordance with its traditions and values, takes into account cultural differences of countries and national peculiarities of perception. The intertwining of many cultural events, changes of values, mentality and worldview led to transformations in the means of artistic expression, introduced a large number of style searches in advertising poster, particularly, in a tourist one.

Nowadays, the main contradiction lies in multiculturalism, cosmopolitanism and globalization, which are opposed by de-globalization and orientation of contemporary advertising at regional consumers. If tourist postcards with views of different countries were very popular in the second part of 19th century and in the first part of 20th century, though, by the middle of 20th century, advertising poster of large and medium formats became the most common.

2. TRAVEL ADVERTISING RESEARCH

2.1. Review of literature

At the beginning of 21st century poster still remains at the forefront of main advertising medium for outdoor advertising (especially in city-lights), indoor (in the interiors for various purposes), even as an element of decoration (instead of paintings), in virtual contests of different thematic focus, and can be completely transformed into online banner ads [10].

To reveal the Balkans advertising poster features let's examine this part of the Europe. Albania, Bulgaria (formerly Thrace, including Macedonia), Greece, Northern Macedonia, partly Romania, the European part of Turkey (Eastern Thrace), countries of former Yugoslavia (Slovenia, Montenegro, Croatia, Serbia, Northern Macedonia, Bosnia and

Herzegovina) are located on the Balkan peninsula. According to Harry Judge, the Balkans is a region with incredible nature and rich culture heritage from different ages [2]. Basically, East and West, Orthodox Christianity and Islam, Antiquity, Romanesque style, Gothic, Baroque and Abstractionism were actively involved in the shaping of the Balkans culture. However, the Adriatic was heavily influenced by Venice (a Latin-Byzantium hybrid). In 9th century Serbia was more influenced by Bulgarian culture than by Byzantium, but the Byzantine and Ottoman empires had a strong impact on Bulgaria culture. Moreover, Etruscan, Greek, Byzantium, Turkish, Italian cultures dominated in the art of Montenegro in 15th – 17th centuries. After, French culture had an impact on the art of Montenegro in 18th century and Austria-Hungary influenced it in 19th century [13].

The outbreak of the First World War contributed to the development of national ideas, and adjusted the national character of struggle between states. National movements led to independence becoming extremely massive at that time. Specifically, it was the desire for Slavic people liberation in Austria-Hungary, Ukrainians – in the Russian Empire, Flemish – in Belgium and Irish – in the United Kingdom [8].

Egidio Ivetic, the author of “History of the Adriatic: A Sea and its Civilization”, in search of the Adriatic identity, carries out a historical tour around large ports, political and shopping centers, such as Venice, Trieste or Dubrovnik, and less-known territories, as the Adriatic is not only the sea, it is also a place of great empires battle for the influence in this region, and, finally, it's home for bright cultural diversity [4]. It's not surprisingly that cultural heritage becomes accessible to all categories of the population through advertising communications. The poster semantics expands, adds new connotations, serves for cognitive, educational and image purposes. Vasyl Sheiko and Yuri Bohutskyi believe that culture is a powerful factor in human activity. They explain that we observe the world in colours of culture, and state that mass culture is one of the most striking manifestations of modern developed societies sociocultural existence. Additionally, they explain the importance of cultures' dialogue in the media, since the forms of folk culture are very plastic and variable in practice [12].

Analyzing the design practice in the South of Europe, Viktor Danylenko notes that countries of this region depend on tourism for much of their income. Though, he identifies two trends in visual communications there. The researcher outlines average and internationalized, often influenced by Italian or Austrian style of visual communications in the sea coastal countries. The areas remote from the sea or large cities, on the contrary, demonstrate folk or Turkish-like elements in their visual communication and mountainous provinces show specific artistic patterns. Slovenia is the most “western” of all the Balkan countries as it is geographically close to Austria and Italy. Croatia and Montenegro have notable individual influences of European Union design activities, but often adapted to local and geographical reality. As for the urban environment of Romania, Moldova and Bulgaria – it is not remarkable, it is surrounded by media design objects in the form of endless banners and billboards with famous world brands. In general, he concludes that

the Baltic countries adapt Scandinavianism, the Balkans accept Italian stylistics, and Central Europe prefers German design [1].

Currently, key questions and notions of the Balkans travel poster in 20th century, including Bulgaria, Yugoslavia, and Greece are not presented in the literature. Riina Iloranta's research is based on marketing literature, and this is discussed with four different approaches: consumer consumption, brand management, service marketing, and consumer behavior-oriented perspective [3]. Therefore, our study contributes to the history of posters related to the conceptualization of visual language. A poster is considered an object of graphic design and main advertising medium, a means of cross-cultural interaction, cultural integration, and regional identification. The analysis of the artistic and style features of the Balkan region posters revealed certain trends in the depiction of tourist zones and natural objects. This study reveals the image-cultural role of travel advertising and its stylistic transformations in the Balkans.

2.2. Materials and methods

A number of modern scientific methods were used to solve this study issue. The authors applied *system-structural method* as predominant to study the poster in detail, analyze its individual factors and their synthesis to highlight and analyze functional aspects of visual communication. Differentiation of the travel poster visual expressive means in past and modern times was provided with the use of *comparative method*. Furthermore, by applying comparative method the author contributed to understanding poster aesthetic information and art imagery, revealed significant influence of artistic styles on advertising creativity, examined compositional organization of advertising messages, specific style features, art-graphic materials and techniques. The *sociocultural method* made it possible to interpret advertising graphics in posters as a reflection of certain stages in society development. We applied the chronological-genre principle for the analysis of visualization means and artistic-style features of the Balkan travel posters in 20th century.

2.3. Results and discussion

The poster with its visual resource and the experience of specific problem solving has been and still is a desirable partner in any activity that requires a reliable communication medium with the end user, the person. It is the level of proficiency in the language of poster that allows the artist or designer to transform the information into advertising product with special characteristics of the finished creative content. Special niche belongs to the Balkan travel poster of the second part of 20th century. Advertising of goods as well as advertising of natural heritage needs creative imagery. For instance, mountains are presented on tourist posters of many countries and regions: The Balkans, Switzerland, Germany, Austria, Italy, France, Slovakia, Poland, India, The United States, and Crimea, The Carpathians, The Caucasus, The Ural and Tibet, providing geopolitical orientations that address issues of historical, cultural and national identity. Mountains are the subject

of philosophical reflection and environmental meditation, a means of spiritual healing, scientific studies, medical therapy and recreation, as well as a source of artistic innovations. Mountains are not only the objects of reflection in art and mass media, they can also be considered as sociocultural hyper projects, influencing the view about our existence, planet Earth and society. Mountains appear on posters as romantic deserts, national parks, sports grounds, recreational resources, etc.

Travel posters of the second part of 20th century, comparing to modern ones, are a bit naive from today's point of view, expressively straightforward, but much more creative and special. Mountains and the sea were main objects to promote tourism development. All images, coding certain messages, formed a state of reliability, stability and openness to consumers. Negative connotations and values, either as doubtful interpretations were absent in posters of the second part of 20th century. Graphic means ranged from partial stylization of natural forms (decorative art) to emphasized geometry or Pop Art. Often added ethnic motives were representation of national cuisine, ethnic festivals as exotics that was interesting to Western Europeans. There was also the diversity of colours – from saturated colours to a limited colour scheme or almost monochrome solution. Accordingly, the levels of stylization in posters were from near realism to formalization and generalization. Often, compositional organization of posters was realized according to the principle of symmetry [11]. First attempts of asymmetry in the arrangement of font and image elements of poster appeared only since the 1970s, and later. The active use of photographs instead of drawings spread at the same time.

In the days of the former Yugoslavia, advertising posters were drawn by hand, because photographing took a lot of time, and printing was not of very high quality. The design had a simple slogan, and the images showed a fusion of tradition and modernity. There are also such tourist offers that attracted guests simply by illustrating the landscape. A good picture with the name of the place was enough to advertise the city [9].

The selection criteria for this article were individual posters from several Balkan countries with different applied stylistics (Fig. 1-4). The history of art shows that strengthening of cross-cultural communication causes the convergence of criteria for aesthetic evaluation. Additionally, specific premises appear to create peculiar local styles. Due to this, the author proves the existence of certain patterns of aesthetic evaluation for advertising objects with their own features. The unification of compositional techniques and orientation to target groups of consumers (within this topic, it was noted that tourism of the second part of 20th century in the Balkans focused mainly on the European middle class). Travel posters demonstrate how interested potential tourists were during this period, being a common sight in travel agent offices, train stations, and airports.

Interpretation of “aesthetic – non aesthetic” remains debatable issues. The aesthetic criterion is a historically changing feature used to evaluate or classify artwork, including its decoration, painting, ideology, illusory, illustrations, kitsch, monumentality,

originality, plasticity, harmony, stylization, tendency, eclecticism, expressiveness, etc. This study has confirmed identification of specific aesthetic parameters as colour and tone contrast, general colour harmony, limited colour palette, the integrity of the composition, uniqueness of the advertising idea, its clarity, the informative nature of advertising, the conciseness of textual and visual information and its structure, the presence of photo images, computer special effects and the technical quality of the performance of the advertising image. It is worth to add the presence of certain style features, including ethno stylistics in the organization of advertising space, and more precisely – their expediency in the poster. While studying advertising graphics in the context of art-project culture as a basic means of graphic design including ethno-art traditions and national colour system, it is quite appropriate to determine the aesthetic parameters of advertising objects as cultural and aesthetic, and further differentiate them with national or international principles. Colour semantics and regional imagery will be distinguished for the cultural evaluation of objects in ethno-style [10].

So, consider this with specific examples. The visual images of Bulgaria and Slovenia in the middle of 20th century most fully reflect the ethnic orientation of travel posters (Fig. 1-2). The travel posters of Yugoslavia are very interesting; on which it appears as a country of impregnable black mountains (Fig. 3, b-c). Greece is richer in sights and symbols, but even here the classic brand has become “real Greece” – Antiquity, preserved on small islands. Later posters embody a more colourful Mediterranean image of Greece (Fig. 4, c). It is obviously seen that folk motives disappear from posters, as international style and / or Postmodernism begins to prevail in Advertising in the 1970s, and later.



Fig. 1. Bulgaria travel ads stylistics: a) 1950-60s;
b-c) 1970s – folk motives are absent.

Source: <https://www.pinterest.com> (free access)



Fig. 2. Slovenia travel ads stylistics: a) 1950-60s;
 b-c) 1970s – folk motives are absent.

Source: <https://www.pinterest.com> (free access)



Fig. 3. Yugoslavia travel ads stylistics: a) 1950-60s;
 b) 1970s, c) 1980s – folk motives are absent.

Source: <https://www.pinterest.com> (free access)



Fig. 4. Greece travel ads stylistics: a) 1940s; b) 1950s;
c) 1970s – folk motives are absent.

Source: <https://www.pinterest.com> (free access)

Military events and the break-up of Yugoslavia in the middle of 1990s significantly inhibited tourism and advertising of tourism in the Balkans. At the end of 20th century, the stylistics of the travel poster fell under the influence of Postmodernism. Due to the development and spread of computer graphics, the postmodern trend continues to develop as a conscious eclecticism at the beginning of 21st century, which can be the subject of another article.

Stevo Nikic believes that nowadays travel advertising with a modern emphasis on ecotourism is especially interesting and promising in the context of cross-cultural interaction [7]. Cultural tourism is a combination of tourism-relevant activities and culture events (adventure tourism, museum, exhibition and festival tourism, preparation and servicing of national traditional dishes and drinks – the so-called gastronomic tourism [15]. The Balkans can offer a wide range of tourist services. In summer it is beach holidays and yacht tourism on the Adriatic and Black Seas coast. Skadar Lake is the largest on the Balkan peninsula, located on the territory of Montenegro and Albania. In winter ski resorts welcome many tourists to visit numerous monasteries and churches, buy regional products or souvenirs. Therefore, visual identity is an important resource that helps to distinguish specific object, city as a tourist destination and its uniqueness. But in modern travel web advertising, except for high-quality photographs, we do not see any creative approaches (Fig. 5).



Fig. 5. Modern travel web advertising of the lakes, 2022

Let's draw attention to the fact that visual elements are perceived faster, easier, more accurately, and understood by people from different countries compared to verbal language. Thus, the travel poster should comply with substantial principle of semantic integrity, which consists of physical, psychological, symbolic set with strong internal connections. Accordingly, colour elements (illustrations, syllables, brand constants of travel agencies) closely interact and determine the advertising effect. Among considerable

disadvantages of travel advertising in the early 21st century the authors outlines the preference for stereotyping, primitively, the actual absence of a national image, the dominance of Kitsch, Eclecticism, which become cultural dominants. While the main purpose of advertising is to attract the attention of potential consumer, create positive image of city, region and country, modern travel posters and their corresponding technical transformations for digital media mostly have low aesthetic level.

The analysis of image formation and art imagery issues allowed to determine the components of advertising image, in particular, for tourism. Uniqueness, aesthetics, regional specificity, compliance with the status of the tourist service and clarity to target audiences (budget, middle, premium, luxury) are examined in this study. Comparison of posters by stylistic tendencies revealed the need for more active use of creative advertising technologies: allusions, associations, allegories, hyperboles, metaphors or metonymies. Christo Kaftandjiev says that visual metaphor becomes universal stylistic figure [5]. Iis Tussyadiah looks at design thinking and how to explore and identify problems associated with the provision of tourism services and propose solutions to these problems in innovative ways. Tourism involves a wide array of services from airlines to accommodation to entertainment, but it also involves exploration of places that enables tourists to interact with objects (e.g., sceneries), people (e.g., locals), and other resources in tourism destinations. Design is getting more attention because of the relevance of design methods in the production of tourism products and services that are experiential in nature [14].

Following specific visual-verbal model, modern advertising message should have an artistic and semantic imagery. Lev Manovich presents a method for analysis of cultural data, with a particular focus on visual media. Cultural analytics refers to the use of computational and design methods, including data visualization, media, and interaction design, and machine learning for the exploration and analysis of contemporary culture. One goal of these explorations is to enable us to see what hundreds of millions of people around the world today create, imagine, and value [6]. Nowadays, visual streams prevail over verbal ones. A new fragmentary, “clip” thinking comes, based on the emotional platform and built on visuality, variability, and perception of a large number of different visual elements. Visualization provides a basis for further analysis of images, symbols, ornaments, colours and their impact on Society through internet banners or outdoor advertising for tourist product.

2.4. Practical implications

This study contributes to the theoretical comprehension of the travel poster as a product of art-project culture and a means of representing regional specifics, the visually orientated, and the digital in the future. Practical implementation is possible at the level of developing advertising messages, conducting lecture courses, thematic seminars and conferences for students and graduate students, and as far as advanced training courses in

the tourism industry. The obtained results deepen the idea of travel posters, generalize their communicative and art-aesthetic aspects, and allow the identification of new factors of education at the conceptual and prognostic levels also.

3. CONCLUSION

The results of analytical and research work indicate that poster actively forms mass consciousness, involves into sign system, provides powerful impact on public opinion, and represents past and modern creative experience. The semantic space of the poster is a visualization of significant idea, generalized reproduction of the advertised object in form and colour, perfect reflection of artifacts or natural phenomena in consciousness. Modern poster should perform perfect aesthetics, non-standard visualization and variability of graphic aids and be interesting for the target audience. Considering the poster as an effective channel of advertising communications, for the first time the idea of the visual language of the Balkan countries tourism service in the second part of 20th century was presented. Undoubtedly, the poster plays a significant role in society, and artistic practices and has a great potential for further development of tourism in the Balkans. Beyond the culture and communications, the authors recognized important relationships of the posters with society, economics, politics, and the environment.

Modern conditions establish the basis for creating peculiar local styles. Active development of Tourism, and the use of the aesthetic potential of natural harmony will contribute to the approval of national identity, creative thinking development and improvement of the visual info space. The travel poster can focus on the latest trends in ecotourism and protection of cultural heritage, national parks development, holding of international summer schools for students, sports competitions, thematic tours, ethnic festivals, etc. Within the framework of the designated vector of research, a special place is supposed to be given to further search and comparative analysis of semantic roots in the use of pictorial elements and colouring of the Balkan region in order to develop cross-cultural communications in currently.

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EFEKAT DIGITALNOG MARKETINGA NA PRIVLAČENJE NOVIH STUDENATA U VISOKOM OBRAZOVANJU

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SAŽETAK:

Visokoobrazovne institucije se u današnje vreme suočavaju sa različitim izazovima koje su donele promene u tehnološkom, socioekonomskom i demografskom okruženju. Digitalizacija i tehnološko okruženje odnosno intenzitet upotrebe tehnoloških inovacija u svakodnevnom životu studenata kreirali su mnogobrojne izazove, ali i mogućnosti za poboljšanje kvaliteta obrazovanja. Jedan od rezultata ovih promena jeste prezasićenost mladih informacijama što je dovelo do situacije u kojoj je visokoobrazovnim institucijama mnogo teže da ih zainteresuju.

Ključne reči: *studenti, digitalni marketing, digitalizacija, tehnološke inovacije*

1.UVOD

Digitalni marketing je kao sama pojava i ekspanzija klasičnog marketing totalno transformisao percepciju promocije i marketiranja jer koristi digitalne tehnologije koje su zasnovane na internetu. U periodu između osamdesetih i devedesetih godina nastaje digitalno doba marketinga koje je obeleženo računarima i internetom. A 1996. godine je projektovan i najveći svetski pretraživač - Google. Polako su nastajali prvi blogovi na Blogger-u, prvi forumi; 2004. godine se pojavio još jedan gigant koji je obeležio svet digitalnog marketinga – Facebook. Tada marketing postepeno zauzima društvene mreže.

Danas je digitalni marketing osnovni vid marketinga, koji se koristi zajedno sa tradicionalnim. No, i digitalno doba nosi razne probleme sa sobom – nikada nije bilo lakše naći pregršt informacija, ali nikada nije bilo teže probiti se na tržištu. Ipak, kvalitet će zauvek ostati ono što će biti na ceni, a marketing je samo sredstvo da proizvod dođe u ruke pravih ljudi. Digitalni marketing je poslednjih godina u punom procvatu i predstavlja

neograničen način promovisanja uz koje je neophodno kreiranje i praćenje digitalne strategije za postizanje najefektivnijih rezultata.

Cilj istraživanja ovog rada je da prikaže u kojoj meri je zapravo neophodno pratiti i koristiti digitalne alate pri promociji visokoškolskih ustanova u privatnom sektoru. Predmet istraživanja ovog rada je ukazivanje da su visokoškolske ustanove u privatnom sektoru u poslednjoj deceniji prikazale neverovatnu konkurenciju državnom sektoru, a njihove strategije u promovisanju svoje ponude su vrlo napredne. Opšta hipoteza rada: Primena digitalnog marketinga obezbeđuje veći stepen upisa studenata na privatnom fakultetu u odnosu na stepen upisa studenata na državnom fakultetu.

2. DEFINISANJE MARKETINŠKIH AKTIVNOSTI NA TRŽIŠTU

Digitalni marketing je čin promocije i prodaje proizvoda i usluga korišćenjem onlajn marketinških taktika kao što su marketing na društvenim mrežama, pretraga marketing i e - mail marketing [1].

Na mnogo načina, digitalni marketing nije mnogo drugačiji od tradicionalnog marketinga. U oba, pametne organizacije nastoje da razviju uzajamno korisne odnose sa perspektivama, potencijalnim klijentima i kupcima [2]. U digitalnom marketingu - onlajn prisustvo je sve.

Digitalni marketing je deo integrisanih marketinških komunikacija koji se odvija na digitalnim platformama, tačnije na internet portalima (display), mobilnim uređajima (mobile), društvenim medijima (affiliate). Postoji bogati raspon različitih “display” formata - od banera do videa. Mediji se obično agregiraju u kanale u skladu sa tržišnom segmentacijom [3]. Iako je termin „digitalni marketing“ skovan 1990 - ih, njegova potpuna upotreba i značaj porasli su tek u nedavnoj prošlosti. Kako je tehnologija brzo napredovala u poslednje dve decenije, digitalni mediji su postali toliko rasprostranjeni da svako može da pristupi informacijama bilo kada, sa bilo kog mesta [9]. Ovo vlasnicima biznisa daje više načina da promovišu proizvode i usluge putem blogova, veb lokacija i kanala društvenih medija. Kroz različite alate koji su sada dostupni, oni takođe mogu da vide šta je u trendu, zašto i kada ljudi traže proizvod ili uslugu [4].

Ljudi često misle da je digitalni marketing samo promocija , prodaja i oglašavanje na internetu. Jeste tačno, ali to je samo jedan deo digitalnog marketinga [5]. Digitalni ili internet marketing je isto što i tradicionalni marketing samo na različitom mediju. Marketing je stvaranje i pronalaženje potreba tržišta i zadovoljenje istih, u ovom slučaju na internet [10]. Za razliku od tradicionalnog, digitalni marketing je skup različitih

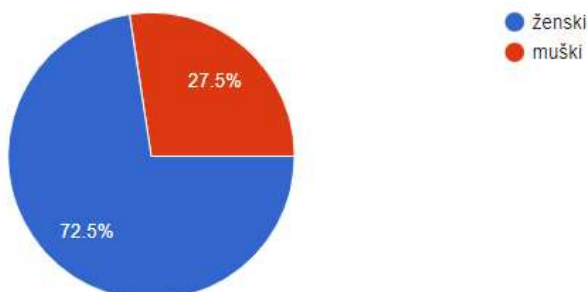
aktivnosti koje za cilj imaju izgradnju identiteta na internetu i poziciju u digitalnom svetu. Zašto bi se identitet gradio na internetu, odnosno online? Jednostavno, danas ljudi „žive“ na internetu. Lakše je iz-Google-ati proizvod ili uslugu ili je „čekirati“ na Facebooku ili Instagramu [6].

Ovi uslovi jednostavno čine razmenu mogućom. Hoće li do razmene stvarno i doći zavisi od dogovora između strana. Ako se dogovore, moramo zaključiti da im je čin razmene doneo korist ili, u najmanju ruku, nije imao negativan učinak [8]. Na kraju, svaka strana može slobodno da odbije ili prihvati ponudu. U tom smislu, razmena stvara vrednost isto kao što i proizvodnja stvara vrednost [7].

3.EFEKAT DIGITALNOG MARKETINGA NA PRIVLAČENJE NOVIH STUDENATA U VISOKOM OBRAZOVANJU NA PRIMERU FAKULTETA ZA PROJEKTI I INOVACIONI MENADŽMENT

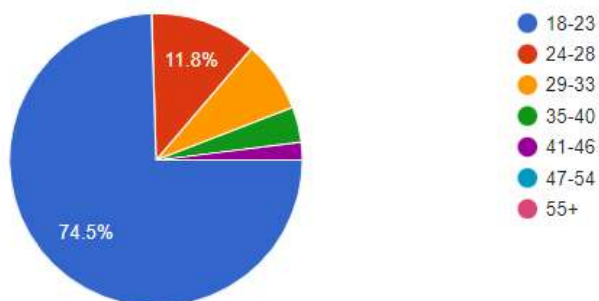
U ovom delu završnog rada objašnjen je sam efekat već uspostavljenog digitalnog marketinga u visokoškolskoj ustanovi Fakultet za projektni i inovacioni menadžment iz Beograda. Cilj je upoznati javnost sa osnovnim podacima koje se odnose na visokoškolsku ustanovu koja je predmet istraživanja. Za potrebe rada, sprovedeno je istraživanje kojim se ispituje efekat primene digitalnog marketinga na privlačenje novih studenata na Fakultet za projektni i inovacioni menadžment.

Kako bi dobili kvalitetnije podatke o predmetu istraživanja kreirali smo anketni upitnik koji se sastoji iz dva dela. U prvom delu upitnika, saznajemo nešto o ispitanicima kao što su polna, starosna, obrazovna struktura zaposlenika i zaposlenost istih. U drugom delu anketnog upitnika se nalaze pitanja koja se odnose na navike koje ispitanici imaju prema društvenim mrežama i digitalnom svetu. Takođe se ovaj deo upitnika istražuje na koji su način ispitanici bili informisani inicijalno o Fakultetu za projektni i inovacioni menadžment. Anketni upitnik se sastoji iz 12 konkretnih pitanja. Istraživanje je sprovedeno na uzorku od 120 ispitanika. Od ukupnog broja ispitanika, 87 ispitanika je ženskog pola dok je 38 ispitanika muškog pola. Procentualno izražena polna struktura ispitanika prikazana je grafički.



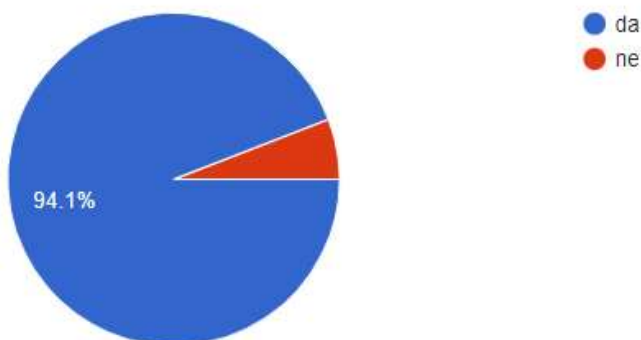
Grafikon 1. Polna struktura ispitanika

Obratili smo pažnju da prilikom određivanja strukture ispitanika ravnomerno budu zastupljene starosne kategorije koje studiraju na fakultetu. Od ukupnog broja ispitanika 64 ispitanika je starosti 18 i 23 godine života, 25 ispitanika je starosti između 24 i 28 godina života, 17 ispitanika je starosti između 29 i 33 godine života, 10 ispitanika je starosti između 35 i 40 godina, dok su 4 ispitanika starosti 41 do 46 godina života. Procentualno izražena starosna struktura ispitanika prikazana je u daljem radu grafički.



Grafikon 2. Starosna struktura ispitanika

Od ukupnog broja ispitanika, 112 ispitanika redovno studira, dok 8 ispitanika ne studira redovno. Redovnost među ispitanicima je prikazana na grafiku.

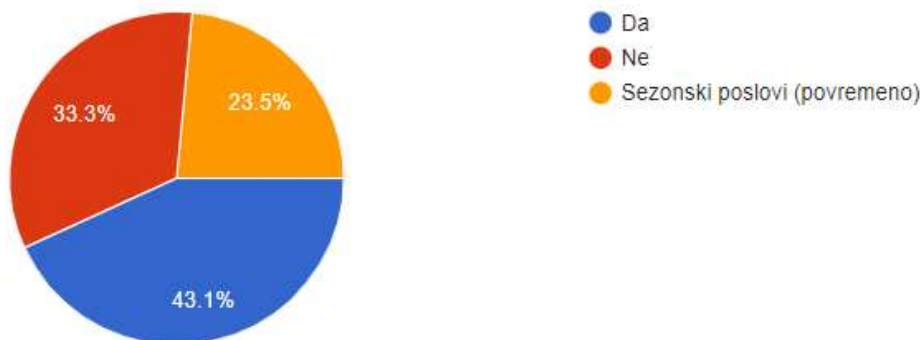


Grafikon 3. Redovnost studiranja ispitanika

Izvor: Vlastita izrada

Od ukupnog broja ispitanika, 52 ispitanika su zaposleni, 38 ispitanika su nezaposleni i 30 ispitanika se bave sezonskim poslovima.

Radni status ispitanika je prikazan na grafiku.

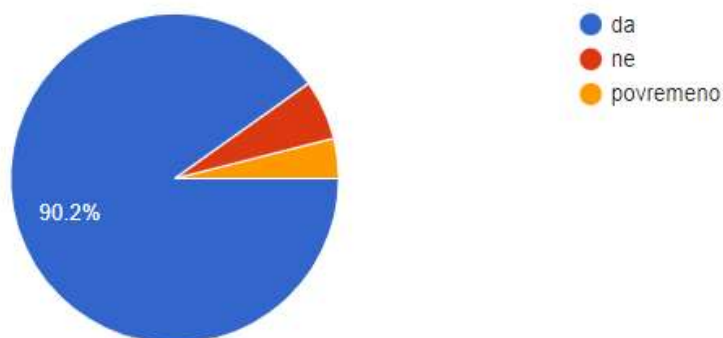


Grafikon 4. Radni status ispitanika

3.1. Rezultati istraživanja

Od ukupnog broja ispitanika 108 ispitanika aktivno koristi društvene mreže, 7 ispitanika ne koristi društvene mreže, a 5 ispitanika povremeno koristi društvene mreže.

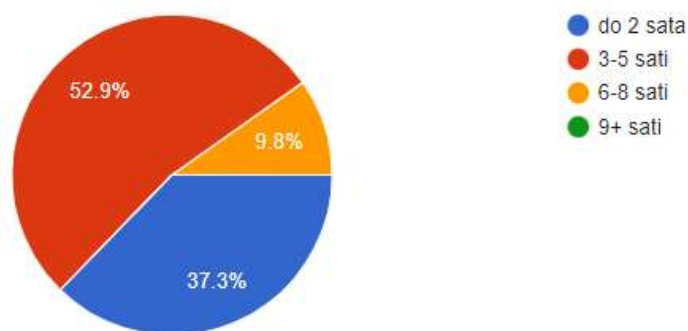
Aktivno korišćenje društvenih mreža među ispitanicima je prikazano na grafiku.



Grafikon 5. Aktivno korišćenje društvenih mreža

Od ukupnog broja ispitanika 64 ispitanika na dnevnom nivou provere 3 do 5 sati na društvenim mrežama, 45 ispitanika na dnevnom nivou provere do 2 sata na društvenim mrežama a 11 ispitanika na dnevnom nivou provere 6 do 8 sati na društvenim mrežama.

Vremensko korišćenje društvenih mreža na dnevnom nivou kod ispitanika je prikazano na grafiku.

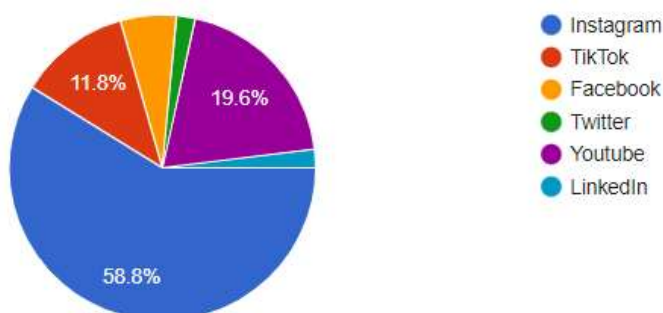


Grafikon 6. Vremensko korišćenje društvenih mreža na dnevnom nivou

Od ukupnog broja ispitanika 71 ispitanik najviše vremena provodi na društvenoj mreži Instagram, 24 ispitanika najviše vremena provodi na društvenoj mreži Youtube, 14 ispitanika najviše vremena provodi na društvenoj mreži Tik Tok, 7 ispitanika najviše vremena provodi na društvenoj mreži Facebook, 2 ispitanika najviše vremena provodi na društvenoj mreži Facebook.

društvenoj mreži Twitter i 2 ispitanika najviše vremena provodi na društvenoj mreži LinkedIn.

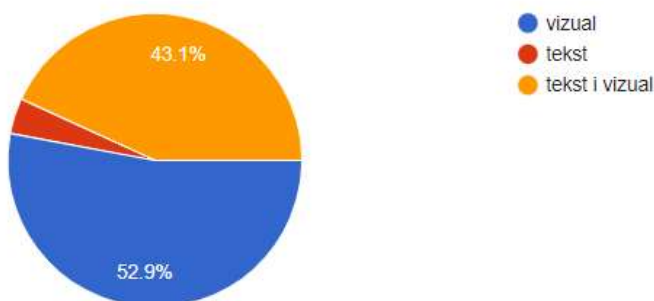
Koju društvenu mrežu ispitanici najviše koriste gde je najviše vremena utrošeno je prikazano na grafiku.



Grafikon 7. Na kojoj društvenoj mreži ispitanici provode najviše vremena

Od ukupnog broja ispitanika 64 ispitanika smatra da im je na određenoj objavi na društvenim mrežama najvažniji vizual, 52 ispitanika smatra da im je na određenoj objavi na društvenim mrežama najvažniji tekst, dok je 4 ispitanika podjednako važan tekst i vizual.

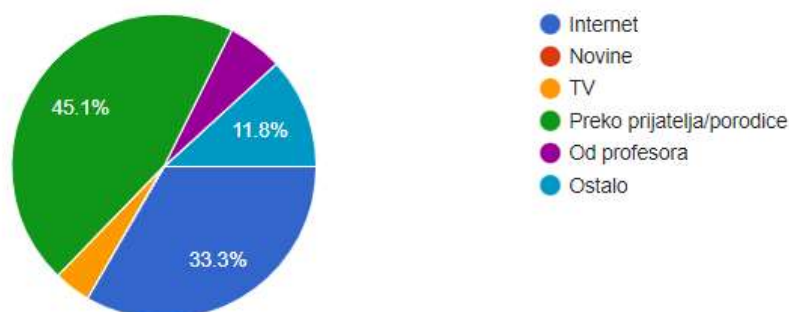
Šta je ispitanicima najvažnije na određenoj objavi na društvenim mrežama prikazano na grafiku.



Grafikon 8. Važnost vizuala i teksta na objavama na društvenim mrežama

Od ukupnog broja ispitanika 54 ispitanika saznao je za Fakultet za projektni i inovacioni menadžment preko prijatelja ili porodice, 40 ispitanika saznalo je za Fakultet za projektni i inovacioni menadžment preko Interneta, 14 ispitanika je saznalo preko drugih kanala informisanja, 7 ispitanika saznalo je za Fakultet za projektni i inovacioni menadžment preko profesora i 5 ispitanika saznalo je za Fakultet za projektni i inovacioni menadžment preko televizije.

Kako su ispitanici saznali za Fakultet za projektni i inovacioni menadžment prikazano je na grafiku.



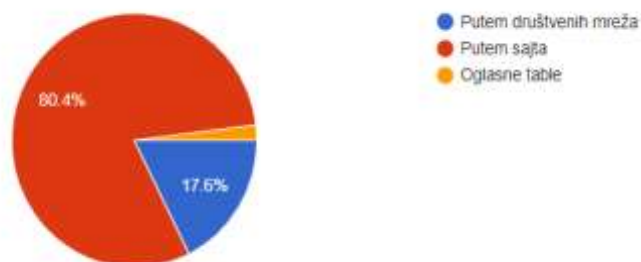
Grafikon 9. Kakos u ispitanici saznali za Fakultet za projektni i inovacioni menadžment
Od ukupnog broja ispitanika, 54 ispitanika saznalo je za Fakultet za projektni i inovacioni menadžment preko prijatelja ili porodice, 33 ispitanika saznalo je za Fakultet za projektni i inovacioni menadžment preko Internet stranice, 22 ispitanika saznalo je za Fakultet za projektni i inovacioni menadžment preko društvene mreže Instagram, 7 ispitanika saznalo je za Fakultet za projektni i inovacioni menadžment preko društvene mreže Youtube i 4 ispitanika saznalo je za Fakultet za projektni i inovacioni menadžment preko društvene mreže Facebook. Preko kog kanala su ispitanici saznali za Fakultet za projektni i inovacioni menadžment prikazano je na grafiku.



Grafikon 10. Preko kog kanala su ispitanici saznali za Fakultet za projektni i inovacioni menadžment

Od ukupnog broja ispitanika 97 ispitanika se najčešće informiše o dešavanjima na fakultetu je putem sajta Fakulteta, 21 ispitanik se najčešće informiše o dešavanjima na fakultetu je putem društvenih mreža dok 2 ispitanika se najčešće informiše o dešavanjima na fakultetu putem oglasne table.

Kako se ispitanici najčešće informišu o dešavanjima na Fakultetu za projektni i inovacioni menadžment prikazano je na grafiku.



Grafikon 11. Kako se najčešće ispitanici informišu o dešavanjima na fakultetu

Od ukupnog broja ispitanika 61 ispitaniku je najvažnije na društvenim mrežama informacije o Fakultetu za projektni i inovacioni menadžment, 56 ispitanika su najvažnije druge informacije sa društvenih mreža Fakulteta za projektni i inovacioni menadžment i 3 ispitanika su najvažnije nagradne igre na društvenim mrežama Fakulteta za projektni i inovacioni menadžment.

Kako se ispitanicima najvažnije na društvenim mrežama Fakulteta za projektni i inovacioni menadžment prikazano je na grafiku.



Grafikon 12. Šta je ispitanicima najvažnije na društvenim mrežama Fakulteta za projektni i inovacioni menadžment

3.2. Analiza rezultata istraživanja

Na osnovu prethodno dobijenih rezultata dolazi se do zaključka da se postižu određeni rezultati sa marketinškim aktivnostima koje Fakultet sprovodi. Upravo ovi rezultati su merljivi i važni za konkurentnost fakulteta na tržištu.

Prema podacima iz istraživanja, može se uočiti da su studenti uzrasta iznad 18 godina i koji većinski redovno studiraju su za Fakultet za projektni i inovacioni menadžment saznali upravo preko Interneta i društvenih mreža, dok dobar deo ispitanika je saznalo iz svoje okoline (porodica, prijatelji, profesori). Aktivno korišćenje društvenih mreža je prisutno kod većeg dela ispitanika. Takođe, prikazano je da najviše ispitanika koristi društvene mreže na dnevnom nivou 3-5 sati dnevno za kojim sledi procenat korišćenja društvenih mreža do 2 sata dnevno i potom 6-8 sati dnevno.

Ispitanici su na osnovu istraživanja iskazali da najviše koriste Instagram kao društvenu mrežu, potom Youtube, Tik Tok, Facebook pa Twitter i LinkedIn. Značaj odgovora na ovo konkretno pitanje leži u tome da se u budućnosti Fakultet može odlučiti za plasiranje svog sadržaja na druge društvene mreže koje bi takođe značile u privlačenju novih studenata ka visokoškolskoj ustanovi. Važno je pratiti aktivnost ciljne grupe na društvenim mrežama jer na taj način visokoškolska ustanova svoj sadržaj može plasirati na poželjno mesto gde se ciljna grupa i potencijalni studenti nalaze.

Ispitanici su iskazali da se značaj društvenih mreža za Fakultet za projektni i inovacioni menadžment ogleda i u informisanju o aktuelnostima na fakultetu pored samog privlačenja novih studenata i informisanju o Fakultetu kao jednoj od opcija gde bi mogli da nadgrade svoje znanje i studiraju. Kao i svaka institucija, u ovom slučaju moderne visokoškolske ustanove treba da rade i na svom sadržaju koji plasiraju. U ovom slučaju, ispitanici se najviše interesuju da vide obaveštenja i aktuelnosti koje se dešavaju na fakultetu dok im je na drugom mestu ostale informacije koje bi Fakultet mogao plasirati (poput različitih takmičenja, praksi, edukacije o sferi rada fakulteta).

Prema istraživanju, ispitanici su iskazali da im najvažniji faktor u objavama predstavlja visual, a potom tekst. Značaj odgovora na ovo pitanje se nalazi u tome da Fakultet može da odluči da li će svoje marketinške napore uložiti u stvaranje vizuala ili testova ispod objava. Ispitanici su iskazali da im je vizual važnija stavka od teksta, samim tim Fakultet može u budućnosti odlučiti da li će uneti nekakve promene u svoj marketinški pristup zbog studentskog iskustva.

Ovim istraživanjem je prikazano koliko važnu ulogu predstavljaju društvene mreže Fakulteta kod ispitanika. Fakultet je svojim aktivnostim privukao potencijalne studente svojim marketinškim aktivnostima i internet prisustvom.

4.ZAKLJUČAK

Značaj ovog završnog rada ogleda se u tome da je na bazi teorijskih i empirijskih saznanja javnost upoznata sa primenom marketinških aktivnostima na visokoobrazovnim ustanovama, s posebnim osvrtom na primenu marketinga na Fakultetu za projektni i inovacioni menadžment. Tržište se menja i kada su visokoškolske ustanove u pitanju pa je potrebno da se pažljivo prate potrebe ciljne grupe kao i u kom se smeru tržište kreće.

Fakultet za projektni i inovacioni menadžment kao visokoškolska ustanova ulaže velike napore u svoj brend i prepoznatljivost. Pre samih marketinških aktivnosti se godinama brend razvijao i menjao. Velika važnost se ogleda i u nastavnom kadru koji je na fakultetu i njegovom kvalitetu, a Fakultet za projektni i inovacioni menadžment je sagledao važnost toga i upravo to u praksi primenjuje. Takođe, jedna od važnih stavki je i sam imidž Fakulteta i doživljaj o njemu. Društvene mreže svakodnevno pružaju šansu svima koji žele da je iskoriste. Činjenica je da se društvene mreže iz dana u dan sve više koriste u svetu, a i da se njihova korist može ogledati u različitim primerima u praksi. Uz digitalno prisustvo, bez obzira na sferu posla možete približiti ciljnoj grupi svoju ponudu. Srednjoškolci i studenti za visokoškolske ustanove predstavljaju važan faktor kada je fakultetsko iskustvo u pitanju. Veliki procenat toga kako su studenti čuli za fakultet nosi komunikacija sa okruženjem (prijatelji, porodica, profesori), ali i iz iskustava studenata koji pohađaju Fakultet. Potom, veliki broj studenata je upravo za Fakultet saznalo putem internet kanala i digitalne prisutnosti brenda Fakulteta. Sam efekat digitalnog marketinga na privlačenje studenata u privatnom sektoru se ogleda u primeru Fakulteta za projektni i inovacioni menadžment koji uviđa veliku važnost i korist od svoje digitalne prisutnosti na različitim platformama jer upravo putem takvih kanala njihova ciljna grupa saznaje za njihove studijske ponude i smerove. Na osnovu dobijenih rezultata istraživanja možemo zaključiti da je definisana hipoteza: Primena digitalnog marketinga obezbeđuje veći stepen upisa studenata na privatnom fakultetu u odnosu na stepen upisa studenata na državnom fakultetu, dokazana.

U narednim godinama, uticaj digitalnog marketinga će postati veći jer su mlađe generacije svoje prisutvo pokazale na društvenim mrežama, pa samim tim visokoškolske ustanove treba da ulažu napore u svoje marketinške aktivnosti posebno u digitalne jer su upravo one budućnost koja iz dana u dan postaje sve stvarnija.

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THE EFFECT OF DIGITAL MARKETING ON ATTRACTING NEW STUDENTS IN HIGHER EDUCATION

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ABSTRACT:

Higher education institutions today face various challenges brought about by changes in the technological, socioeconomic and demographic environment. Digitization and the technological environment, that is, the intensity of the use of technological innovations in the everyday life of students, have created numerous challenges, but also opportunities for improving the quality of education. One of the results of these changes is the oversaturation of young people with information, which has led to a situation where it is much more difficult for higher education institutions to interest them.

Keywords: students, digital marketing, digitization, technological innovation

PRIMENA STANDARDA ISO 9001:2015 U POSLOVANJU ŠPEDICIJE

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SAŽETAK:

Zadovoljstvo korisnika predstavlja jedan od ključnih faktora postizanja konkurentske prednosti u špediterskim organizacijama. Serija standarda ISO 9000 naglašava primenu procesnog pristupa i usmerenost ka korisniku, a posebno merenje i praćenje zadovoljstva korisnika. Postizanje zadovoljstva korisnika se nalazi u neraskidivoj vezi sa ostvarivanjem ciljeva sistema menadžmenta kvalitetom (QMS). Poslovanje špedicije, unapređenje kvaliteta i zadovoljstvo korisnika vezano je za ključne procese carinskog zastupanja i organizacije transporta. Ovaj rad prikazuje značajne aspekte QMS-a u radu špedicije, kroz praktični primer realnog poslovnog sistema. Date su preporuke za zadovoljenje zahteva standarda ISO 9001:2015, primenu procesnog pristupa i izbor ciljeva kvaliteta.

Ključne riječi: QMS, zadovoljstvo korisnika, procesni pristup

1. UVOD

Špedicija podrazumeva poslove oko otpreme, dopreme i organizovanja transporta robe u međunarodnom i unutrašnjem transportu a po nalogu i za račun komitenata. To je posebna privredna delatnost u grupaciji, za saobraćaj i veze i grane spoljne trgovine, koja ima uslužni karakter, čiji se zadaci i sadržaj delovanja identifikuju sa savetodavnom funkcijom u poslovima carinskog posredovanja, organizacije transporta u poslednje vreme i poslovima osiguranja, trgovine i turizma.

Za opstanak organizacije u današnjim surovim uslovima poslovanja koja nameću konstantne promene u okruženju, globalizacija, velika tržišna borba, sve zahtevniji kupci za određenim nivoom kvaliteta proizvoda i usluga, veoma važna je njena sposobnost upravljanja i prilagođavanja svim tim uslovima. Promene koje se dešavaju na svetskom tržištu uzrokuju takvu dinamičnost da gotovo ništa nije stalno, već je samo u pitanju sposobnost organizacije da promene predvidi i da izvrši odgovarajuće transformacije u organizacionoj strukturi, odnosno u upravljanju organizacije, njenom ponašanju i poslovanju, kako bi sebi obezbedila mesto i opstanak u poslovnom svetu.

Špedicije su pod ogromnim pritiskom konkurencije i sve zahtevnijih korisnika po pitanju kvaliteta pružanja usluga. Obezbeđenje potrebnog nivoa kvaliteta je moguće samo ako je u primeni odgovarajući menadžment sistem čiji se zahtevi ispunjavaju realizacijom

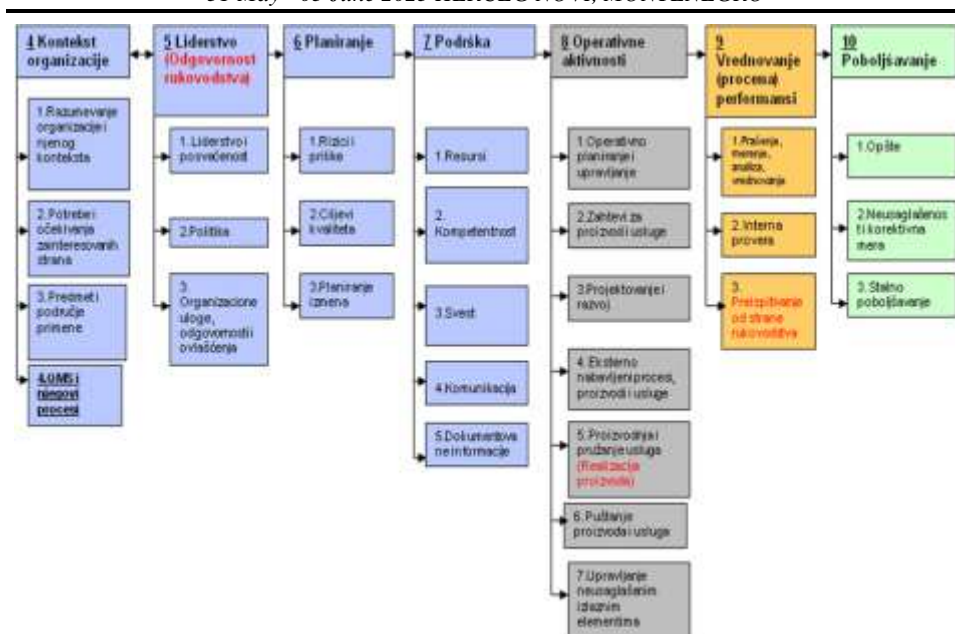
procesa, što za rezultat ima povećanje produktivnosti, smanjenje troškova i povećanje profita. Dugoročan razvoj organizacije je omogućen ako se ostvari zahtevani kvalitet od strane korisnika kroz planiranje, preventivu i poboljšanje poslovnih procesa, čime se sprečavaju neželjeni efekti u svim poslovnim procesima organizacije.

Podrška izgradnji „očekivanog“ kvaliteta usluga u špediterskim organizacijama, predstavlja i primena QMS-a (prema standardu ISO 9001:2015) u poslovanju špedicije, što je i predmet ovog rada.

2. ZAHTEVI STANDARDA ISO 9001:2015

Ovim međunarodnim standardom se specificiraju zahtevi za sistem menadžmenta kvalitetom (QMS) onda kada organizacija: a) treba da pokaže svoju sposobnost da dosledno obezbeđuje proizvod ili uslugu koji ispunjavaju zahteve korisnika i primenljivih zakona i ostalih propisa i b) ima za cilj da poveća zadovoljstvo korisnika efektivnom primenom sistema, uključujući procese stalnog poboljšavanja sistema i dokazivanje usaglašenosti sa zahtevima korisnika i primenljivih zakona i ostalih propisa.

Zahtevi QMS definisani su tačkama 4. do 10., kako je to prikazano slikom 1[1]. Tačka 1. je predmet i područje primene. Tačkom 2. daju se normativne reference, a termini i definicije u tački 3. Organizacija zadovoljava sve zahteve standarda. Ukoliko neki zahtev iz elementa 8 nije primenljiv, organizacija mora da da obrazloženje za to, i da ga isključi iz sistema, pod uslovom da ne utiče na efektivnost. Kod špedicija su to pretežno zahtevi 7.1.5 – Upravljanje resursima za praćenje i merenje (kada organizacija u svom radu ne koristi merno-kontrolnu opremu) i zahtev 8.3 (Projektovanje i razvoj).



Slika 1. Zahtevi standarda ISO 9001:2015

3. KONTEKST I ZAINTERESOVANE STRANE

Zahtev 4 standarda ISO 9001:2015, je novina u odnosu na prethodno izdanje standarda iz 2008. godine. Od organizacije zahteva da izvrši analizu konteksta organizacije, sagleda i interne i eksterne zainteresovane strane (ZS).

3.1. Kontekst špedicije

Kroz dokumentovanu informaciju kontekst organizacije, špedicija razmatra i analizira interno i eksterno okruženje i uticajne faktore na sistem usluga i poslovanja.

Metode koje se najčešće koriste su PEST i SWOT analiza. PEST analiza se bavi proučavanjem okruženja kroz analizu političkih, ekonomskih, socio-kulturoloških i tehnoloških faktora.

SWOT analiza (akronim engleskih reči: *Strengths, Weaknesses, Opportunities, Threats* - snage, slabosti, prilike, pretnje) je tehnika strategijskog menadžmenta putem koje se uočavaju strateški izbori dovodenjem u vezu snaga i slabosti preduzeća sa šansama i pretnjama u eksternom okruženju. U tabeli 1 je ilustrovana SWOT analiza iz realnih uslova poslovanja (sertifikovane špedicije prema standardu ISO 9001:2015).

Tabela 1. SWOT analiza špedicije STAR&SS trade [2]

<i>Snage</i>	<i>Slabosti</i>
<ul style="list-style-type: none"> • Kvalitetna usluga • Obrazovan kadar • Poštovanje rokova • Reference • Veliko iskustvo u carinskom zastupanju • Veliki broj stalnih korisnika • Fleksibilnost organizacijskog sistema 	<ul style="list-style-type: none"> • Povremena fluktuacija carinskih zastupnika • Inopozicija isporučioaca • Rigidnost u ugovaranju velikih poslova • Nedovoljna informisanost o akcijama konkurencije
<i>Prilike</i>	<i>Pretnje</i>
<ul style="list-style-type: none"> • Kreditiranje putem banaka • Standardi QMS • Uspon delatnosti špediterskih usluga • Povećanje standarda inokupaca • Postojanje podrške inostranih partnera 	<ul style="list-style-type: none"> • Politička situacija • Slaba kupovna moć potrošača • Nesređeno tržište radne snage • Loša likvidnost kupaca u zemlji • Veliki broj konkurenata • Nedostatak kvalifikovanih carinskih zastupnika na području Leskovca • Energetska kriza

3.2. Zainteresovane strane špedicije

Analiza zahteva značajnijih zainteresovanih strana data je u tabeli 2.

Tabela 2. Potrebe i očekivanja zainteresovanih strana [adaptirano prema 3].

EKSTERNE ZAINTERESOVANE STRANE			RELEVANTNI ZAHTEVI DA/NE
R.br.	Zainteresovana strana	Potrebe i očekivanja	QMS
1	Korisnici – fizička lica	Pružanje usluga u dogovorenom roku	DA
		Konstantan kvalitet	DA

		Mogućnost e-mail komunikacije	DA
		Širok asortiman	DA
		Stabilne cene	DA
		Mogućnost odloženog plaćanja	DA
		Bezbednost za robu	Delimično
2	Korisnici – pravna lica	Pružanje usluga u ugovorenom roku	DA
		Visok kvalitet	DA
		Konstantan kvalitet	DA
		Kontinuitet u cenama	DA
		Mogućnost dobijanja usluga tokom važenja ugovora/dogovora	DA
		Mogućnost proširenja dogovorenih usluga	DA
		Mogućnost e-mail komunikacije	DA
		Bezbednost robe	Delimično
3	Regulatorna tela/Carina	Poštovanje zakonskih propisa	DA
		Poštovanje obligatornih elemenata dokumentacije	DA
		Komisija za vanrednu kontrolu	DA
4	Opština	Zaštita životne sredine	DA
		Plaćanje poreza i opštinskih taksi	DA
5	Društvo	Razvoj privrede	DA
		Plaćanje poreza	DA
		Zaštita životne sredine	Delimično
INTERNE ZAINTERESOVANE STRANE			
6	Zaposleni	Jasno definisani radni zadaci	DA
		Dobra obuka u cilju sticanja kompetentnosti	DA
		Redovna primanja	DA
		Visoka primanja	DA
		Aдекватni uslovi rada	Delimično/da
		Aдекватni ekološki uslovi	DA

		Poštovanje radnog vremena	DA
		Poštovanje vremena za odmor	DA
		Stimulacija za dobro obavljen posao	Delimično/da
		Bezbednost na radu	DA

4. PROCESI I DOKUMENTACIJA

4.1. Procesi špedicije

Potrebno je da špedicija uspostavlja, dokumentuje, primenjuje i održava QMS i poboljšava njegovu efektivnost u skladu sa zahtevima standarda SRPS ISO 9001:2015, kroz dokumenta QMS (DQMS), negovanjem dobre prakse i stalnom orijentacijom ka kupcima/korisnicima i ostalim zainteresovanim stranama.

Radi povećanja zadovoljenja zahteva kupaca/korisnika i poboljšanja upravljanja, primenjuje se procesni pristup. Aktivnost koja koristi resurse i kojom se obavlja menadžment da bi se transformisali ulazni elementi u izlazne, smatra se procesom (oznaka "P"). Procesi su definisani u Poslovniku, a razrađuju su u procedurama QMS, u kojima je prikazan standardni postupak odvijanja procesa, identifikovani su njihovi "vlasnici", ulazi i izlazi i odgovornost ostalih učesnika.

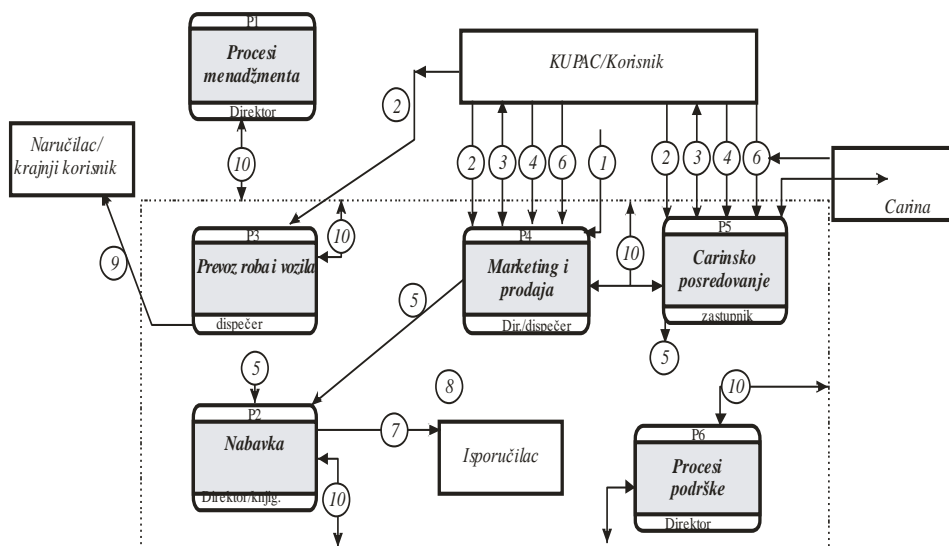
Za poslovanje „STAR&SS trade“ doo, identifikovane su tri grupe procesa (P) sa aspekta QMS-a: Menadžment, Osnovni procesi i Procesi podrške

Menadžment procesi (P1) podrazumevaju sve aktivnosti u pogledu upravljanja, rukovođenja i planiranja, analize rizika, a u cilju funkcionisanja i razvoja društva.

Osnovni procesi (glavni procesi) predstavljaju primarne procese koji direktno utiču na zahteve kupaca/korisnika i održavaju (odslikavaju) delatnost organizacije (društva). Procesi podrške (podržavajući procesi) podrazumevaju procese koji imaju uticaja na performanse (karakteristike) glavnih procesa i koji su njihova podrška u izvršenju svojih funkcija i ciljeva. To su: upravljanje ljudskim resursima, održavanje, informatika, finansije i knjigovodstvo, pravni i opšti poslovi, implementacija QMS-a.

Procese koje primenjuju društvo, a koji su neophodni za QMS, odnosno realizaciju delatnosti (usluga), prikazani su na slici 2 (mapa/mreža procesa), a veze tabelom 3.

Identifikovani procesi su polaz za merenje performansi. Menadžmentom performansi (*Performance management*) postiže se konstantan uspeh u poslovanju poboljšavanjem performansi od strane zaposlenih. Tome doprinosi i razvoj sposobnosti zaposlenih koje iziskuje obogaćivanje posla, kao i sticanje znanja i veština putem obuka i treninga.[4]



Slika 2. Mapa (mreža) procesa [2]

Tabela 3. Master proizvodi (ulazi/izlazi) procesa

Oznaka	Naziv	Oznaka	Naziv
1	Informacije sa tržišta	6	Ovlašćenje za carinjenje
2	Zahtev-porudžbina	7	Upit dobavljaču
3	Ponuda/Ugovor/Predračuna	8	Ulazni proizvodi-usluga, prateća dokumentacija
4	Podaci o zadovoljstvu korisnika	9	Propratna dokumenta (CMR, putni nalog, Carinska dokumentacija-CD)
5	Zahtev za nabavku	10	Planovi, programi, ciljevi, karakteristike procesa i mere unapređenja

4.2. Dokumenti QMS-a

Kriterijumi i metode potrebne da se obezbedi, da izvođenje svih procesa i upravljanje njima bude efektivno propisuju se dokumentacijom - regulativom procesa. Sagledavajući veličinu organizacije, postojeća dokumenta, identifikovane procese i zahteve standarda, utvrđeni su sledeći dokumenti (dokumentovane informacije)[2]:

- Politika kvaliteta,
- Poslovnik o kvalitetu (QM),
- QP.01 – Upravljanje dokumentima i zapisima,
- QP.02 – Marketing i zadovoljstvo korisnika,
- QP.03 – Ugovaranje i prodaja,
- QP.04 – Nabavka,
- QP.06 – Uvoz i izvoz robe,
- QU.01 – Režimi uvoza i izvoza,
- QU.02 – Poreklo robe,
- QU.03 – Uvozno i izvozno carinjenje,
- QP.07 – Organizacija transporta (prevoz robe),
- QP.08 – Procesi podrške i
- QP.09 – Analiza rizika i prilika.

5. POLITIKA I CILJEVI KVALITETA

Politika kvaliteta je sastavni deo poslovne politike špedicije i predstavlja vezu između definisane misije organizacije i ciljeva i programa kvaliteta.

Polazni dokument pri uspostavljanju QMS-a predstavlja definisanje Politike kvaliteta. Ista mora da odlikava stav rukovodstva u pogledu kvaliteta, i da je javno dostupna (što je zahtev 5.2 ISO 9001). Polaz je za ciljeve kvaliteta.

Elemente procesa menadžmenta ciljeva čine:

- Iz poslovnih ciljeva, iz oblasti odgovornosti menadžmenta i zaposlenih proizilaze operativni ciljevi
- Identifikacija ciljeva i postavljanje metrike se vrši kroz diskutovanje menadžmenta i vlasnika procesa ili zaposlenog zajedno sa nadređenim,
- Fokus nije na aktivnostima koje treba obaviti, nego na ciljevima koje treba ostvariti [5].

Ciljevi kvaliteta definišu se od strane rukovodstva. Isti treba da budu u skladu sa planovima poslovanja. Potencijalni su sledeći ciljevi:

1. Zadovoljstvo korisnika (≥ 8 , na skali od 1 do 10),
2. Reklamacije korisnika ($\leq 3\%$, iznos u odnosu na realizovane usluge),
3. Ostvarene usluge u odnosu na ugovorene ($\geq 95\%$, procenat ispunjenja),
4. Revizija carinskih dokumenata ($\leq 5\%$, iznos u odnosu na podnešene JCI),
5. Zadovoljstvo zaposlenih ($\geq 8,5$, na skali od 1 do 10),
6. Kompetentnost zaposlenih (min 5 obuka godišnje),
7. Povećanje broja korisnika ($\geq 7\%$, u odnosu na prošlu godinu).

Potrebno je da direktor, pored ciljeva i indikatora – tj. planiranih vrednosti, definiše i preciznije rokove, mere – akcije, kao i odgovornosti i način praćenja.

6. ANALIZA RIZIKA I CILJEVA

Važan zahtev standarda (tačka 6.1), a i samog poslovanja je analiza rizika i prilika. Rizik predstavlja neizvesnost da se planirani ciljevi ostvare, pa je stoga veoma važno upravljati rizicima.

Postupak se primenjuje da se identifikuju potencijalni problemi i pozitivni uticaji (prilike) koje su vezane za kontekst organizacije, a obuhvataju sve segmente u špediciji i zahteve za analizu rizika od strane carinskih organa. Proces obezbeđuje identifikaciju pre nego da se pojave problemi, tako da se kroz analizu rizika mogu planirati potrebne akcije i uspostaviti kontrola čime bi se smanjili i/ili neutralisali negativni uticaji na postizanje ciljeva organizacije. Proces pruža sve informacije o tome kako da se identifikuju, analiziraju, ocenjuju i smanjuju rizici. U cilju ostvarenja potencijalnih prilika, ovaj proces obezbeđuje mehanizam da se na vreme identifikuju prilike, analiziraju i ocene, a u cilju da se preduzmu aktivnosti koje će da dovedu do njihovog ostvarenja.

Procena rizika i prilika je u skladu sa metodologijom koja je prikazana u nastavku [6]. Za procenu nivoa rizika i prilika koristi se matrica 5x5 (tabela 4).

Rizici i prilike se izračunavaju po sledećim formulama:

$$\begin{aligned}\text{Rizik} &= \text{Verovatnoća} \times \text{Ozbiljnost posledica} \\ \text{Prilika} &= \text{Verovatnoća} \times \text{Pozitivan uticaj}\end{aligned}$$

Tabela 4. Matrica rizika i prilika

Verovatnoća	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Ozbiljnost posledica					
Verovatnoća	5	25	20	15	10	5
	4	20	16	12	8	4
	3	15	12	9	6	3
	2	10	8	6	4	2
	1	5	4	3	2	1
		5	4	3	2	1
	Pozitivan uticaj					

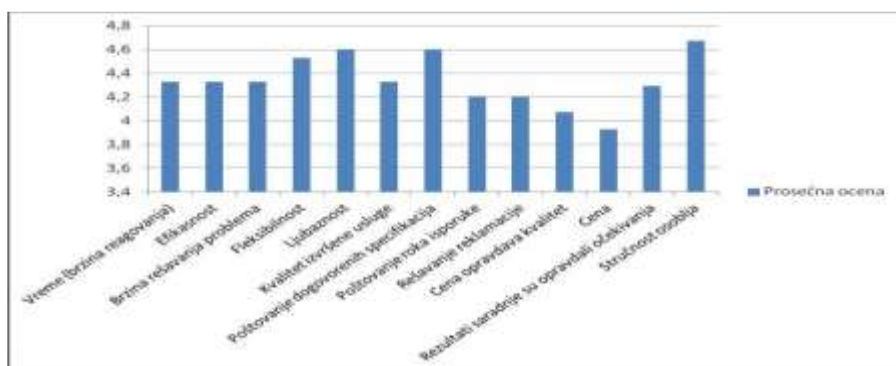
Potrebno je definisati skale ocena i indekse nivoa rizika i prilika (visok, srednji, nizak).
 Identifikovani visoki rizici: nepouzdanost rada softvera za JCI, nestanak električne

energije (struje), revizija JCI, nedostatak normativa klijenata, fluktuacija kadrova, kompetentnost za carinske agente, nezadovoljstvo klijenta (korisnika usluga).[2]

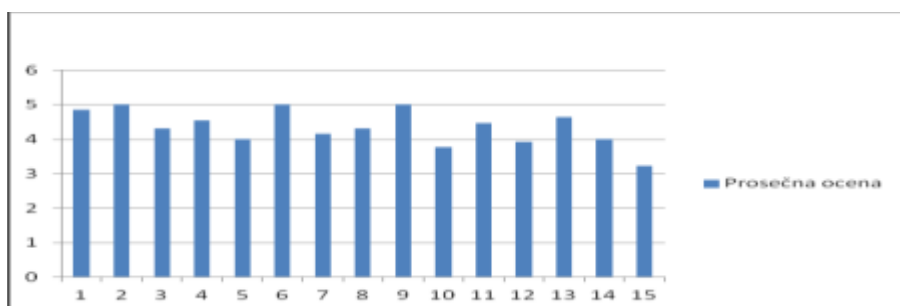
Za identifikovane rizike definisati mere, resurse i odgovornosti.

7. ZADOVOLJSTVO KORISNIKA

Marketing i zadovoljstvo korisnika opisuje metode promocije, način istraživanja tržišta i utvrđivanja zadovoljstva korisnika (što je i zahtev 9.1.2 ISO 9001). Istraživanje zadovoljstva korisnika vrši se elektronskim načinima ili putem anketnih upitnika i sprovodi se analiza dobijenih rezultata. Na osnovu analiza je moguće izvesti zaključke o merama čijim bi sprovođenjem doprinelo poboljšanju kvaliteta poslovanja. Na slici 3 i 4 prikazani su rezultati anketiranja po elementima ankete (skala od 1 do 5), i po nalogodavcu – korisniku špediterskih usluga. Korisnici usluga su najviše zadovoljni (najbolje ocene) ljubaznošću osoblja, poštovanjem dogovorenih specifikacija kao i stručnošću osoblja, dok su najmanje zadovoljni cenom usluga i onome čime se ona opravdava.



Slika 3. Prikaz rezultata ankete o zadovoljstvu korisnika po postavljenom pitanju [7]



Slika 4. Grafički prikaz rezultata ankete o zadovoljstvu korisnika (po nalogodavcu) [7]

8. ZAKLJUČAK

Da bi špedicija uspešno poslovala, ona mora da vrši proces upravljanja na sistematični i transparentni način, što podrazumeva i korišćenje QMS-a. Poslovni procesi se stalno moraju održavati i poboljšavati. Neophodno je definisati interni i eksterni kontekst organizacije. Važna aktivnost je i utvrđivanje ciljeva i očekivanja svih zainteresovanih strana. Upravljanje procesima ostvaruje se dokumentovanim informacijama, pri čemu analiza rizika i prilika predstavlja osnov za poboljšanje procesa i QMS-a u celini. Utvrđeni nivo zadovoljstva korisnika omogućuje preciznije definisanje mogućih pravaca unapređenja kvaliteta usluga u špediterskom poslovanju.

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APPLICATION OF ISO 9001:2015 STANDARD IN FREIGHT FORWARDING BUSINESS

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ABSTRACT:

Customer satisfaction is one of the key factors in achieving competitive advantage in freight forwarding organizations. The ISO 9000 standard series emphasizes the application of a process approach and customer orientation, and especially the measuring and monitoring of customer satisfaction. Achieving customer satisfaction is inextricably linked with achieving the goals of the quality management system (QMS). Freight forwarding business, quality improvement and customer satisfaction are related to the key processes of customs representation and transport organization. This study shows the significant aspects of QMS in the work of a freight company, through a practical example of a real business system. Recommendations are given for meeting the requirements of the ISO 9001:2015 standard, applying a process approach and choosing quality objectives.

Keywords: *QMS, customer satisfaction, process approach*

INSTITUCIONALNE MOGUĆNOSTI BRŽEG RAZVOJA DIGITALNOG PREDUZETNIŠTVA

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Sažetak

U ovom radu analiziraju se institucionalne mogućnosti za plasiranje digitalnih proizvoda i usluga putem digitalnih kanala, koje predstavljaju potencijal za razvoj digitalnog preduzetništva. Poseban akcenat u istraživanju dat je na stvaranju institucionalne infrastrukture koja će omogućiti digitalnom preduzetništvu podršku javnog mnjenja, poreskog i bankarskog sistema, kao i obrazovnog i zdravstvenog sistema u državi.

Delovanje u online prostoru, koje obuhvata i poslovanje koje omogućavaju digitalne platforme za rad, stvara koncepte relevantne za frilensere i digitalno preduzetništvo. Kombinujući poslovanje, znanje i institucionalne mogućnosti, digitalni preduzetnici proširuju spektar poslovnih mogućnosti u stvaranju finansijske dobiti, a istovremeno jačaju osnove za stvaranje novih institucija i jačanje postojećih, u prodaji digitalnih proizvoda i usluga domaćem i inostranom tržištu.

U zemljama srednjeg nivoa razvoja institucionalno podržano digitalno preduzetništvo može stvoriti dodatnu ekonomsku vrednost, omogućavajući fleksibilnost rada, koje daje priliku za radno angažovanje dela radno aktivnog stanovništva koje se suočava sa strukturnim problemima zapošljavanja.

Ključne reči: digitalizacija, digitalna transformacija, digitalno preduzetništvo

1.Uvod

Stvaranje digitalnih preduzeća i usvajanje digitalnih tehnologija od strane postojećih preduzetnika u formi digitalnog preduzetništva, predstavlja potencijal za nedovoljno zastupljene grupe stanovništva u preduzetništvu. Na ovaj način digitalno preduzetništvo pomaže da se klasično preduzetništvo učini inkluzivnijim i daje veće šanse da određene grupe stanovništva imaju koristi od određenih karakteristika digitalnih tehnologija za stvaranje profita. To uključuje niže početne troškove potrebne za mnoga digitalna preduzeća i širi pristup spoljnim tržištima koje nudi internet.

Digitalno preduzetništvo obuhvata sve nove poduhvate i transformaciju postojećih preduzeća koja pokreću ekonomsku i društvenu aktivnost stvaranjem i upotrebom novih digitalnih tehnologija. Digitalna preduzeća karakteriše visok intenzitet korišćenja novih digitalnih tehnologija za poboljšanje poslovanja, stvaranje novih poslovnih modela, kao i jačanje poslovne inteligencije za rad sa klijentima i zainteresovanim stranama.

Savremeno preduzetništvo se suočava sa preprekama u stvaranju biznisa, uključujući visok nivo administrativnog i regulatornog opterećenja, pristup finansijama, kao i nedostatak preduzetničkih veština. Mnoge od ovih prepreka koje se sreću u klasičnom preduzetništvu se odnose i na digitalno preduzetništvo, ali na drugačije načine, jer se organizacione strukture, procesi i aktivnosti razlikuju u digitalno intenzivnim poslovima. Zato je neophodno razmotriti institucionalne prepreke digitalnom preduzetništvu, koje se mogu razlikovati od tradicionalnih prepreka za stvaranje biznisa.

2. Digitalno okruženje savremenog preduzetništva

Usled ubrzanih tehnoloških promena i digitalizacije poslovanja, dubina promena u poslovnim procesima i strategiji koja stvara podršku za profitabilan biznis, definiše novo digitalno okruženje za preduzetništvo. Kroz implementaciju savremenih informacionih tehnologija ostvaruje se veća mikro konkurentnost, a to uključuje i nove modele baza podataka, savremenu informacionu infrastrukturu i računarsku komunikaciju koja vodi računa o kvalitetnijem upravljanju podacima, u smislu efikasnijeg skladištenja i zaštite poslovnih podataka.

Kombinujući znanje, poslovanje i institucionalne mogućnosti, digitalni preduzetnici ulažu napore za stvaranje finansijske dobiti kroz realizaciju svojih poslovnih poduhvata zasnovanih na digitalnim medijima i informacionim i komunikacionim tehnologijama. Stvaranjem novih institucija i transformacijom postojećih institucija, poslovne mogućnosti znanja usmerene su ka pretraživanju informacija i drugim mogućnostima vezanim za znanje u digitalnom preduzetništvu.

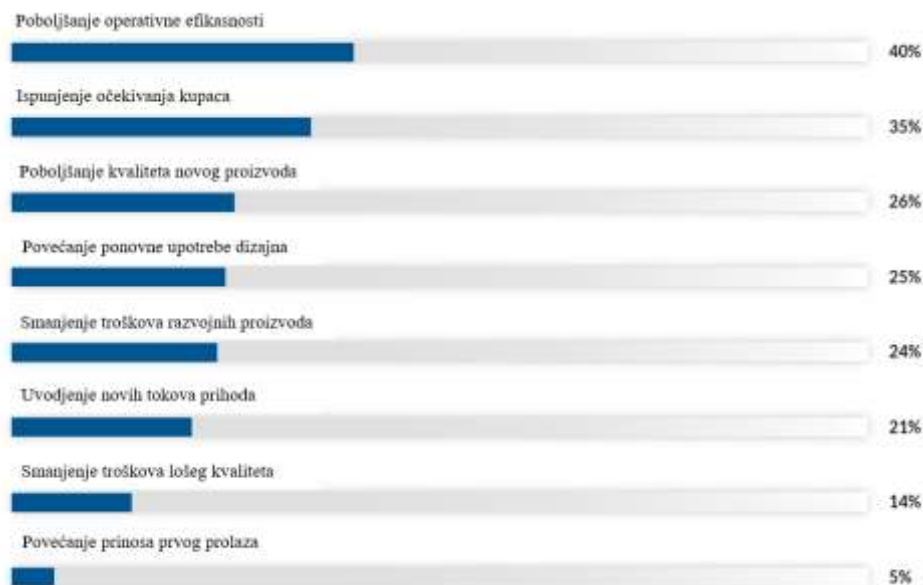
Nova realnost između fizičkog i digitalnog sveta znatno utiče na sve učesnike na tržištu i na strani ponude i na strani tražnje, akcentujući značajnu ulogu novih poslovnih trendova u mrežnoj zajednici. Na taj način, menjaju se i ciljevi poslovanja preduzeća koja organizacioni uspeh baziraju na digitalizaciji poslovanja kroz različite oblike korišćenja digitalnih resursa. U digitalnoj ekonomiji, efikasniji poslovni modeli obezbeđuju rast i razvoj novih preduzetničkih poduhvata koji se ogledaju i u digitalnom preduzetništvu.

Setom praktičnih alata, koji mogu direktno da se primene u sferi digitalnog preduzetništva, motivišu se budući preduzetnici da pokrenu sopstveni biznis, razvijajući sopstveni potencijal digitalnih preduzetničkih kompetencija. Na taj način, digitalni preduzetnik koristeći savremene informacione i komunikacione tehnologije i alate, ostvaruje ključne poslovne aktivnosti i funkcije, kao što su proizvodnja, marketing, distribucija i upravljanje zainteresovanim stranama. Samim tim, digitalno preduzetništvo, koje se zasniva na principima otvorenih inovacija, najsavremenije tehnologije i društveno odgovornog poslovanja, najbolji je način za identifikovanje i razvoj rešenja takvog kvaliteta koje je sposobno da ostvari korelaciju ciljeva održivog razvoja i izazova sa kojima se suočavaju preduzetnici u njihovom postizanju.

Usled jedinstvenih izazova i mogućnosti sa kojima se suočavaju digitalna preduzeća u pogledu strategija ulaska, generisanja prihoda i upravljanja odnosima sa kupcima i korisnicima usluga, informaciono-komunikacione tehnologije koje povezuju računare i nove digitalne tehnologije kao što su pametni telefoni, mrežne platforme i

veštačka inteligencija, dodatno dobijaju na značaju. Stub digitalnog preduzetničkog sistema mora biti zasnovan na vladavini prava, a posebno imovinskih prava, kao i efikasnosti pravnog okvira u posebnim propisima prava intelektualne svojine.

Na grafikonu 1 prikazane su glavne prednosti digitalnog modela poslovanja u preduzetništvu.



Grafikon 1: Glavne prednosti digitalnog modela poslovanja u savremenom preduzetništvu (izvor: <https://www.oecd-ilibrary.org/sites/28e047ba-en/index.html?itemId=/content/component/28e047ba-en>)

Međuzavisnost digitalnog rada i ostvarivanja principa dostojanstvenog rada u zemljama u razvoju koje karakterišu nizak privredni rast, ograničena ponuda poslova za visokoobučene kadrove, niske zarade i visoka nezaposlenost, dovodi do toga da digitalni rad u takvim okolnostima nosi velike pogodnosti. Ove pogodnosti se ogledaju u nadprosečnoj zaradi, dobarom balansu između privatnih i poslovnih obaveza i snažnoj motivisanosti radnika da rade i usvršavaju se. Međutim, postoje i nedostaci takvog rada koji se ogledaju u visokom stepenu nesigurnosti radnog mesta, odsustvom osiguranja koje proizlazi iz sistema socijalne zaštite i nemogućnošću učešća u socijalnom dijalogu koji je rezervisan za klasične forme radnog odnosa. U periodu uspona digitalne ekonomije, položaj digitalnih preduzetnika postaje ranjiv jer su rešenja koja se tiču odnosa poslodavaca i zaposlenog, te prava i zaštite izvedenih iz radnog odnosa, zasnovana na principima funkcionisanja tradicionalne privrede kojoj oni ne pripadaju. U Srbiji, ponuda digitalnog rada konstatno je visoka, bez obzira na to da li digitalni preduzetnici biraju da im rad na platformama bude prvi izvor prihoda koji dopunjavaju povremenim

angažovanjem u oflajn sferi rada, ili im je jedini izvor prihoda koji ostvaruju. U obavljanju digitalnog rada, radnici iz Srbije suočavaju se sa znatno većim izazovima od digitalnih preduzetnika u drugim evropskim zemljama. Postojeći modaliteti regulisanja rada digitalnih preduzetnika u Srbiji, često nisu zadovoljavajući, jer ovi modaliteti rada produkuju visok obim skrivene zaposlenosti, a s druge strane, ne pružaju optimalno zadovoljenje prava radnika i radnica kroz postojeća rešenja kao što je registracija u svojstvu preduzetnika. Ova rešenja negiraju mogućnost ostvarivanja prava koja proizlaze iz njihovog statusa radnika, a zasnovana su na postulatima dostojanstvenog rada. Poboljšanje statusa digitalnih radnika u Srbiji u smislu sigurnijeg i izvesnijeg poslovnog ambijenta predstavlja korak ka odgovorima na pitanja sa kojima će se Srbija kontinuirano sretati na putu ka izgradnji digitalne ekonomije, stvarajući uslove za dobrobit svih radnika i kvalitet zapošljavanja u digitalnom dobu, koje mora da uzme u obzir rastući značaj autonomije u odnosu na društveni karakter rada, ali ne na račun solidarnosti, socijalne pravde i jednakosti.

Pri definisanju odgovarajućih rešenja koja će uvažavati potrebu za zaštitom individualnih prava digitalnih radnika i omogućiti im da srazmerno doprinesu sopstvenom razvoju i dobrobiti u društvu, strategija razvoja digitalnog preduzetništva predstavlja dugoročni cilj u izgradnji konkretne privrede, zasnovane na intenzivnom korišćenju digitalnih rešenja i fleksibilnijim modelima angažovanja radnika.

Na grafikonu 2 prikazana je motivacija za rad na digitalnoj platformi kod žena i muškaraca.



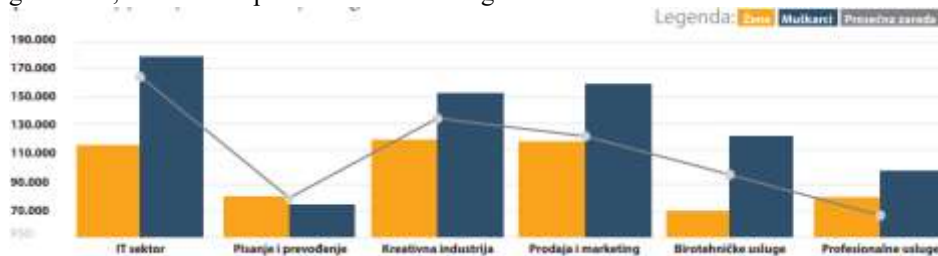
Grafikon 2: Motivacija za rad na digitalnoj platformi kod žena i muškaraca¹ (Izvor: Centar za istraživanje javnih politika- dostupno na <https://www.publicpolicy.rs>)

Prema analizi Centra za istraživanje javnih politika², glavna motivacija za rad na digitalnim platformama, i kod žena i kod muškaraca je fleksibilnost u načinu rada. Takođe, kao značajni motivacioni faktori za rad na digitalnim platformama su želja za sticanjem

¹ <https://publicpolicy.rs/publikacije/510aabc124b560434e2a433e81ca2eaa4ff6013b.pdf>

² www.publicpolicy.rs

novih veština, kao i i bolja plaćenost ovakvog posla u odnosu na druge poslove. Upravo ovaj motiv vezan za bolju plaćenost ovakvog posla, evidentno je potvrđen na sledećem grafikonu, na kome su prikazane zarade u digitalnom radu žena i muškaraca.



Grafikon 3: Pregled zarada žena i muškaraca u digitalnom radu¹ (Izvor: Centar za istraživanje javnih politika- dostupno na <https://www.publicpolicy.rs>)

3. Institucionalna podrška digitalnom preduzetništvu

Poboljšanje pristupa resursima za stvaranje digitalnog poslovanja i digitalizaciju za samozaposlene treba da uključuje jasne ciljeve za različite grupe stanovništva u nacionalne digitalne planove i strategije, kako bi se osiguralo da dostupnost Interneta ne isključuje ljude iz digitalnog preduzetništva. Potrebno je da mreže digitalnog preduzetništva povećaju svest o digitalnom preduzetništvu i digitalnim poslovnim mrežama i njihovim prednostima.

Pristup finansijama za digitalno preduzetništvo treba biti poboljšan u pravcu podrške i promovisanja platformei za digitalni rad kako bi se poboljšao pristup finansiranju početnika za digitalne preduzetnike, posebno žene i mlade.

Programi nagrada treba da obezbede male grantove i vidljivost digitalnih preduzetnika iz nedovoljno zastupljenih i ugroženih grupa, a kroz proces prijave i selekcije treba obezbeditei radionice o ključnim temama predstavljanja poslovnih ideja i identifikovanje mogućnosti, kao i odgovarajuću obuku. Veoma je bitno i promovisanje rodne ravnoteže u finansijskom sektoru, posebno u onima koji primaju javna sredstva.

U naučne programe u visokom obrazovanju potrebno je uključiti module preduzetništva kako bi se povećala svest o potencijalu preduzetništva među studentima.

Najvažnije institucije čije su regulatorna i nadzorna uloga od presudnog značaja u procesu inoviranja poslovanja i digitalne transformacije preduzetništva, svrstane su u nekoliko kategorija.² Svakako, najvažniju ulogu u institucionalnoj podršci digitalnom preduzetništvu imaju odgovarajuća ministarstva.

U tom smislu, Ministarstvo nauke, tehnološkog razvoja i inovacija nadležno je za inovacionu delatnost, i odgovorno za utvrđivanje i realizaciju inovacione politike,

¹ <https://www.publicpolicy.rs/documents/bdf69e7eff3a6b0eb7766aa24a4db6d79bae8c2c.pdf>

² <https://startech.org.rs/htdocs/Files/01009/Analiza-Stanje-inovacija-i-procesa-digitalne-transformacije-u-Republici-Srbiji.pdf>

podsticanje tehnopreduzetništva, transfera znanja i tehnologija u privredu, razvoj i unapređenje inovacionog sistema u Republici Srbiji, kao i propise u oblasti zaštite i prometa prava intelektualne svojine.

Ministarstvo privrede obavlja poslove državne uprave koji se odnose na predlaganje mera za podsticanje investicija i propise u oblasti zaštite i prometa prava intelektualne svojine. Ministarstvo informisanja i telekomunikacija ima nadležnosti u oblasti elektronskih komunikacija i informacionog društva, a koje se odnose na predlaganje politika i strategija u domenima, pripreme zakona, drugih propisa, standarda, kao i predlaganje mera za podsticanje istraživanja i razvoja u oblasti elektronskih komunikacija i informacionog društva.

Sektori za Inovacije i tehnološki razvoj imaju za cilj obezbeđivanje većih investicija i stvaranje povoljnog ambijenta za razvoj i promociju inovacija i inovacionog preduzetništva.

Savet za podsticanje razvoja digitalne ekonomije, inovacija, visokotehnološkog preduzetništva i digitalizacije u poslovanju privrednih subjekata, kao radno telo Vlade, ima zadatak da razmatra pitanja i daje predloge neophodne za značajno i sistemsko podizanje obima izvoza u oblasti digitalne ekonomije, visoko-tehnoloških proizvoda i usluga i inovacionog preduzetništva, povećavanje bruto domaćeg proizvoda (BDP) u ovim oblastima, povećanje obima stručnog kadra, poboljšanje infrastrukture za poslovanje, unapređenje primene visokih tehnologija i povećanje ukupne zaposlenosti razvojem inovacionog preduzetništva, uključujući i prekvalifikaciju i druge mere.

Zavod za intelektualnu svojinu obavlja stručne poslove i poslove državne uprave koji se odnose na: patent i mali patent, žig, dizajn, oznaku geografskog porekla, topografiju integrisanog kola, autorsko pravo i srodna prava; primenu međunarodnih ugovora iz oblasti zaštite intelektualne svojine, kao i druge poslove određene zakonom. Kancelarija za informacione tehnologije i elektronsku upravu obavlja stručne poslove koji se odnose na projektovanje, usklađivanje, razvoj i funkcionisanje sistema elektronske uprave i informacionih sistema i infrastrukture organa državne uprave i službi Vlade, kao i razvoj i primenu standarda u uvođenju informaciono-komunikacionih tehnologija u organima državne uprave i službama Vlade. Ona ostvaruje na taj način i podršku u primeni informaciono-komunikacionih tehnologija u organima državne uprave i službama Vlade.

Razvojna agencija Srbije (RAS) obavlja razvojne, stručne i operativne poslove podsticanja i realizacije direktnih ulaganja, promocije i povećanja izvoza, razvoja i unapređenja konkurentnosti privrednih subjekata, ugleda i razvoja Republike Srbije u oblasti privrede i regionalnog razvoja. Nadzor nad radom Agencije vrši Ministarstvo privrede. RAS u svojoj mreži ima 16 akreditovanih regionalnih razvojnih agencija (ARRA), sprovodi ciljeve podsticanja regionalnog razvoja ekonomije bazirane na znanju, inovativnosti, savremenim naučno-tehnološkim dostignućima i organizaciji upravljanja.

Institut za standardizaciju Srbije je nacionalno telo za standardizaciju u Republici Srbiji koje donosi, objavljuje, preispituje i povlači srpske standarde, daje tumačenje srpskih standarda, kao i tumačenje primene srpskih standarda, obezbeđuje usaglašenost srpskih standarda sa međunarodnim i evropskim standardima, vodi registar donetih i povučenih srpskih standarda, sarađuje sa međunarodnim i evropskim organizacijama za

standardizaciju i nacionalnim telima za standardizaciju država potpisnica odgovarajućih sporazuma iz oblasti standardizacije.

Za uspešnost sprovođenja programa digitalnog preduzetništva, potrebno je prikupiti više podataka razvrstanih po polu i uzrastu o digitalnoj ekonomiji i digitalnom samozapošljavanju. a module digitalnog preduzetništva uključiti u obrazovanje o preduzetništvu kako bi se pomoglo mladima da paralelno razviju digitalne i preduzetničke veštine. To takođe zahteva razvoj nastavnih materijala i obuku nastavnika o digitalnoj ekonomiji i programe obuke za digitalno preduzetništvo, koji pokrivaju identifikaciju prilika u digitalnoj ekonomiji, efektivnu upotrebu društvenih medija, dostizanje međunarodnih tržišta i razumevanje regulatornih razlika. Neophodno je osigurati da inicijative za obuku uključuju mogućnosti za izgradnju mreža i dobijanje pristupa pružaocima usluga za razvoj poslovanja.

4. Finansijska podrška unapređenja digitalnog preduzetništva

Država osniva i fondove u cilju unapređenja inovacionih kapaciteta privrede u oblasti digitalnog preduzetništva, preko javnih razvojnih finansijskih institucija (javni razvojni fondovi) odnosno skupu novčanih sredstava sa unapred određenom svrhom. Putem fondova moguće je i finansiranje javnih rashoda - uključujući i one koji se odnose za podršku inovacijama, razvoju, digitalnoj transformaciji i slične namene. U budžetskom smislu, fondovi mogu biti budžetski i vanbudžetski.

Fond za inovacionu delatnost vrši povezivanje i unapređivanje veza između nauke i privrede, podržavanje inovativnog preduzetništva, naročito u ranoj fazi razvoja, radi razvoja novih proizvoda i tehnologija i njihovog plasiranja na tržištima, i to sve u saradnji sa međunarodnim finansijskim institucijama, organizacijama, donatorima i privatnim sektorom. Fond za nauku obezbeđuje uslove za kontinuirani razvoj naučnoistraživačkih i razvojnih aktivnosti u Republici Srbiji, neophodnih za napredak društva zasnovanog na znanju. Sredstva za osnivanje i rad ovog fonda obezbeđuju se iz budžeta Republike Srbije. Fond za nauku obavlja poslove u vezi sa finansiranjem pripreme, realizacije i razvoja programa, projekata i drugih aktivnosti u oblasti sprovođenja naučnoistraživačke politike. Fond za razvoj svojom delatnošću ostvaruje podsticanje ravnomernog regionalnog razvoja, uključujući i razvoj nedovoljno razvijenih područja, uz podsticanje poslovanja pravnih lica i preduzetnika U tom smislu, ovaj Fond je kroz razvojne projekte, usmeren i na podsticanje inovativnosti, digitalizacije i primene novih tehnologija.

Brojni zakoni, strategije i mere Vlade Srbije odnose se na pitanja samozapošljavanja i preduzetništva. To su pre svega Zakon o zapošljavanju i osiguranju za slučaj nezaposlenosti, zatim Zakon o radu, Zakon o porezu na dohodak građana, i Zakon o privrednim društvima, kao i zakoni koji se odnose na regulisanje socijalnih prava po osnovu radnog ugovora.

Nacionalna služba za zapošljavanje (NSZ) sprovodi programe obuke za preduzetništvo, subvencionise samozapošljavanje, pruža usluge mentoringa i daje subvencije za otvaranje novih radnih mesta, a Privredna komora Srbije ga takođe ohrabruje. Povoljni krediti za digitalno preduzetništvo dostupni su i kroz bankarske kredite

zahvaljujući podršci EBRD, koja ima razvijen paket namenjen ženama i muškarcima frilenserima/paušalcima.

Prema analizama Centra za istraživanje javnih politika, u studiji “Rodna nit digitalnog preduzetništva”¹, grafički su prikazane osnovne prepreke poslovanju preduzetnika paušalaca po kategorijama žena i muškaraca.



Grafikon 4: Prepreke razvijanju poslovanja preduzetnika paušalaca² (Izvor: Centar za istraživanje javnih politika- dostupno na <https://www.publicpolicy.rs>)

Barijere u preduzetništvu karakteristične za oba pola u mnogim slučajevima imaju poseban uticaj na preduzetnice koje su uslovljene malim obimom nepokretnosti na svoje ime, izborom sektora, rodnom diskriminacijom i postojanjem stereotipa, nedovoljno razvijenim sistemom brige o deci, poteškoćama u usklađivanju porodičnih, privatnih i radnih obaveza, ili razlike u stavovima žena i muškaraca prema preduzetništvu.

5. Zaključak

Digitalno preduzetništvo nastalo kao posledica razvoja digitalnih tehnologija i digitalizacije, iz osnova je promenilo sve segmente funkcionisanja i načine poslovanja u delatnostima putem digitalnih platformi. Digitalni rad omogućava klijentima da dopru do radne snage širom sveta u bilo kom trenutku s obzirom da u digitalnom svetu nema fizičkih granica. Digitalno preduzetništvo je omogućeno platformama za rad koje su kao biznis modeli nastale na talasu digitalnih inovacija. i zapravo obavljaju neke od funkcija poslodavca. Ove platforme propisuju procedure za obavljanje posla, deluju kao ekonomski aktivni subjekti koji stiču profit, odlučuju ko i pod kojim uslovima može biti angažovan, odnosno prestati.

Kao nova paradigma poslovanja usled globalizacije tržišta, digitalno preduzetništvo u velikoj meri je sistemski i institucionalno onemogućeno ljudima koji se generalno bave preduzetništvom, i predstavlja izvesnu prepreku da budu uspešni u tome.

¹ <https://publicpolicy.rs/publikacije/510aabc124b560434e2a433e81ca2eaa4ff6013b.pdf>

² <https://publicpolicy.rs/publikacije/510aabc124b560434e2a433e81ca2eaa4ff6013b.pdf>

Glavni problemi razvijanja digitalnog preduzetništva u Srbiji je u tome što je ovaj način poslovanja nedovoljno promovisan kao karijerni put.

Normativni okvir u Srbiji odvojeno prepoznaje značaj digitalizacije i preduzetništva za podsticanje ekonomskog rasta, ali nijedan dokument do sada nije stavio u fokus digitalno preduzetništvo kao takvo. Veoma je važno da kreatori politike razmotre kako regulatorno okruženje utiče na digitalno preduzetništvo. Činjenica je da su postojeći propisi uglavnom primenjeni za nedigitalne industrije i mogu sputavati razvoj digitalnog preduzetništva.

Takođe politika konkurencije je važna za podsticanje inovacija i stvaranja biznisa, posebno u sektoru telekomunikacija koji često olakšava digitalno preduzetništvo. Smanjenjem cena telekomunikacionih proizvoda i usluga sektori telekomunikacija više podstiču usvajanje tehnoloških rešenja u preduzetništvu, omogućavajući veću upotrebu IKT.

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INSTITUTIONAL OPPORTUNITIES FOR FASTER DEVELOPMENT OF DIGITAL ENTREPRENEURSHIP

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Abstract

This paper analyzes the institutional possibilities for marketing digital products and services through digital channels, which represent the potential for the development of digital entrepreneurship. Special emphasis in the research was given to the creation of an institutional infrastructure that will enable digital entrepreneurship to be supported by public opinion, the tax and banking system, as well as the education and health systems in the country.

Acting in the online space, which includes businesses enabled by digital platforms for work, creates concepts relevant to freelancers and digital entrepreneurship. By combining business, knowledge and institutional opportunities, digital entrepreneurs expand the range of business opportunities in creating financial profits, while at the same time strengthening the foundations for creating new institutions and strengthening existing ones, in the sale of digital products and services to the domestic and foreign markets.

In countries with a medium level of development, institutionally supported digital entrepreneurship can create added economic value, enabling flexibility of work, which gives an opportunity for work engagement of a part of the working population that faces structural employment problems.

Keywords: digitization, digital transformation, digital entrepreneurship

RAST I REFORMSKI NAPREDAK TRANZICIONIH DRŽAVA JIE IZMEĐU DVE RECESIJE

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SAŽETAK:

Tranzicione države JIE imale su kratkotrajni predah između dve globalne recesije. Nakon recesije 2020. (prosečan pad država JIE -5%), usledio je period rasta u 2021. (7%) i 2022. (4%), da bi se procene rasta za 2023. kretale oko 1%. Ekonomske posledice globalnog potresa izazvanog ratom u Ukrajini su ubrzan rast cena energije i hrane, lanci snabdevanja se prekidaju, dugovi kompanija rekordno rastu kao rezultanta prethodno uzetih povoljnih zajmova. S obzirom da su u sukob u Ukrajini involvirane brojne države, posledice će biti globalne i dugotrajne. Istraživanje u radu je usmereno na analizu rasta i reformskog napretka tranzicionih ekonomija JIE između dve globalne recesije, sa glavnom hipotezom da snažan privredni rast u tranzicionim ekonomijama JIE u 2021. nije doprineo rešavanju ključnih višegodišnjih strukturnih problema u poslovanju privrede. Poseban akcenat je usmeren na analizu rasta duga tranzicionih država JIE. Metodološki instrumentarijum je baziran na strukturnoj i dinamičkoj makroekonomskoj analizi rasta.

Ključne riječi: *postpandemijski rast JIE, rast duga, reformski napredak, konvergencija produktivnosti, rizici.*

1. UVOD

*‘Postoji jaka sinergija strukturnih reformi na rast. Interakcije između reformi kroz strukturne oblasti su često komplementarne.’
(Ari, Pula & Sun, IMF, WP/22/184)*

Nakon globalne recesije 2020. izazvane pandemijom COVID-19, usledila je početkom 2022. nova globalna kontrakcija rasta izazvana ratom u Ukrajini. Privrede se suočavaju sa ubrzanim rastom cena energije i hrane, lanci snabdevanja se prekidaju, dugovi kompanija rekordno rastu. Efekti globalnih recesija usporavaju strukturne reforme u tranzicionim ekonomijama, sve teže je odgovoriti izazovu ‘strukturne transformacije’, odnosno usmeriti resurse u moderne visokoproduktivne delatnosti [3].

Problem koji se analizira u radu je sporost u sprovođenju strukturnih reformi u godini snažnog rasta, posebno imajući u vidu da istraživanja pokazuju da se kumulativni uticaj strukturnih reformi na rast u periodu od 5 godina kreće u intervalu od 2,5-6,5 p.p. u zavisnosti od strukturne oblasti [1].

Predmet istraživanja u radu je analiza rasta i strukturnih reformi tranzicionih država JIE u godini snažne ekspanzije (2021.), odnosno u godini predaha između dve globalne recesije. Cilj istraživanja je sagledavanje stepena međuzavisnosti rasta na sprovođenje strukturnih reformi u poslovanju privrede. Istraživanje u radu testira sledeću hipotezu:

H1: Snažan privredni rast u tranzicionim ekonomijama JIE u 2021. nije doprineo rešavanju ključnih višegodišnjih strukturnih problema u poslovanju privrede;

Takođe, u radu se testiraju i pomoćne hipoteze:

H2: Ključna posledica svake recesije je dužnička kriza, odnosno rast javnog duga;

H3: Konvergencija produktivnosti tranzicionih država ka prosečnoj produktivnosti u EU je brža u godinama kada je rast BDP veći od od rasta zaposlenosti.

Metodološki instrumentarijum u radu se bazira na komparativnoj i dinamičkoj makroekonomskoj analizi tranzicionih ekonomija JIE. Rad je strukturiran u četiri celine: u *prvoj* je prikazana komparativna analiza rasta i javnog duga u tranzicionim ekonomijama JIE, u *drugoj* su dati rezultati analize konvergencije produktivnosti u tranzicionim državama za prosekom EU, *treća* je fokusirana na reformski napredak tranzicionih ekonomija, dok je su *na kraju* prikazani ključni rizici rasta u narednom periodu.

2. EKSPANZIJA RASTA U 2021.- GLOBALNI, EU I REGIONALNI NIVO

Nakon globalne recesije u 2020. izazvane posledicama pandemije COVID-19, ekonomski izgledi tokom cele 2021. su bili povoljni: produžena i snažna faza ekspanzije, situacija sa pandemijom se popravljala, većina logističkih problema i uskih grla u snabdevanju bila je otklonjena, tržišta rada su registrovala poboljšanja, uslovi finansiranja su bili povoljni [5].

Snažnom globalnom rastu u 2021. od 6% najviše su doprinele zemlje u razvoju (rast od 6,3%), od kojih je dominirao rast u Indiji (8,3%) i Kini (8,1%). Ekspanzija 2021. uticala je i na strukturna pomeranja globalnog rasta: smanjeno je učešće razvijenih država u globalnom BDP (sa 46,8% na 45,6%), SAD (sa 15,9% na 15,7%), EU (sa 15,4% na 14,8%), Japana (sa 4,1% na 3,8%) i Velike Britanije (sa 2,4% na 2,3%); dok je sa druge strane povećano učešće najrazvijenije svetske ekonomije Kine (sa 17,3% na 18,6%).

Tabela 1. Globalni rast 2019-2021 i prognoza 2022-2024.

	% učešće u svetskom BDP (PPS)		Međugodišnje stope BDP (%)			Prognoza rasta BDP-a		
	2019	2021	2019	2020	2021	2022	2023	2024
Svet	100,0	100,0	2,8	-3,2	6,0	3,1	2,5	3,1
Razvijene zemlje	46,8	45,6	1,8	-4,1	5,6	2,7	0,9	1,8
SAD	15,9	15,7	2,3	-2,8	5,9	1,8	0,7	1,7
EU-27	15,4	14,8	1,8	-5,7	5,4	3,3	0,3	1,6
Evrozona	12,5	12,0	1,6	-6,1	5,3	3,2	0,3	1,5
Japan	4,1	3,8	-0,4	-4,6	1,7	1,7	1,6	1,2
Velika Britanija	2,4	2,3	1,6	-11,0	7,5	4,2	-0,9	0,9
Zemlje u razvoju	53,2	54,3	3,6	-2,5	6,3	3,4	3,8	4,3
Kina	17,3	18,6	6,0	2,2	8,1	3,4	4,5	4,7
Indija	7,1	7,0	4,5	-6,6	8,3	6,9	6,0	6,3

Ruska Federacija	3,1	3,1	2,2	-2,7	4,7	-5,1	-3,2	0,9
Zemlje kandidati za EU	2,0	2,2	1,0	1,5	10,5	4,8	3,4	3,0

Izvor: EC, European Economic Forecast, Autumn 2022 (novembar 2022).

Evropska unija je suočena sa najvećim izazovima, kako zbog energetske zavisnosti od uvoza fosilnih goriva, tako i zbog svoje sve veće uključenosti u Ukrajinsku krizu. Sve ekonomije EU su suočene sa oštrom erozijom kupovne moći domaćinstava i padom poverenja u poslovni sektor, zbog sve većih troškova proizvodnje, uskih grla u snabdevanju i sve strožijih uslova finansiranja. Fiskalni deficit i javni dug su se značajno povećali tokom globalne pandemije 2020. i 2021. zbog kontinuiranih mera podrške, u 2023. se ne očekuje njihov dalji rast. U svim velikim EU ekonomijama je budžetski deficit oko -5% BDP u 2022., osim u Nemačkoj (-2,6% BDP).

Tabela 2. Tranzicione ekonomije EU: rast, kupovna moć i prognoza rasta

	BDP (PPS)/st (EU-27=100)			BDP (mg stope, %)			Prognoza rasta BDP (mg stope, %)		
	2019	2020	2021	2019	2020	2021	2022	2023	2024
Češka Rep.	93,2	92,8	91,0	3,0	-5,5	3,5	2,5	0,1	1,8
Slovenija	88,6	88,6	90,1	3,5	-4,3	8,2	6,2	0,8	1,7
Mađarska	73,0	74,2	75,5	4,0	-4,0	7,6	3,1	1,1	2,4
Rumunija	69,5	72,1	72,9	4,9	-4,5	7,1	5,5	0,1	2,6
Hrvatska	66,4	64,3	69,8	3,4	-8,6	13,1	6,0	1,0	1,7
Slovačka Rep.	69,8	70,8	69,0	2,5	-3,4	3,0	1,9	0,5	1,9
Bugarska	53,2	54,9	57,7	4,0	-4,0	7,6	3,1	1,1	2,4
Crna Gora	50,1	44,5	47,4	4,1	-15,3	13,0	7,0	2,9	3,2
Srbija	40,9	42,5	44,2	4,3	-0,9	7,5	2,7	2,4	3,0
Sev. Makedonija	38,1	37,2	42,0	3,9	-6,1	4,0	2,3	2,5	2,8
Albanija	30,4	30,3	32,2	2,1	-3,5	8,5	3,2	2,6	3,4

Izvor: EC, European Economic Forecast, Autumn 2022 (novembar 2022).

Snažan rast ostvarile su sve tranzicione ekonomije Evrope u 2021: prosečan rast je bio iznad 7%, osim u Slovačkoj i Češkoj Republici. U 2022. rast u tranzicionim ekonomijama je bio dosta heterogen (od 1,9% u Slovačkoj Rep., pa do iznad 6% u Sloveniji, Hrvatskoj i Crnoj Gori). U 2023. u razvijenim tranzicionim državama faktički se i ne očekuju rast, dok se u državama kandidatima očekuje rast od oko 2,5% [10].

3. POSLEDICE GLOBALNE RECESIJE 2020. I KONTRAKCIJE 2022.

Analiza posledica svih ratova u poslednja dva veka pokazuje da BDP per capita opada najmanje za 9%, pa do 40-70% u najštetnijim ratovima, a da državni dug u proseku raste za 47 p.p. BDP [4]. Ali, podatak koji je još više zabrinjavajući je da su varijacije oporavka od ratova još veće: u 29% ratnih sukoba BDP per capita se vraća na predratni nivo za 5 godina, ali u skoro 50% svih ratnih sukoba BDP per capita ostaje ispod predratnog nivoa i posle 25 godina. Najteža trajna posledica ratova je gubitak ljudskog kapitala: čak i 25

godina kasnije, populacija u državama pogođenih ratom je obično znatno manja od stanovništva zemalja poređenja koje nisu imale ratne sukobe (broj žrtava, odliv izbeglica i opadajuća stopa nataliteta). Dosta relevantne demografske procene pokazuju da će do kraja 2022. broj prisilno raseljenih u svetu premašiti 100 miliona ljudi, 2/3 su iz Sirije, Ukrajine, Zapadne obale i Gaze, Venecuele i Avganistana, od čega su skoro polovina deca. Interesantno je, da se trećina izbeglica nalazi u 35 tranzicionih država. Trenutno su izbeglice iz Ukrajine povećale radnu snagu EU za 0,5%, od ukupnog broja izbeglica 30% je već zaposleno u evropskim državama, što je znatno ublažilo hronični nedostak radne snage u državama EU.

Dve najveće ekonomske posledice globalnih recesija iz 2020. i aktuelne iz 2022. su sve učestaliji prekidi globalnih lanaca snabdevanja i rast duga. Imajući u vidu da trgovina intermedijarnim proizvodima čini oko polovinu ukupne globalne trgovine, tranzicione ekonomije su, u proseku, više upletene u globalne lance snabdevanja nego tipične zemlje sa srednjim prihodima. Dug preduzeća je na rekordnom nivou u svim tranzicionim ekonomijama. Kao rezultanta toga je rast tzv. *zombi firmi* - to su zadužene kompanije koje su u finansijskim problemima, ali izbegavaju izvršenje obaveza zahvaljujući svom kontinuiranom pristupu jeftinom finansiranju (subvencionisani krediti, najčešće preko državnih banaka), što se direktno preliva na zdrave firme. Negativna preliivanja poslovanja zombi firmi su posebno izražena duž lanca vrednosti, jer dovode do poremećaja globalnog lanca snabdevanja.

Ekonomske posledice recesije iz 2022., za razliku od globalne recesije iz 2020., teško je vremenski predvideti i proceniti. Inflacioni pritisci su sve veći, i nalaze se pod snažnim pritiscima u prvom redu cena energije i hrane. EU je suočena sa najvećim izazovima, kako zbog energetske zavisnosti od uvoza fosilnih goriva, tako i zbog svoje sve veće uključenosti u Ukrajinsku krizu. To će otežati realizaciju proklamovanog cilja EU da će do 2050. postati klimatski neutralna ekonomija, i povećati jaz u postizanju kompromisa između individualnih ciljeva blagostanja jedne zemlje i zajedničkih ciljeva EU [9].

Tabela 3. Trend učešća javnog duga u BDP u tranzicionim državama Evrope (%)

	2019	2020	2021	2022 (proгноza)
Mađarska	65,3	79,3	76,8	76,4
Crna Gora	76,5	105,3	82,5	75,5
Hrvatska	71,0	87,0	78,4	70,0
Slovenija	65,4	79,6	74,5	69,9
Albanija	65,8	74,5	73,2	69,4
Slovačka Republika	48,0	58,9	62,2	59,6
Srbija	52,8	58,6	57,1	55,2
Sev. Makedonija	40,5	51,9	51,8	51,4
Rumunija	35,1	46,9	48,9	47,9
Češka Republika	30,0	37,7	42,9	42,9
Bugarska	22,5	23,6	25,6	25,1

Izvor: EC, European Economic Forecast, Autumn 2022 (novembar 2022).

Ključna makroekonomska refleksija globalnih recesija je rast javnog duga, sa čijim posledicama će se suočiti sve države u razvoju u narednoj deceniji. S obzirom da se mnogo toga promenilo od načela zdravih finansija iz Ugovora iz Mاستrihta (rast duga i deficita, novi izazovi energetske i digitalne tranzicije), Evropska komisija je usvojila novi *referentni put fiskalnog prilagođavanja* (novembar 2022.), koji bi pokrивao period od 4 godine, na osnovu svoje metodologije analize održivosti duga. Cilj je jačanje održivosti duga i unapređenje održivog i inkluzivnog rasta kroz investicije i reforme, kako bi se dug u visoku i srednje zaduženim zemljama smanjio i kako bi deficit bio ispod referentne vrednosti od 3% BDP-a. Kamen temeljac *novog referentnog puta fiskalnog prilagođavanja* su nacionalni srednjoročni fiskalno-strukturni planovi država članica koji su usidreni u ovom konceptu i koji bi integrisali fiskalne, reformske i investicione ciljeve i prioritete, uključujući i one za rešavanje makroekonomskih neravnoteža. Države članice bi imale veće slobode u određivanju svog puta fiskalnog prilagođavanja, dok bi sa druge strane Komisija kontinuirano i transparentno pratila sprovođenje planova i kroz strožije instrumente nadzora ukazivala i finansijski sankcionisala prekomerne deficite (dug iznad 60% BDP) država članica.

4. KONVERGENCIJA PRODUKTIVNOSTI TRANZICIONIH DRŽAVA

Od rasta produktivnosti zavisi rast životnog standarda. Konvergencija produktivnosti (efekat sustizanja) tranzicionih država za prosekom EU je spora, konstantno je prisutan veliki jaz u produktivnosti tranzicionih država za prosekom EU [6]. Zbog efekata globalne pandemije u 2020, realna produktivnost u EU-27 (prosek) u periodu 2014–2021. porasla je za svega 4%, ali je životni standard porastao za 10%. Tranzicione države imale su visok stepen konvergencije životnog standarda u odnosu na prosek EU-27 u periodu 2014–2021, prema proseku EU najviše su konvergirale Rumunija, Srbija i Hrvatska, koje su ostvarile tri puta brži rast BDP/st od prosečnog u EU-27 (kumulativni rast u Rumuniji 33%, u Srbiji 30%, u Hrvatskoj 32%). Konvergencija produktivnosti je niža od konvergencije životnog standarda. Najveća konvergencija produktivnosti je registrovana u Rumuniji (kumulativan rast od 28%) i Bugarskoj (20%). Uticaj produktivnosti na rast životnog standarda je različit u tranzicionim državama, pre svega u zavisnosti od strukture njihovih privreda. U Rumuniji je 2021. prosečan godišnji rast produktivnosti od 1% generisao 1,2% rast životnog standarda, u Srbiji je taj odnos 1:4, u Mađarskoj 1:2,32; u Slovačkoj 1:1,81; Bugarskoj 1:1,34 i Sloveniji 1:2,21.

Dinamička komparativna analiza produktivnosti u tranzicionim državama po potperiodima pokazuje da su najveće stope produktivnosti tranzicione države imale u potperiodima u kojima je rast zaposlenosti bio u senci snažnog privrednog rasta.

Tabela 4. Produktivnost u tranzicionim državama po potperiodima 2015–2021. (%)

2015–2019	2020–2019	2021–2020	2015–2021
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BDP	Zap.	Produkti- vnost		BDP	Zap.	Produkti- vnost		BDP	Zap.	Produkti- vnost		BDP	Zap.	Produkti- vnost	
EU 27		11,5	6,6	4,6	-5,7	-1,4	-4,3	5,4	1,4	3,9		10,8	6,5	4,0	
Bugarska		16,9	2,9	13,8	-4,0	-2,3	-1,7	7,6	0,2	7,4		20,8	0,8	20,1	
Hrvatska		16,7	9,9	6,0	-8,6	-1,2	-7,5	13,1	1,2	11,7		20,6	9,9	9,5	
Mađarska		22,2	11,7	9,1	-4,5	-1,1	-3,5	7,1	1,0	6,0		25,0	11,6	11,6	
Rumunija		26,5	0,2	26,2	-3,7	-2,1	-1,7	5,1	1,8	3,2		28,1	-0,2	28,0	
Slovenija		19,5	12,2	6,5	-4,3	-0,7	-3,7	8,2	1,3	6,8		23,8	12,9	9,5	
Slovačka		17,6	10,0	7,1	-3,4	-1,9	-1,5	3,0	-0,6	3,6		17,0	7,2	9,2	
Srbija		17,0	13,3	3,3	-0,9	-0,2	-0,7	7,5	2,6	4,9		24,7	16,1	7,6	

Izvor: Autor na osnovu podataka Eurostata.

5. REFORMSKI NAPREDAK TRANZICIONIH DRŽAVA JIE

5.1. Kreditni rejting tranzicionih evropskih država u 2022.

U 2022. sve tri najrenomiranije rejting agencije nisu menjale kreditne rejtinge tranzicionih država u regionu. Na primeru Srbije *Standard and Poor's* nije menjao kreditni rejting Srbije (BB+) u 2022. i 2023. ističući stabilne izgleda za njegov dalji rast kao rezultantu kontinuirane makroekonomske stabilnosti, visokog nivoa deviznih rezervi i uređenih javnih finansija. Fiskalni prostor za krizne intervencije (pandemija, energetska kriza) stvoren je zahvaljujući smanjenju javnog duga u prethodnom periodu. *Fitch Ratings* je takođe potvrdio kreditni rejting Srbije (BB+) sa stabilnim izgledom za dalje poboljšanje, potencirajući odgovorno vođenje ekonomske politike u ranijem periodu. Agencija *Moody's* je u martu 2021. povećala kreditni rejting Republike Srbije sa Ba3 na Ba2, uz stabilne izgleda za dalje poboljšanje, naglasivši otpornost privrede na recesione udare i fiskalnu održivost.

Tabela 5. Kreditni rejting tranzicionih država u 2022.

	Standard and Poor's	Fitch Ratings	Moody's	Rang (1–100)
Češka Rep.	AA-	AA-	Aa3	85
Slovačka Rep.	A+	A	A2	76
Slovenija	AA-	A	A3	75
Poljska	A-	A-	A2	71
Bugarska	BBB	BBB	Baa1	61
Hrvatska	BBB-	BBB	Ba1	60
Mađarska	BBB	BBB	Baa2	60
Rumunija	BBB-	BBB-	Baa3	55
Srbija	BB+	BB+	Ba2	48
Makedonija	BB-	BB+	-	45

Crna Gora	B	-	B1	35
Albanija	B+		B1	35
BiH	B	-	B3	27

Izvor: Standard and Poor's, Fitch Ratings i Moody's.

Nijedna država kandidat za članstvo u EU nema kreditni rejting „*investicioni nivo*“, za razliku od svih ostalih tranzicionih država članica EU koje imaju taj status, što je izuzetno bitno, jer potencijalni investitori prate rejtinge zbog stepena rizika prilikom donošenja investicionih odluka, a sa druge strane, rejting države utiče na kreditne rejtinge drugih izdavalaca hartija od vrednosti u konkretnoj državi.

5.2. Reformski napredak (EBRD)

Efekti globalnih recesija se odražavaju na usporavanje strukturnih reformi u svim tranzicionim ekonomijama. Dok je u oblastima konkurentnosti, otpornosti, inkluzije i ekonomskim integracijama primećen blag stepen konvergencije [2], u oblasti životne sredine sve je jača *divergencija između zelenih i manje zelenih ekonomija*.

Koncept „merjenja“ stepena i kvaliteta preduzetih reformi, tokom proteklih više od tri decenije, Evropska banka za obnovu i razvoj (EBRD) kontinuirano je unapređivala kvalitetnim informacijama, izveštajima i tranzicionim indikatorima, koji su sadržali godišnju ocenu napretka u tranziciji, ukazivali na osnovna ograničenja, na značaj prelaska na otvorenu tržišnu privredu i koji su promovisali preduzetništvo i privatizaciju. Poslednja suštinska konceptualna metodološka promena (2019) fokus je usmerila na „merenje“ šest ključnih dimenzija reformi: (1) konkurentnost, (2) dobro upravljanje, (3) ekološka orijentisanost („zeleni“ ekonomija), (4) inkluzivnost, (5) otpornost i (6) integrisanost (i interno i sa susednim tržištima i sa globalnom privredom).

Za ceo region JIE najveći reformski izazovi predstavljaju problemi inkluzije (mladi ljudi imaju nedovoljan pristup poslu, migracioni tokovi). Pored toga, ekonomski rast može da se ostvari samo ukoliko je inkluzivan, u smislu većeg uključivanja žena, mladih talenata i sl., kao i jačanja rodne ravnopravnosti na radnom mestu.

Tabela 6. Vrednost tranzicionih indikatora EBRD 2021-2022.

	Konkurentnost		Dobro upravljanje		Zelena ekonomija		Inkluzivnost		Otpornost		Integrisanost		Prosek	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Češka Rep.	6,77	6,79	7,30	7,32	6,90	7,14	6,87	6,97	7,48	7,48	8,11	7,98	7,24	7,28
Slovenija	6,29	6,32	7,31	7,24	7,05	7,29	6,97	7,06	7,44	7,46	7,23	7,25	7,05	7,10
Poljska	6,32	6,33	6,92	6,88	6,58	6,82	6,89	6,81	7,62	7,62	6,94	6,96	6,88	6,90
Slovačka Rep.	6,43	6,44	6,35	6,35	7,05	7,29	6,54	6,55	7,50	7,51	7,28	7,22	6,86	6,89
Mađarska	6,38	6,39	6,04	5,97	6,41	6,65	5,88	5,95	6,88	6,97	7,73	7,79	6,55	6,62
Hrvatska	5,69	5,71	6,08	6,08	6,52	6,76	6,82	6,76	6,54	6,54	6,39	6,55	6,34	6,60
Rumunija	6,27	6,33	6,20	6,18	6,20	6,44	5,95	5,92	6,59	6,59	6,35	6,34	6,26	6,30
Bugarska	5,55	5,57	6,17	6,12	6,22	6,46	5,59	5,61	5,94	5,94	6,74	6,71	6,04	6,07
Crna Gora	5,54	5,46	6,31	6,32	5,53	5,57	5,35	5,37	5,43	5,38	6,12	6,06	5,71	5,69
Srbija	5,47	5,49	5,94	5,90	5,38	5,51	5,36	5,39	5,03	5,03	6,13	6,24	5,55	5,59

S.Makedonija	5,22	5,19	5,43	5,47	5,15	5,56	4,90	4,92	5,13	5,15	5,84	5,83	5,28	5,35
Albanija	5,16	5,16	4,71	4,62	4,76	4,76	5,07	5,08	4,45	4,46	5,45	5,47	4,93	4,93
BiH	4,82	4,83	4,16	4,10	4,98	5,20	4,86	4,96	4,94	4,94	5,01	5,03	4,80	4,84

Izvor: EBRD Transition report 2022-23.

Tranzicione ekonomije Češke Republike, Slovačke Republike, Mađarske, Srbije i Rumunije su zabeležile rast vrednosti indeksa konkurentosti, dok je pad registrovan u Poljskoj, Sloveniji i Hrvatskoj.

6. OČEKIVANJA I RIZICI RASTA U EU I U TRANZICIONIM DRŽAVAMA

Ključni eksterni rizici rasta u 2023. su veliki stepen neizvesnosti završetka rata u Ukrajini, nepredvidivost cena energetskih inputa i rizici od velikih nestašica. Veliki rizik je i formiranje spirale plata i cena koja bi učvrstila visoku inflaciju [7] i potencijalno neuredno prilagođavanje finansijskih tržišta novom okruženju visokih kamatnih stopa. Takođe, značajan rizik dolazi od negativnog uticaja klimatskih promena.

Evropska komisija očekuje da će se kontrakcija rasta nastaviti i u 2023. Prognoza za EU za 2023. je dosta pesimistička, minimalni rast od 0,3%, dok bi prosečna inflacija ostala visoka (7,0% u EU). Ekonomija bi se, prema očekivanjima EK, stabilizovala tek u 2024. – inflacija bi se smanjila na 3% u EU i 2,6% u evrozoni, dok bi rast iznosio 1,6%:

- Očekuje se da će *inflacija energenata rasti do kraja godine, da bi počela da opada sledeće godine. Paralelno, očekuje se pad cena hrane. Pošto je energija ključni input za rast privrede, očekuje se preliivanje inflacije na rast plata;*
- *U borbi sa inflacionim pritiscima, očekuje se i dalje oštra monetarna politika, odnosno rast referentne kamatne stope i u 2023;*
- *Fiskalna politika neće moći da kompenzuje veliki gubitak realnog raspoloživog dohotka domaćinstava i u 2023;*
- Ne očekuje se *porast privrednih bankrota;*
- *Očekuje se da će slabost u spoljnom okruženju EU opstati, a predviđa se da će neto izvoz neznatno doprineti rastu u 2023. i 2024.*

Tabela 7. Najveći rizici u naredne dve godine (WEF)

Zemlja	Rizik 1	Rizik 2	Rizik 3	Rizik 4	Rizik 5
BiH	Ekološka šteta Produžena stagnacija	ek.	Krize zapošljavanja i sr za život	Digitalna nejednakost Razočaranje mladih	-
Bugarska	Ekološka šteta	Zarazne bolesti	Međudržavni sukob	Dužničke krize u vel. ek. Krize zapošljavanja	-
Hrvatska	Produžena stagnacija	ek. Geopolitizacija strateških resursa	Digitalna nejednakost	Ekološka šteta	Razočaranje mladih

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Češka Rep.	Dužničke krize u velikim ek.	Kolaps ključnih industrijskih grana	Pucanje balona imovine u velikim ek.	Zarazne bolesti	Nemogućnost suzbijanja rasta cena
Mađarska	Nemogućnost suzbijanja rasta cena	Ekstremne prirodne nepogode	Neuspeh klimatskih akcija	Zarazne bolesti	Lom međudržavnih odnosa
Crna Gora	Krize zapošljavanja	Lom međudrž. odnosa	Produžena ek. stagnacija	Digitalna nejednakost	Ekološka šteta
Severna Makedonija	Ekološka šteta	Nedostatak javne infrastrukture	Dužničke krize u velikim ek.	Produžena ek. stagnacija	Digitalna nejednakost
Rumunija	Ekološka šteta	Krize zapošljavanja i sr. za život	Dužničke krize u velikim ek. Migracije	-	Geopolitizacija strateških resursa
Srbija	Ekološka šteta	Dužničke krize u velikim ek.	Krize zapošljavanja	Digitalna nejednakost	Geopolitizacija strateških resursa
Slovačka	Kolaps ključnih industrijskih grana	Kolaps sistema soc. sigurnosti	Dužničke krize u velikim ek. Ekološka šteta	-	Digitalna nejednakost
Slovenija	Veliki prekidi u GVC (globalnim lancima vrednosti)	Geopolitizacija strateških resursa	Pucanje balona imovine u velikim ek.	Ekstremne nepogode Ekološka šteta	-

Izvor: WEF, The Global Risks Report 2022. Napomena: Anketa je sprovedena u 124 države između maja i septembra 2021, više od 12.000 lidera je izabralo 5 najvećih rizika od 35 ponuđenih, u slučaju da su dva rizika dobila podjednak broj glasova, sledeći rizik ostaje prazan (-).

- **Očekivanja su da će tržište rada ostati stabilno. Stope nezaposlenosti su rekordno niske, a stope zaposlenosti rekordno visoke. Rast zarada se povećao na iznadprosečne stope u 2022, i očekuje se dalji rast, ali ispod inflacije u 2023;**
- **Predviđa se dalji pad budžetskih deficita, uprkos novim merama usvojenim za ublažavanje uticaja porasta cena energije na domaćinstva i preduzeća. Nakon pada na 4,6% BDP-a u 2021, predviđa se da će deficit na centralnom nivou u EU opasti za više od 1 p. p. u 2022;**
- **U 2024. predviđa se vraćanje ukupnog deficita u EU na 3,2%, zahvaljujući projektovanom podsticanju privrednog rasta. Odnos duga prema BDP-u bi pao sa 89,4% BDP-a u 2021. na 84,1% BDP-a u 2024.**

7. ZAKLJUČAK

Za tranzicione ekonomije JIE 2021. godina je bila jedna od najuspešnijih tranzicionih godina. Prosečna stopa rasta je iznosila iznad 7%. Međutim, snažna ekspanzija rasta u 2021. bila je kratkotrajna, početkom 2022. sve ekonomije suočile sa novim izazovima i rizicima izazvanim nesagledivim posledicama rata u Ukrajini [10, 5]. S obzirom da su u sukob u Ukrajini involvirane brojne države, posledice će biti globalne i dugotrajne sa nizom poznatih 'starih' rizika, za koje smo mislili da su relikv prošlosti: inflacija [8], kriza

troškova života, trgovinski ratovi, odlivi kapitala sa tržišta u razvoju, široko rasprostranjeni društveni nemiri, eskalacija geopolitičkih konfrontacija.

Istraživanje je potvrdilo i glavnu i sve pomoćne hipoteze u radu:

- U godini snažnog rasta rešavanje višegodišnjih ključnih strukturnih problema u privredi je ostalo u senci, njihovo rešavanje je prolongirano za naredni period (glavna hipoteza H1). To se posebno odnosi na reforme u oblasti zelene ekonomije i konkurentnosti;
- Analiza javnog duga u tranzicionim ekonomijama JIE u 2020. i 2022. potvrdila je hipotezu da je posledica svake recesije rast javnog duga (pomoćna hipoteza H2);
- Komparativna strukturna analiza konvergencije produktivnosti ka prosečnoj produktivnosti u EU u tranzicionim ekonomijama potvrdila je hipotezu da je konvergencija brža u onim godinama kada je rast BDP brži od rasta zaposlenosti (pomoćna hipoteza H3).

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GROWTH AND REFORM PROGRESS OF THE TRANSITIONAL COUNTRIES OF SEE BETWEEN TWO RECESSIONS

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ABSTRACT:

The transition states of SEE had a brief respite between two global recessions. After the recession in 2020 (average decline of SEE countries -5%), a period of growth followed in 2021 (7%) and 2022 (4%), so that growth estimates for 2022 would hover around 1%. The economic consequences of the global upheaval caused by the war in Ukraine are the accelerated growth of energy and food prices, supply chains are being interrupted, company debts are growing at a record high as a result of previously taken favorable loans. Since numerous countries are involved in the conflict in Ukraine, the consequences will be global and long-lasting. The research in the paper is focused on the analysis of the growth and reform progress of the transition economies of SEE between two global recessions, with the main hypothesis that the strong economic growth in the transition economies of SEE in 2021 did not contribute to solving the key multi-year structural problems in the business of the economy. A special emphasis is focused on the analysis of debt growth in the transition states of SEE. The methodological instrumentation is based on structural and dynamic macroeconomic analysis of growth.

Keywords: *post-pandemic growth of SEE, debt growth, reform progress, productivity convergence, risks.*

EMPIRIJSKA ANALIZA DOHODOVNE KONVERGENCIJE EVROPSKIH TRANZICIONIH EKONOMIJA KA EU-15

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SAŽETAK:

Nakon otpočinjanja procesa tranzicije, jedno od glavnih očekivanja evropskih tranzicionih ekonomija je bilo da će izgradnja tržišne ekonomije i integracija u Evropsku uniju (EU) voditi povećanju životnog standarda i sustizanju dohotka po stanovniku razvijenih evropskih zemalja. Stoga, pitanje konvergencije, odnosno mogućnosti smanjenja ekonomske nejednakosti ključno je kako za postojeće članice EU, tako i za zemlje koje nameravaju da postanu njen sastavni deo. Predmet ovog rada je analiza konvergencije dohotka po glavi stanovnika tranzicionih zemalja koje su pristupile EU (CEE-11) i zemalja Zapadnog Balkana prema dohotku ostvarenom u razvijenim zemalja EU (EU-15) u periodu od 1996. do 2020. godine. U cilju testiranja postojanja konvergencije korišćen je panel regresioni model. Rezultati regresionog panel modela pokazuju da ne postoji dugoročna konvergencija dohotka evropskih tranzicionih ekonomija u periodu od 1996. do 2020. godine i u postkriznom periodu od 2009. do 2020. godine. S druge strane, u predkriznom periodu, od 1996. do 2008. godine, postoji sustizanje dohotka razvijenih ekonomija EU-15 i smanjenje razlika u razvijenosti između evropskih tranzicionih ekonomija, s jedne strane i razvijenih ekonomija EU, s druge strane.

Ključne reči: konvergencija dohotka, ekonomski razvoj, evropske tranzicione ekonomije, evropska ekonomska integracija

1. Uvod

Nakon perioda stagnacije tokom sedamdesetih i početkom osamdesetih godina, tokom poslednje tri decenije ekonomski rast je ponovo zauzeo važno mesto u ekonomskoj literaturi. Nakon značajnog interesovanja tokom četrdesetih, pedesetih i šezdesetih godina prošlog veka, kada su i postavljeni temelji neoklasične teorije rasta, u sedamdesetim godinama se smanjuje interesovanje za istraživanje rasta. Pad interesovanja posledica je ekonomskih dešavanja u svetu, gde je do tada stabilan rast zamenjen nestabilnošću uzrokovanom inflacijom, naftnom krizom i porastom nezaposlenosti. Zbog toga, je tokom sedamdesetih godina akcenat bio više na obeležjima ekonomskih kretanja u kratkom i srednjem roku (poslovnim ciklusima), dok su pitanja koja se odnose na faktore koji dugoročno determinišu ekonomski rast stavljena u drugi plan. Međutim, pojavom nove

teorije rasta i poboljšanim uslovima za testiranje različitih pretpostavki i teorija oličenih u većem kvalitetu i dostupnosti podataka, krajem osamdesetih i početkom devedesetih godina ponovo raste interesovanje za pitanje ekonomskog rasta.

Jedno od važnih makroekonomskih pitanja tokom proteklih decenija jeste da li među zemljama postoji konvergencija – definisana kao proces smanjivanja razlika u dohotku *per capita* tokom vremena, odnosno da li siromašne zemlje mogu sustići bogate u pogledu životnog standarda. Povećano interesovanje makroekonomista za pitanje konvergencije i faktore koji je određuju rezultat je većeg interesovanja za ekonomski rast i njegove determinante. Ekonomski i rast i konvergencija jedna su od najistraživanijih oblasti u ekonomiji, jer dugoročni rast determiniše blagostanje zemlje (Atilla, 2012). Testiranje hipoteze o postojanju konvergencije značajno je ne samo sa stanovišta relevantnosti pitanja o sustizanju zemalja različitog nivoa razvijenosti, već i zbog utvrđivanja valjanosti dva alternativna teorijska modela ekonomskog rasta: neoklasičnog modela, sa jedne strane i modela endogenog rasta, sa druge strane (Islam, 2003). Prema neoklasičnom modelu rasta (Solow, 1956) konvergencija postoji, dok novije teorije rasta, tzv. teorije endogenog rasta (Romer, 1986; Lucas, 1988) odbacuju pretpostavku o postojanju konvergencije. Brži rast siromašnih u odnosu na bogate zemlje i smanjenje dispariteta u dohotku *per capita* u neoklasičnom modelu rasta posledica je opadajućih prinosa na kapital budući da je marginalni proizvod kapitala u siromašnijim zemljama sa manjim dohotkom po stanovniku veći u odnosu na bogate regione sa većim obimom kapitala po stanovniku (Cherodian & Thirwall, 2015). Dohodak *per capita* zemalja konvergira ka različitim ravnotežnim stanjima (uslovna konvergencija) ili ka zajedničkom ravnotežnom stanju (apsolutna konvergencija), nezavisno od inicijalnog nivoa dohotka. Razlike u ravnotežnom dohotku među zemljama odražavaju razlike u stopi štednje, stopi rasta populacije i stopi depresijacije kapitala (Miller & Upadhuay, 2002). Zagovornici novih, odnosno endogenih teorija o rastu odbacuju pretpostavku o opadajućim prinosima i bržem rastu siromašnih u odnosu na bogate zemlje i ističu da su prinosi ili konstantni ili rastući. Zbog rastućih prinosa proizvodna aktivnost će biti koncentrisana u određenom broju zemalja i intenziviraće se nejednakosti u razvijenosti, odnosno doći će do divergencije između zemalja. Osim različitih predviđanja u pogledu konvergencija, različite su i preporuke za vođenje regionalne politike (Hofer & Wörgötter, 1997).

Predmet ovog rada je analiza konvergencije dohotka po glavi stanovnika tranzicionih zemalja koje su pristupile EU (CEE-11) i zemalja Zapadnog Balkana prema dohotku ostvarenom u razvijenim zemalja EU (EU-15) u periodu od 1996. do 2020. godine. U skladu sa definisanim predmetom istraživanja, cilj rada jeste da se na bazi teorijske i empirijske analize ispita da li evropske tranzicione zemlje (zemlje CEE-11 i Zapadnog Balkana) konvergiraju ka dohotku *per capita* razvijenih zemalja EU-15. Saglasno opredeljenom predmetu i cilju istraživanja, hipoteza koja se testira u radu glasi: Među zemljama CEE-11 i Zapadnog Balkana s jedne strane, i EU-15 s druge strane postoji konvergencija dohotka.

Struktura rada prati standardnu strukturu naučnog rada. U uvodnom delu je dat predmet i cilj istraživanja, i teorijski osvrt na dva alternativna modela ekonomskog rasta i njihovo shvatanje konvergencije dohotka. Pregled literature sumira radove koji su ispitivali

konvergenciju dohotka u evropskim tranzicionim ekonomijama. U metodologiji istraživanja dat je pregled modela koji se koristi za empirijsku analizu i prikazani su izvori podataka korišćenih u istraživanju. Rezultati i diskusija prikazuju empirijsku analizu, validaciju hipoteze, glavna ograničenja rada kao i preporuke za buduća istraživanja. U zaključnim razmatranjima su sumirani glavni rezultati do kojih se u radu došlo.

2. Pregled literature

Ispitivanje konvergencije u dohotku *per capita* između različitih zemalja, kao predmet naučnog istraživanja dobija na značaju nakon nastanka tzv. „kontroverze o konvergenciji“, koja nastaje kao posledica teorijsko-naučne rasprave nakon pojave nove, odnosno endogene teorije rasta (Azzoni, 2001). Ekonomska i socijalna kohezija je Ugovorom o osnivanju Evropske zajednice definisana kao jedan od glavnih prioriteta Unije, a način za postizanje kohezije jeste pospešivanje rasta i smanjenje dispariteta u nivou razvijenosti među regionima EU. Od samog početka ovaj cilj se tumači kao promovisanje konvergencije između regiona EU, odnosno smanjenje regionalnih dispariteta u razvijenosti kroz sustizanje regionalnog nivoa BDP po stanovniku prosečnog BDP-a po stanovniku EU. Na osnovu toga je procenjivana efikasnost kohezivne politike. Poseban akcenat se stavlja na ruralna područja koja se suočavaju sa prirodnim i demografskim problemima ili su pogođena industrijskim promenama.

Matkowski i Prochniak (2004) ispituju postojanje konvergenije dohotka među tranzicionim zemljama CEE (CEE-8) i između njih i „starih“ članica EU. Autori potvrđuju postojanje konvergencije među osam novih članica, kao i smanjenje jaza u razvijenosti u odnosu na članice EU-15. Studija autora sprovedena tri godine kasnije na istom uzorku, ali u dužem vremenskom periodu potvrđuje postojanje dohodovne konvergencije među „starijima“ i „novim“ članicama (Matkowski & Prochniak, 2004). U istraživanju sprovedenom 2016. godine, Matkowski i saradnici ponovo su dokazali postojanje konvergencije dohotka između CEE-11 i EU-15 u periodu 1993-2015. godine. Međutim, proces sustizanja nije bio kontinuiran, budući da je bilo i nekih perioda divergencije. Najintenzivnija konvergencija bila je u periodu 2000-2007. godine, pre i posle velikog proširenja Evropske unije, što ukazuje na pozitivan uticaj ekonomske integracije na proces konvergencije. Da proširenje EU doprinosi bržem rastu u zemljama Centralne i Istočne Evrope, ubrzavajući njihovu konvergenciju ka razvijenim zemljama EU potvrđeno je u brojnim radovima (European Commission, 2009; Čihák & Fonteyne, 2009; Iancu, 2009; Ingiánni & Zdarek, 2009; Niebuhr & Schlitte, 2009; Vamvakidis, 2009; Marelli & Signorelli, 2010; Tatomir & Alexe, 2012; Glodowska & Pera, 2019). S druge strane, autori navode i da je globalna ekonomska kriza, zajedno sa finansijskim poteškoćama u Evrozoni, usporila konvergenciju u većini zemalja centralne i istočne Evrope, što se odrazilo na promene u dohodovnom gepu u periodu 2007-2015. godine.

Smanjenje jaza u razvijenosti između „novih“ i „starih“ članica potvrđeno je i u radovima Kaitila, 2004; Vojinović & Oplotnik, 2008; Vojinović et al., 2009; Vojinović et al., 2010), a razlike u rezultatima ogledaju se brzini konvergencije. Postojanje konvergencije između „novih“ članica i EU-15 i velike razlike u brzini konvergencije su dokazane i u radovima Vamvakidis (2008) i Cavenaile & Dubois (2011). Viskovic i saradnici (2020)

takođe potvrđuju da postoji konvergencija „novih“ članica EU, navodeći da se trgovinska otvorenost i bruto kapitalna formacija identifikuju kao ključni faktori rasta realnog dohotka analiziranih zemalja. Szeles i Marinescu (2010) potvrđuju postojanje i apsolutne i uslovne konvergenije u zemljama Centralne i Istočne Evrope. Smanjivanje jaza u razvijenosti između CEE-10 i EU-15 potvrđeno je i u studiji Stanišić (2012), sa naglaskom na negativan uticaj globalne finansijske krize na brzinu konvergenije. Cabral i Castelalnos-Sosa (2019) su ispitivali efekat finansijske krize na ekonomski rast i konvergenciju između evropskih zemalja u periodu od 1973. do 2012. godine i takođe ukazali na njen negativan efekat. Rezultati su pokazali da su prosečan autput po stanovniku i stopa konvergenije opali za oko 7%. Da globalna ekonomska kriza i dužnička kriza u Evrozoni usporava proces konvergenije dohotka u EU i vodi u nekim slučajevima do divergencije potvrđeno je i u radovima Nanovsky & Tochkov 2014; Simionescu, 2016; Smirnykh & Wörgötter, 2021. Proces sustizanja između „novih“ i „starih“ članica potvrđen je i u radu Gligorić (2014).

Strielkowski i Höschle (2016) analiziraju konvergenciju dohotka u EU tokom proteklih nekoliko decenija proširenja i ne pronalaze dokaze o postojanju konvergenije unutar Evropske unije. Takođe, i Borsi i Metiu (2015) ne pronalaze dokaze o postojanju konvergenije dohotka u EU u poslednjih četrdeset godina. Umesto toga, oni identifikuju nekoliko klubova koji konvergiraju u svoje zasebno stabilno stanje. Jedan od njihovih zaključaka je i da postoji jasno dugoročno razdvajanje između novih i starih članica EU. Akhvlediani i Cieslik (2020) navode da periferne zemlje EU, kao i zemlje koje još nisu njene članice, pokazuju slabu stopu konvergenije zbog nedovoljnog ulaganja u ljudski kapital. Cieslik i Wcislik (2020) su ispitivali konvergenciju BDP *per capita* zemalja CEE-8 prema razvijenim ekonomijama EU-15. Emirijski rezultati su pokazali da postoji konvergencija među zemljama CEE-8, ali se odbacuje hipoteza o konvergenciji CEE-8 prema EU-15. Ipak, kako pokazuju rezultati čini se da se CEE-8 približava dvema najvećim zemljama: Nemačkoj i Francuskoj.

Iako su studije o konvergenciji dohotka „novih“ članica EU brojne, istraživanja o smanjenju jaza u razvijenosti između zemalja Zapadnog Balkana i EU-15 su retka. Ključni problem za istraživanja predstavljaju ekonomska, politička i društvena ograničenja u ovim zemljama koja usporavaju njihov ekonomski napredak i ostvarivanje punopravnog članstva u Evropskoj uniji. El Ouardighi i Somun-Kapetanović (2007) analiziraju proces konvergenije dohotka *per capita* između zemalja Zapadnog Balkana i EU-24 tokom perioda 1989-2005. godine. Autori dokazuju da nakon povećanja jaza u razvijenosti između dve grupe zemalja tokom 1991-1993. godine, on se smanjuje, ali i dalje je jako dubok i proces konvergenije sa EU je previše spor. Borys i saradnici (2008) su ispitivali konvergenciju dohotka pet zemalja Zapadnog Balkana prema CEE-10 u periodu 1993-2005. godine. Rezultati su pokazali da su glavni pokretači konvergenije bili rast ukupne faktorske produktivnosti i kapital, dok je rad malo doprineo ekonomskom rastu. Botrić (2013) uključuje pored pet zemalja Zapadnog Balkana i Hrvatsku u analizu i zaključuje da ove zemlje ne konvergiraju ka EU-15 u periodu 1995-2010. godine.

Tsanana i saradnici (2012) su analizirali konvergenciju dohotka balkanskih zemalja i EU-15 i zaključili da se ona može potvrditi samo u slučaju Slovenije i Grčke, a ne i u slučaju

zemalja Zapadnog Balkana. Nekoliko godina kasnije, Tsanana i Katralikidis (2014) su upotrebom testova jediničnih korena dokazali postojanje konvergencije dohotka između balkanskih zemalja kao i između ovih zemalja i EU, uz napomenu da iako sve balkanske ekonomije beleže oporavak nakon 2000. godine, većina zemalja je pogođena Globalnom ekonomskom krizom pa stoga pitanje konvergencije dohotka sa članicama EU ostaje pod znakom pitanja. Postojanje konvergencije između zemalja Zapadnog Balkana i njihova konvergencija ka EU potvrđeno je u radu Meksi & Xhaja (2017). U radu se takođe navodi da je brzina konvergencije ka EU sporija u regionu Zapadnog Balkana neko u zemljama „novim“ članicama EU i ukazuje na negativan uticaj krize na proces sustizanja. Takođe, Krestovska (2018) tvrdi da je apsolutna konvergencija zemalja Zapadnog Balkana bila mnogo jača do 2008. godine zbog nižeg inicijalnog rasta u ranoj fazi tranzicije i globalne ekonomske ekspanzije pre krize. Generalno, region Zapadnog Balkana konvergira ka EU, ali je realna konvergencija ka prosečnom dohotku EU relativno spora (Krestovska, 2018). Studija Međunarodnog monetarnog fonda (Murgasova et al., 2015) zaključuju da je u periodu 2000-2007. godine ostvarena slaba konvergencija među zemljama Zapadnog Balkana i EU-15, obrazlažući to činjenicom da je rast slabije razvijenih zemalja, kao što su Bosna i Hercegovina i Albanija bio sporiji u odnosu na razvijenije zemlje, kao što je Hrvatska. U istom periodu, došlo je do značajne konvergencije dohotka „novih“ zemalja članica i EU-15. Nakon perioda izbijanja krize, autori su dokazali postojanje konvergencije za zemlje Zapadnog Balkana, iako slabiju od one koju ostvaruju „nove“ zemlje članice. Proces sustizanja (engl. catching-up process) *per capita* dohotka razvijenih zemalja EU u zemljama Centralne i Istočne Evrope brži je nego u regionu Zapadnog Balkana delimično zbog destruktivnog uticaja jugoslovenskih ratova tokom 90-ih godina koji su odložili proces tranzicije u ovom regionu za deceniju (Žuk et al., 2018). Stanišić (2016) testira brzinu i postojanje konvergencije dohotka zemalja Zapadnog Balkana i razvijenih zemalja EU, uz poređenje sa „novim“ zemalja članica. Rezultati pokazuju da je uprkos ostvarenoj konvergenciji u predkriznim godinama, Globalna finansijska kriza zaustavila smanjenje jaza u ekonomskoj razvijenosti između razvijenih članica EU i zemalja Zapadnog Balkana, uz istovremeno povećanje dohodovnog jaza između zemalja Zapadnog Balkana i „novih“ zemalja članica. Dve godine kasnije Stanišić i saradnici (2018) su analizirali stohastičku konvergenciju dohotka *per capita* između zemalja Zapadnog Balkana i CEE-10 u poređenju sa razvijenim zemljama EU. Rezultati su potvrdili postojanje stohastičke konvergencije dohotka po stanovniku prema proseku EU-15 u slučaju Češke, Slovačke, Poljske, Slovenije i Estonije. S druge strane, dohodovna konvergencija nije pronađena u slučaju zemalja Zapadnog Balkana. Nagy-Gyula i Siljak (2019) su analizirali konvergenciju dohotka zemalja Zapadnog Balkana prema EU-15 u periodu 2004-2016. godine i u dva podperioda: 2004-2008. godine i 2009-2013. godine. Empirijski rezultati potvrđuju da zemlje Zapadnog Balkana konvergiraju ka zemljama EU-15 u svakom analiziranom periodu. Međutim, nedavna finansijska kriza je imala negativan efekat na proces konvergencije, budući da je stopa konvergencije u periodu 2004-2008. godine bila veća od stope u periodu 2009-2013. godine. U skladu sa empirijskim rezultatima ovog rada, zemlje Zapadnog Balkana bi trebalo da vode politiku koja će omogućiti veću otvorenost ovih ekonomija za investicije i trgovinu, smanjenje

nezaposlenosti i održavanje javnog duga i inflacije na niskom nivou. Vođenje takve politike bi doprinelo većim per capita stopama rasta i bržoj konvergenciji.

Tomljanović (2019) je u svom radu analizirao realnu konvergenciju u zemljama Zapadnog Balkana i utvrdio da postoje pozitivna kretanja u pogledu BDP-a po stanovniku, dinamike ekonomskog rasta kao i sve veća okrenutost savremenim pokretačima ekonomskog rasta. Međutim, kako se ove zemlje i dalje suočavaju sa problemima vezanim za tržište rada, životni standard i produktivnost, kreatori ekonomske politike moraju da definišu sveobuhvatne politike i sprovedu strukturne reforme kako bi se omogućila konvergencija ka razvijenim članicama Evropske unije. Radosavljević i saradnici (2020) su ispitivali konvergenciju dohotka osam ekonomija Jugoistočne Evrope (Albanija, Bosna i Hercegovina, Bugarska, Hrvatska, Severna Makedonija, Crna Gora, Rumunija i Srbija) ka prosečnom dohotku EU u periodu 2000-2018. godine osvrćući se na period pre i posle ekonomske krize. Rezultati istraživanja su pokazali da postranzicioni model rasta koji je dominantan u ovom regionu, zasnovan na prilivu stranih direktnih investicija, nije dovoljan za konvergenciju dohotka u ovom regionu. Takođe se navodi da su privatne domaće investicije faktor koji je neophodan za bržu konvergenciju dohotka. Istraživanje koje su sprovedli Sanfey i Milatovic (2018) pokazuje da će regionu Zapadnog Balkana biti potrebne decenije da dostignu prosečan životni standard EU, a potpuna konvergencija će zahtevati veću produktivnost i ulaganja. Kako se navodi u ovom izveštaju, produktivnost predstavlja ključni problem ovog regiona koji se ogleda u nedovoljnim ulaganjima, nerazvijenim institucijama i poslovnom okruženju.

1. Metodologija i podaci

Za testiranje konvergencije dohotka *per capita* „novih“ zemalja članica CEE-11 i zemalja Zapadnog Balkana ka dohotku razvijenih zemalja EU-15 korišćena je sledeća jednačina:

$$y_{i,t} - y_{i,t-1} = \beta_0 + \beta(y_{i,t} - y_{EU15,t}) + \varepsilon_i + v_t + u_{it}$$

gde je:

$y_{i,t} - y_{i,t-1}$ - godišnja promena BDP *per capita*;

$y_{i,t} - y_{EU15,t}$ - razlika u BDP *per capita* ;

ε_i - individualni efekti,

v_t - vremenski efekti

u_{it} - slučajna greška sa nultom srednjom vrednošću i konstantnom varijansom,

β_0 - konstanta;

β - parametar konvergencije.

Polazni uzorak čini jedanaest zemalja Centralne i Istočne Evrope (CIE-11) i četiri zemlje Zapadnog Balkana, a analizom je obuhvaćen period pre i nakon svetske ekonomske krize. Emirirsko istraživanje se odnosi na period od 1996. do 2020. godine. U istraživanju su korišćeni panel podaci koji imaju karakter balansiranih makro podataka, a formirani model se svrstava u grupu linearnih panel modela. Baltagi (2005) navodi da je prednost

korišćenja panel podataka to što pružaju veće mogućnosti za identifikovanje i merenje efekata koji se ne mogu utvrditi upotrebom samo uporednih podataka više jedinica posmatranja ili samo vremenskih podataka jedne jedinice posmatranja. Pored navedene, Hsiao (2003) navodi da se prednosti korišćenja panela podataka ogledaju i u mogućnosti kontrolisanja individualne heterogenosti, pružanju više i kvalitetnijih informacija, većoj varijabilnosti, većoj efikasnosti i manjoj kolinearnosti između varijabli.

Uticaj nezavisnih promenljivih na zavisnu promenljivu ocenjen je upotrebom modela fiksnih efekata (engl. *fixed effects model*) i modela slučajnih efekata (engl. *random effects model*). U cilju odabira adekvatnog i reprezentativnog modela, vršen je izbor između modela fiksnih efekata i modela slučajnih efekata primenom Hausman testa.

Podaci korišćeni u istraživanju su preuzeti iz baze podataka Svetske banke.

2. Rezultati i diskusija

Rezultati deskriptivne statistike uz obrazloženje vrednosti aritmetičke sredine, standardne devijacije, minimalnih i maksimalnih vrednosti, asimetrije i spljoštenosti prikazani su u Tabeli 1.

Tabela 1. Deskriptivna statistika

	Godišnja promena BDP <i>per capita</i>	Razlika u BDP <i>per</i> <i>capita</i>
Broj opservacija	375	375
Aritmetička sredina	724,61	21.896,31
Standardna devijacija	2.229,2	6.960,3
Minimum	-29.929	7.950
Maksimum	3.098	43.068
Asimetrija (енгл. <i>skewness</i>)	-1,03	0,69
Spljoštenost (енгл. <i>kurtosis</i>)	130,97	3,28

Izvor: Autor

Prosečna vrednost godišnje promene BDP *per capita* u posmatranim evropskim tranzicionim ekonomijama tokom perioda od 1996. do 2020. godine iznosila je 724,61 dolara. Najveći pad BDP *per capita* u jednoj zemlji tokom tekuće u odnosu na prethodnu godinu iznosio je 29.929 (u Estoniji u 2020. godini u odnosu na 2019. godinu), a najveći rast je iznosio 3.098 (u Rumuniji u 2008. u odnosu na 2007. godinu). Prosečno odstupanje od srednjih vrednosti godišnje promene BDP *per capita* u posmatranim evropskim tranzicionim ekonomijama iznosilo je 2.229 u posmatranom periodu. U okviru deskriptivne statistike analiziran je koeficijent asimetrije i spljoštenosti kao pokazatelj odstupanja zasvisne promenljive od normalne raspodele. Na osnovu vrednosti koeficijenta asimetrije i vrednosti koeficijenta spljoštenosti može se zaključiti da postoji odstupanje vrednosti godišnje promene BDP *per capita* od normalne raspodele.

Prosečna vrednost razlike u BDP *per capita* jedne zemlje CIE-11 i Zapadnog Balkana i prosečnog BDP *per capita* EU-15 tokom perioda od 1996. do 2020. godine iznosila je 21.896,31 dolara. Najmanja razlika u BDP *per capita* između pojedinačne zemlje CIE-11 i Zapadnog Balkana, s jedne strane i prosečnog BDP *per capita* EU-15 iznosila je 7.950

dolara (u Češkoj u 1996. godini), a najveća razlika je iznosila 43.068 (u Albaniji u 2019. godini). Prosečno odstupanje od srednjih vrednosti u posmatranim evropskim tranzicionim ekonomijama iznosilo je 6.960 u posmatranom periodu. I kod ove varijable vrednosti koeficijenta asimetrije i koeficijenta spljoštenosti pokazuju da postoji odstupanje vrednosti razlika u BDP *per capita* jedne zemlje CIE-11 i Zapadnog Balkana i prosečnog BDP *per capita* EU-15 od normalne raspodele.

Na osnovu rezultata Hausman testa ($\chi^2(1) = 1,07$ i $\text{prob} > \chi^2 = 0,3015$) može se zaključiti da je bolje primeniti model sa slučajnim efektima nego model sa fiksnim efektima u periodu 1996-2020. godine. S druge strane, Hausman-ov test ($\chi^2(1) = 95,76$ i $\text{prob} > \chi^2 = 0,000$) pokazuje da je u podperiodu 1996-2008. godine bolje primeniti model sa fiksnim efektima, a u podperiodu 2009-2020. godine model sa slučajnim efektima ($\chi^2(1) = 0,02$ i $\text{prob} > \chi^2 = 0,892$).

Pre tumačenja dobijenih ocena prikazani su rezultati testiranja autokorelacije i heteroskedastičnosti (Tabela 2). Za testiranje prisustva heteroskedastičnosti korišćen je Wald test (za model fiksnih efekata) i Breush and Pagan test (za model slučajnih efekata), a za testiranje autokorelacije Wooldridge test. Rezultati testiranja postojanja heteroskedastičnosti u ovom istraživanju pokazuju da se nulta hipoteza o nepostojanju heteroskedastičnosti prihvata u periodu od 1996. do 2020. godine jer je $\chi^2(01)=0,00$, $p > \chi^2 = 1,000$ i heteroskedastičnost ne postoji, odnosno varijansa rezidualnih odstupanja je jednaka. Rezultati testiranja postojanja autokorelacije pokazuju da se prihvata nulta hipoteza o nepostojanju autokorelacije jer je $F(1,4)=4,612$ i $p > F=0,05$ i zaključuje se da ne postoji autokorelacija, odnosno slučajne greške nisu međusobno korelisane. U podperiodu 1996-2008. godine takođe ne postoji problem autokorelacije ($F(1,4)=2,556$, $p=0,1322$), ali se ne prihvata nulta hipoteza o nepostojanju heteroskedastičnosti jer je $\chi^2(15)=436,10$, $p > \chi^2 = 0,000$, odnosno varijansa rezidualnih odstupanja nije jednaka. Problem autokorelacije ne postoji ni u podperiodu 2009-2020. godine, pa se prihvata nulta hipoteza o nepostojanju autokorelacije, odnosno da slučajne greške nisu međusobno korelisane ($F(1,14)=6,098$ i $\text{prob} > F=$) pri nivou značajnosti $\alpha=0,01$, kao ni problem heteroskedastičnosti ($\chi^2(01)=0,00$, $p > \chi^2 = 1,000$).

Tabela 2. Rezultati dijagnostičke provere

	Wald test for groupwise heteroskedasticity/ Breush and Pagan test	Wooldridge test for autocorrelation
1996-2020	$\chi^2(01)=0,00$	$F(1,4)=4,612$
	$p > \chi^2 = 1,000$	$p > F=0,05$
1996-2008	$\chi^2(15)=436,10$	$F(1,14)=2,556$
	$p > \chi^2 = 0,000$	$\text{prob} > F=0,1322$
2009-2020	$\chi^2(01)=0,00$	$F(1,4)=6,098$
	$p > \chi^2 = 1,000$	$\text{prob} > F=0,0270$

Izvor: Autor

Rezultati panel regresionog modela su prikazani u Tabeli 3. Analiza je sprovedena na uzorku zemalja CIE-11 i Zapadnog Balkana za period 1996-2020. godine, kao i u

podperiodima 1996-2008. i 2009-2020. godine. Na nivou celokupnog uzorka u u okviru posmatranog vremenskog intervala od 1996. do 2020. godine ne postoje signifikantni dokazi o postojanju dugoročne konvergencije, odnosno ne postoji smanjenje gepa u razvijenosti između evropskih tranzicionih ekonomija s jedne strane i razvijenih ekonomija Evropske unije, s druge strane. S druge strane, konvergencija dohotka postoji u evropskim tranzicionim zemljama u predkriznom periodu (1996-2008). U zemljama gde je razlika između BDP *per capita* veća u odnosu na prosečan BDP *per capita* EU-15 veći je godišnji rast BDP *per capita*. To zapravo znači da se u periodu pre krize gep u razvijenosti, odnosno razlika u dohotku *per capita* smanjivala između evropskih zemalja. Vrednost koeficijenta determinacije od 0,688, pokazuje da je medelom objašnjeno 68,9% varijabiliteta zavisne promenljive, godišnja promena BDP *per capita*. U postkriznom periodu od 2009. do 2020. godine konvergencija dohotka *per capita* ne postoji u evropskim tranzicionim zemljama. Na osnovu dobijenih rezultat, hipoteza od koje su u radu pošlo da evropske tranzicione zemlje konvergiraju ka razvijenim zemljama EU-15 može se samo delimično prihvatiti.

Tabela 3. Ocenjene specifikacije modela

Varijabla	Godišnja promena BDP <i>per capita</i>		
	RE	FE	RE
	1996-2020	1996-2008	2009-2020
Razlika u BDP <i>per capita</i>	-0,0218 (0,0165)	0,114** (0,0261)	-0,023 (0,0307)
Konstanta	1.201,97** (380,087)	-1.394,9** (510,495)	1167,193 (786,326)
Broj opservacija	375	195	180
R ²	0,2082	0,689	0,04

Izvor: Autor

Nepostojanje dugoročne konvergencije dohotka *per capita* evropskih tranzicionih ekonomija ka dohotku razvijenih ekonomija EU-15 posledica je promena kojima su bile izložene brojne evropske ekonomije u razvoju nakon otpočinjanja procesa tranzicije sa centralno-planske na tržišnu privredu, razlika u intenzitetu i brzini odvijanja tih promena, individualnih karakteristika ekonomija, značajnih razlika u nivou razvijenosti između tih tranzicionih ekonomija i razvijenih evropskih ekonomija. Ključni problem za zemlje Zapadnog Balkana predstavljaju ekonomska, politička i društvena ograničenja u ovim zemljama koja usporavaju njihov ekonomski napredak i ostvarivanje punopravnog članstva u Evropskoj uniji. Osim toga, u ovim zemljama, produktivnost, nedovoljna ulaganja, nerazvijene institucije i poslovno okruženje predstavljaju ozbiljan problem. Takođe, zemlje Zapadnog Balkana su bile suočene sa destruktivnim uticajem jugoslovenskih ratova tokom 90-ih godina koji su odložili proces tranzicije u ovom regionu za deceniju u odnosu na tranzicione zemlje Centralne i Istočne Evrope. Unapređenje efikasnosti i pravičnosti javne potrošnje, smanjenje poreskih izdataka i

adekvatnije usmeravanje socijalnih davanja bi pružilo mogućnosti za više javnih investicija. Stoga, neophodno je da se u ovim zemljama definišu i implementiraju strukturne reforme kojima bi se povećala konkurentnost, izvoz i unapredile performanse javnog sektora i time omogućila konvergencija dohotka ka dohotku razvijenih zemalja EU. Istovremeno, jačanje državnih institucija koje štite vladavinu prava i konkurenciju privatnog sektora i borba protiv korupcije bi doprineli ostvarivanju dinamičnijeg, održivijeg i ujednačenijeg rasta što bi impliciralo konvergenciju dohotka u ovim zemljama sa dohotkom u razvijenim zemljama EU. Pored toga, sustizanje razvijenih zemalja EU, u narednom periodu osim od priliva SDI zavisice i od efikasnosti evropskih tranzicionih zemalja da pređu na model ekonomskog rasta koji se bazira na inovacijama. Ovakav model ekonomskog rasta zahteva veće oslanjanje na sopstvene kapacitete za istraživanje i razvoj, kao i fundamentalnu izmenu institucija i ekonomskog sistema, koja bi po ugledu na razvijene zemlje trebalo da podrazumeva podsticanje razvoja i implementaciju domaćih inovacija (Petrović & Gligorić-Matić, 2021).

Konvergencija dohotka ka EU-15 postoji u predkriznom periodu. Ovakav rezultat ne iznenađuje budući da je pred globalnu ekonomsku krizu rast BDP-a bio izrazito snažan, dostižući nivo iznad 5% kako u zemljama CIE-11 tako i u zemljama Zapadnog Balkana. Snažna ekonomska ekspanzija doprinela je procesu sustizanja naprednih ekonomija EU-15. Visok rast dohotka *per capita* bio je rezultat velikih investicija zahvaljujući kojima su ove zemlje iskoristile mogućnosti za rast koje su im pružene na osnovu „prednosti zaostalosti“. Velike investicije su omogućile transfer novih tehnologija i znanja što je doprinelo porastu produktivnosti i porastu dohotka po stanovniku.

Za razliku od predkriznog perioda, u postkriznom periodu ne postoji konvergencija dohotka evropskih tranzicionih ekonomija. Razlog za nepostojanje konvergencije u ovom periodu može se objasniti globalnom ekonomskom krizom, koja je usporila ekonomski rast u svim analiziranim ekonomijama, kao i činjenicom da ovaj period obuhvata godine ekonomskog oporavka zemalja i finansijske poteškoće uzrokovane dužničkom krizom u Evrozoni. Jedan od razloga za nepostojanje konvergencije nakon krize u zemljama Zapadnog Balkana je i taj što je u predkriznom periodu ekonomski rast bio više rezultat globalnih trendova, povećane likvidnosti na inostranom tržištu kapitala, većeg priliva kapitala i kreditnog buma, nego stvarnog napretka u ekonomskim reformama u ovim zemljama. Jedan od argumenata za ovo jeste i stopa nezaposlenosti u zemljama Zapadnog Balkana preko 20%, odnosno nedovoljna iskorišćenost raspoloživih ljudskih kapaciteta čak i u uslovima dinamičnog ekonomskog rasta pre krize. Imajući u vidu dobijene rezultate može se zaključiti da je sustizanje razvijenih članica EU-15 od strane zemalja „novih“ članica EU (CEE-11) otpočelo pre pristupanja Evropskoj uniji. Na proces sustizanja razvijenih zemalja EU-15 i proces integracije veliki uticaj je imala pretpristupna harmonizacija zajedno sa implementacijom značajnih ekonomskih reformi. Zemlje CEE-11 i Zapadnog Balkana u cilju sustizanja razvijenih zemalja EU-15 bi trebalo da promene model rasta, umesto onog zasnovanog na velikim investicijama trebalo bi se okrenuti rastu koji se više bazira na kvalitetu institucija. Negativan uticaj globalne ekonomske krize na konvergenciju dohotka evropskih tranzicionih ekonomija potvrđen je u brojnim radovima

(Stanišić, 2012; Dvorokova, 2014; Forgó & Jevčák, 2015; Grela et al., 2017; Smirnykh & Worgotter, 2021).

3. Zaključak

Konvergenција dohotka je glavni aspekt ekonomske konvergencije i podrazumeva da manje razvijene zemlje, sa nižim dohotkom po stanovniku, rastu brže od razvijenih ekonomija, sa većim dohotkom po stanovniku. Kao rezultat toga jaz u dohotku između bogatih i siromašnih zemalja se vremenom smanjuje. Konvergenција dohotka, direktno je implicirana neoklasičnim modelima rasta (Solow 1956, 1957; Swan 1956). Ovi modeli sugeriraju da će, imajući u vidu istu egzogenu tehnologiju, stopu štednje i rast stanovništva, zemlje sa nižim dohotkom po stanovniku i nižim kapitalom po radniku (ali sa dovoljno radne snage i drugih resursa) brže rasti, jer nude veće prinose na kapital, koji privlače strane investicije, osiguravajući time veću stopu akumulacije i brži rast proizvodnje. Zagovornici endogenih teorija rasta odbacuju pretpostavku o opadajućim prinosima i dovode u pitanje direktnu negativnu korelaciju između početnog nivoa dohotka i stope rasta, odnosno brži rast siromašnih u odnosu na bogate zemlje, i ističu da su prinosi ili konstantni ili rastući. Zbog rastućih prinosa, proizvodna aktivnost će biti koncentrisana u određenom broju zemalja i intenziviraće se nejednakosti u razvijenosti, odnosno doći će do divergencije između zemalja.

Pitanje konvergencije dohotka, odnosno smanjenja ekonomskih nejednakosti jedno je najvažnijih ekonomskih i političkih pitanja u Evropskoj uniji, budući da se Evropa sastoji od heterogenih zemalja koje odlikuju dispariteti u dohotku *per capita* (Sutherland, 1986). Tokom protekle tri decenije odigrale su se značajne transformacije u bivšim evropskim komunističkim zemljama koje su za rezultat imale njihovu integraciju u globalnu ekonomiju i povećanje životnog standarda. Međutim, prvih nekoliko godina tranzicije ka tržišnoj privredi i reformi političkog i pravnog sistema praćeno je drastičnim padom autputa, visokom inflacijom i porastom nezaposlenosti (Fisher & Sahay, 2000). Nakon inicijalne recesije, usledio je period divergencija u dohotku *per capita* između socijalističkih zemalja i ostatka Evrope, kao i unutar samih zemalja. Iako su tranziciju ka tržišnoj privredi pratili brojni problemi u svim zemljama, sa posebnim teškoćama suočavale su se zemlje Zapadnog Balkana, u kojima je kao posledica ratova, političkih nemira, sankcija, ekonomske nestabilnosti i izolovanosti, proces tranzicije otpočeo sa decenijom zakašnjenja u odnosu na zemlje Centralne i Istočne Evrope.

Kada je reč o konvergeniji dohotka između evropskih tranzicionih zemalja i razvijenih ekonomija Evropske unije, rezultati ovog istraživanja nisu dokazali da postoji dugoročna konvergenција u periodu od 1996. do 2020. godine. Takođe, konvergenција nije potvrđena ni u postkriznom periodu (2009-2020). Razlozi za nepostojanje konvergencije u dva navedena perioda su promene sa kojima su se suočile brojne evropske ekonomije u razvoju nakon otpočinjanja procesa tranzicije sa centralno-planske na tržišnu privredu, razlike u intenzitetu i brzini odvijanja tih promena, individualnim karakteristikama ekonomija, značajne razlike u nivou razvijenosti između tranzicionih ekonomija i razvijenih evropskih ekonomija. S druge strane, postojanje konvergencije između tranzicionih evropskih

zemalja i razvijenih zemalja EU (EU-15) dokazano je u predkriznom periodu (1996-2008). Ovakav rezultat posledica je činjenice da je pred globalnu ekonomsku krizu rast BDP-a bio izrazito snažan, dostižući nivo iznad 5% kako u zemljama CEE-11 tako i u najsiromašnijim zemljama Zapadnog Balkana. Snažna ekonomska ekspanzija doprinela je procesu sustizanja naprednih ekonomija EU-15. Visok rast dohotka *per capita* bio je rezultat velikih investicija zahvaljujući kojima su ove zemlje iskoristile mogućnosti za rast koje su im pružene na osnovu prednosti zaostalosti. Velike investicije su omogućile transfer novih tehnologija i znanja što je doprinelo porastu produktivnosti i porastu dohotka po stanovniku.

Neka od ograničenja rada se odnose na nedostupne podatke za Crnu Goru zbog čega nije uključena u analizu. Dačllje istraživanjem je obuhvaćen period u kome su ispoljeni efekti globalne ekonomske krize i dužničke krize u Evrouoni koji su imali veliki uticaj na dobijene rezultate istraživanja. Pored toga, tokom 90-ih godina prošlog veka zemlje Zapadnog Balkana su bile suočene sa brojnim socijalnim i političkim problemima i sukobima, koji su imali veliki uticaj na njihov dohodak, a samim tim i na dobijene rezultate u ovom radu.

Preporuka za buduća istraživanja kada je reč o konvergenciji dohotka ekonomija CEE-11 i Zapadnog Balkana je da se pored nivoa BDP *per capita*, ispita i uticaj dodatnih faktora koji utiču na konvergenciju dohotka kao što su transfer tehnologije, nivo ljudskog kapitala, stopa nezaposlenosti, stopa investicija, inflacije, spoljnotrgovinska otvorenost, kvalitet institucija i slično. Uključivanjem u analizu dodatnih faktora bilo bi moguće objasniti zašto je u nekim zemljama smanjena razlika u razvijenosti u odnosu na razvijene zemlje EU-15, a u nekim nije došlo do smanjenja.

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TRENDOVI U DIGITALNOM UPRAVLJANJU LJUDSKIM RESURSA U HOTELIJERSTVU

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SAŽETAK:

Ljudski resursi u hotelskoj organizaciji imaju veliki značaj i upravljanje njima je vrlo složena aktivnost. Uticaj digitalizacije u području upravljanja ljudskim resursima obuhvata i zaposlene i one koji to potencijalno mogu da budu. Upravljanje ljudskim resursima predstavlja proces u kojem organizacija sprovodi određene aktivnosti kao što su odabir kadrova, selekcija, obuka, usavršavanje, usmeravanje, kontrolu zaposlenih, kao i mnogo drugih aktivnosti, a sve u cilju ostvriavanja zadataka organizacije. Poseban deo organizacije koji se bavi tim poslom je menadžment ljudskih resursa. Postoji mnogo funkcija ovog menadžmenta - jedna od ključnih je postavljanje pravih ljudi na prava mesta ali i njihovo zadržavanje. Digitalizacija u ovoj oblasti hotelijerstva ne znači samo transformaciju i smanjenje administrativnih zadataka već usmeravanje ljudskih resursa na razvoj njihovih kompetencija kao i na transformaciju oblika zapošljavanja i upravljanja ljudskim resursima. Prelazak na digitalno upravljanje ljudskim resursima podrazumeva da organizacija između ostalog ima i određene softvere kojima može da vodi lakši i efikasniji proces selekcije kandidata, obuku, delegiranje, ocenu učinka, ali i povratne informacije zaposlenih i njihove motivacije. Njena primena poboljšava kvalitet poslovanja i u oblasti hotelijerstva. Da bi se ostvarila i održala konkurentnost uspešno poslovanje i da bi realizovali profitabilnost mora se ići u korak sa inovacijama na globalnom nivou. Stari okviri poslovanja se zamenjuju novim i to uključuje digitalizaciju. Cilj ovog rada je istakne značaj digitalizacije u menadžmentu ljudskih resursa i pogodnosti koje donose organizaciji u primeni novih savremenih tehnologija.

Ključne reči: *Ljudski resursi, digitalizacija, informacione tehnologije, hotelijerstvo.*

TRENDS IN DIGITAL MANAGEMENT OF HUMAN RESOURCES IN THE HOTEL INDUSTRY

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ABSTRACT:

Human resources in the hotel organization are of great importance and their management is a very complex activity. The impact of digitization in the field of human resources management includes employees and those who can potentially become employees. Human resource management is a process in which the organization carries out certain activities such as personnel selection, selection, training, training, guidance and control of employees, as well as many other activities, all with the aim of achieving the organization's tasks. A special part of the organization that deals with that work is human resources management. There are many functions of this management, but one of the key ones is placing the right people in the right places and keeping them. Digitization in this area of the hotel industry does not mean only the transformation and reduction of administrative tasks, but the directing of human resources to the development of their competences as well as to the transformation of the form of employment and human resource management. The transition to digital human resources management implies that the organization has, among other things, certain software that can lead an easier and more efficient process of candidate selection, training, delegation, performance evaluation, as well as feedback from employees and their motivation. Its application improves the quality of business in the hotel industry as well. In order to achieve and maintain competitiveness, successful business and to realize profitability, one must keep pace with innovations on a global level. Old business frameworks are being replaced by new ones, and this includes digitization. The aim of this paper is to highlight the importance of digitization in human resources management, and the benefits they bring to the organization in the application of new modern technologies.

Keywords: Human resources, digitization, information technologies, hotel industry.

1. UVOD

Menadžment ljudskih resursa je funkcionalna oblast menadžmenta. Definiše se kao strateški pristup upravljanju najvrednijim resursima jedne organizacije a to su zaposleni koji rade u njoj i pojedinačno i kolektivno doprinose ostvarivanju ciljeva organizacije (Bogićević 2004) .

Menadžment ljudskih resursa se takođe može posmatrati i kao sistem koji obuhvata sve menadžment odluke, strategije politike i aktivnosti koje direktno utiču na zaposlene u organizaciji, njihovo ponašanje, rezultate, stavove, vrednosti i motivaciju. Menadžment ljudskih resursa predstavlja sastavni deo ukupnog menadžmenta savremenog preduzeća, odnosno njegov sastavni ali i najosetljiviji deo kao sadržaj menadžment procesa.

Kada je reč o fazama upravljanja ljudskim resursima, počinje se od sadržaja analize posla, preko formulisanja strategije i planiranja ljudskih resursa, kroz regrutovanje, selekciju, socijalizaciju i orijentaciju zaposlenih, poboljšavanje performansi zaposlenih (kroz obuku, trening i razvoj zaposlenih i njihove karijere i motivacije za učenje), ocene performanse zaposlenih (kroz vrednovanje poslova, motivisanje zaposlenih, vrste motivacionih tehnika), sistem zarada (kroz sistem i ciljeve zarada, upravljanje troškovima rada) stimulacije i beneficije zaposlenih i menadžera (Čerović 2019). Način na koji se upravlja ljudskim mogućnostima postaje presudan faktor konkurentne sposobnosti savremenog preduzeća, uslov njegovog opstanka i razvoja na svim prostorima. U skladu sa težnjom ka savremenim tendencijama menadžment ljudskih resursa se razvija u pravcu u kome poboljšava kvalitet saradnje zaposlenih i uključuje kreativnost u dostizanju zacrtanih ciljeva kompanije. Upravljanje ljudskim resursima predstavlja složeni proces koji omogućava efikasno korišćenje ljudskih resursa sa ciljem da se realizuje misija organizacije. Pošto strategija ukupnog kvaliteta organizacije obuhvata zaposlene na svim organizacionim nivoima neophodna je usklađenost između stvarnih potreba za ljudskim resursima u organizaciji i njihove raspoloživosti. Radi ostvarivanja što boljih rezultata neophodan je i individualni pristup, jer čovek u organizaciju ne unosi samo svoje znanje i sposobnosti već i želje, ambicije i očekivanja (Čerović 2019).

U dinamičnom procesu menadžmenta ljudskih resursa, kontinuirano se kroz aktivnosti ostavljaju zadaci organizacije tako što se na najbolji način usmeravaju znanja i veštine i interesi zaposlenih. Menadžment ljudskih resursa ondosi se na praksu i politiku potrebnu da se izvrše menadžerski zadaci u vezi sa personalnim pitanjima zapošljavanjem, obukom, procenom i nagrađivanjem zaposlenih u kompaniji i obezbeđivanjem etički prihvatljivog okruženja (Dessler 2011).

2. DEFINISANJE POJMA DIGITALNO UPRAVLJANJE LJUDSKIM RESURSIMA

Digitalizacija predstavlja proces transformacije koji je neophodno uvesti radi usklađenosti sa savremenim tokovima funkcionisanja organizacije. Digitalno upravljanje ljudskim resursima ostavlja se kroz korišćenje elektronskih medija, informacionih tehnologija, svih njenih dostignuća koja omogućavaju usklađivanje sa savremenim tokovima. Digitalizacije ili digitalna transformacija je proces, koji vremenski tokovi nameću organizacijama radi njihove relevantnosti u budućnosti. Pобољшanje performansi organizacije neophodni su i trebaju kontinuirano da se primenjuju. Uticaj digitalnih resursa na organizacione resurse ima tendenciju povećanja u budućnosti.

U svom istraživanju Nawaz & Gomes (2017.) naveli su da informacioni HR sistemi deluju kao strateški alat za razvoj organizacije. Anthony (2014.) je rekao da tehnologija koja deluje kroz digitalizaciju omogućava bolji učinak u kompletnom funkcionisanju cele organizacije. Digitalni svet menja način života i poslovanja i vođenja organizacije. Njegov uticaj se ispoljava u svim oblastima upravljanja ljudskim resursima. Proces koji je naročito unapređen procesom digitalizacije je komunikacija između zaposlenih i poslodavca, njihova međusobna komunikacija i komunikacija sa poslovnim okruženjem. Pošto digitalizacija utiče na sve nivoe organizacije neophodno je pratiti njene tokove kontinuirano i prilagođavati nova znanja radi omogućavanja novih i savremenijih načina rada. Kiesler et al (1984.) tvrdio je u svojim istraživanjima da tehnologija posreduje u odnosu između pojedinca i organizacije, podređenih i supervizora. Ovakvim načinom razmišljanja smanjio distancu u organizacijama. Mogućnost zaposlenih da rade od kuće i komuniciraju sa ljudima širom sveta imala je veliki značaj. Heracleous (2003.) je naglasio važnost ulaganja u razvoj novih veština posebno kada promena uključuje novu tehnologiju i nove procese u poslovanju. Na osnovu toga tvrdi da će digitalna tehnologija kontinuirano menjati način na koji organizacija zapošljava i organizuje zaposlene. Putem digitalnih platformi, aplikacija i svih procesa koje omogućava digitalizacija poboljšava se celokupano funkcionisanje zaposlenih. Transformacija HR procesa u smislu primene digitalnih sistema ima značaja u doprinosu ekoloških performansi organizacije. Primena digitalnog HRM-a smatra se zelenim konceptom upravljanja ljudskim resursima.

Era digitalne transformacije za stručnjake iz oblasti HRM-a, nosi brojne izazove. Oni nose potrebu za prilagođavanjem promenljivim uslovima. Das, S., & Sureshkrishna, G. (2019.) su u svojim istraživanjima zaključili da spoljni pritisak za promene u smislu digitalizacije nosi brojne izazove za HRM. Potrebne su nove HR kompetencije zbog digitalizacije i unapređenja fleksibilnosti rada. Takođe ističu da su izazovi podeljeni u nekoliko grupa.

1. Razumevanje digitalizacije
2. Prilagodljivost novim ulogama
3. Agilnost
4. Istraživanje i razvoj digitalnih kompetencija
5. Ispunjavanje promenjenih organizacionih očekivanja
6. Implementacija organizacione promene
7. Suočavanje sa novim oblicima zapošljavanja.

U svojim istraživanjima Paladin (2022.) ukazuje na važne korisne karakteristike digitalizacije upravljanja ljudskim resursima i povezanim procesima i aktivnostima. Ona ukazuje pre svega važan ekonomski faktor odnosno ušedu novca ali i ušedu vremena. Mnoge organizacije ne samo da digitalizuju interne procese već se odlučuju za eksterne uloge određenih usluga prema svojim klijetima putem različitih digitalnih alata. Prednost digitalizacije se ogleda i u primenu e-obrasca, koji služi za prijavu na slobodna radna mesta. Ovaj obrazac omogućava lako i brzo popunjavanje i automatsko evidentiranje podataka o potencijalnim kandidatima za novo radno mesto. Pri tome izbor može biti direktan, a može biti i vezan za dalji proces selekcije. Ovakv način prijavljivanja ima niz pogodnosti. On nosi ušedu vremena i brz pristup podacima o potencijalnim kandidatima za radna mesta, ali i sve potrebne informacije o zaposlenima. Digitalizacija menja način na koji se izvode upravljačke aktivnosti. Korišćenje različitih metoda i procesa digitalnih alata menja stil rukovođenja. Radi ostvarenja ovakvog načina poslovanja menadžer treba da razvije i koristi veštine i kompetencije i da ih kontinuirano razvija (Halid et al., 2020).

3. ZNAČAJ DIGITALNOG UPRAVLJANJA LJUDSKIM RESURSIMA U HOTELIJERSTVU

Upravljanje u hotelijerstvu u poređenju sa vremenom kada digitalizacija nije bila prisutna je u tome što menadžeri imaju trenutni pristup svim podacima o zaposlenima i mogućnost da na osnovu toga brzo urade sve potrebne analize i akcije. Informacije su danas veoma bitne, i njihovo posjedovanje u pravom trenutku je od velikog značaja za donošenje dobrih odluka. Digitalna praksa upravljanja ljudskim resursima u hotelijerstvu, obuhvata niz aktivnosti a to su: analiza podataka, selekcija, digitalno zapošljavanje, digitalna obuka, razvoj, upravljanje. Primećeno je da su u organizacijama uglavnom usvojeni ovi procesi . (Burbach, 2019; Parri & Battista, 2019). Izazovi koji odvarčaju organizaciju od digitalizacije trebaju da budu prevaziđeni radi unapređenja celokupnog poslovanja. „ Nove tehnologije su svuda oko nas“. To se potvrđuje i u oblasti upravljanja ljudskim resursima. Huselid je ukazao na značaj razumevanja pozitivnih posledica e-HRM na organizaciju ljudskih resursa (Huselid 2004). Primena svake inovacije u poslovanju ima prednosti i nedostatke. Ne može se očekivati da bilo koja metoda koju uključujemo u poslovni proces nema nikakve nedostatke.

Sa strateške tačke gledišta postoji kritički pristup uticaju e-HRM na prepoznatljivost u konkurentsku prednost. U istraživanjima nalzi su kontradiktorni. E-HRM ima sledeće prednosti : ušteda vremena, ušteda troškova, fleksibilnost usluge, brzina komunikacije i prenošenja informacije, pristup podacima na lakši i brži način, a nedostaci se mogu ogledati u blokadama i tehničkim problemima u prenošenju podataka, stres i potreba za specifičnom edukacijom ljudskih resursa (Strohmeier 2007). Ipak kada se sagleda odnos prednost i nedostataka na e-HRM treba gledati kao na investiciju u profesionalizaciju upravljanja ljudskim resursima. Značaj digitalnog upravljanja se ogleda u olakašnom

upravljanju ljudskim resursima. On uključuje primenu novih tehnologija koje treba kontinuirano pratiti i vršiti unapređivanje. Procedure i procesi trebaju da budu što više pojednostavljeni ali istovremeno i precizni. Spremenost na komunikaciju između organizacije i zaposlenih pomaže u smanjenju složenosti posla i stimuliše efikasnost rada zaposlenih (Ružić et al., 2009).

Kada govorimo o funkcijama e-HRM, primetno je da se funkcije upravljanja ljudskim resursima može i digitalno posmatrati. Sve ovo zavisi od organizacije od organizacije. U modernim hotelima korišćenje e-HRM je veoma korisno i ono se može posmatrati kroz digitalizaciju procesa planiranja tj regrutovanja i selekcije kadrova, njihov razvoj tj. obuku i upravljanje karijerom, nagrađivanje kroz obaveznu ocenu učinka, ali i obezbeđivanje kompenzacija i beneficija (Findikli et al., 2015).

Regrutovanje ljudskih resursa je jedna od početnih faza. Kada govorimo o primeni digitalizacije u regrutovanju ljudskih resursa, ono se najčešće vezuje za prijavu kandidata putem određene forme koju potencijalni zaposleni popunjava, i koja se ona odmah evidentira u elektronskoj bazi. Na ovaj način menadžer i tim ljudi koji se bavi ljudskim resursima može na brz i lak način da dodje do potrebnih podataka u svakom trenutku. Nakon selekcije svih kandidata, kojoj je prethodilo jasno i precizno određivanje i opis posla koji je potrebno da novo zaposleni obavlja, i odabira onih koji ispunjavaju najviše kriterijume za određenu poziciju u hotelu, tim sprovodi krajnju selekciju u vidu rađenja online testova, online intervju sa direktorima, rešavanje studije slučajeva, itd. Sledeća faza koja ne sme da propusti je obuka zaposlenih i upoznavanje sa kulturom organizacije. Njegovo uvođenje u posao i uključivanje u tim je ključno za dalji razvoj i prilagođavanje. Korišćenjem programa ili softvera e-mentor, može da olakša „on boarding“ novo zaposlenog. Kroz nove i modernije programe, usvajaju se nove prakse, norme, pravila i procedure u hotelu. Digitalizacijom procesa u menadžmentu ljudskih resursa oblikovani su sistemi e-treninga i e-učenja koji olakšavaju ceo proces. Na ovaj način dolazi do uštede vremena i resursa, ali i do povećavanja efikasnosti u učenju i razvoju zaposlenih (Benson et al., 2002: 398). Sistemi koji služe za efikasno upravljanje i obuku zaposlenih zasnovani na digitalizaciji su alati koji identifikuju prioritete i određuju potrebe kod zaposlenih. Ono što je takođe važno a to je da ovi alati u digitalnoj formi omogućuju zaposlenima da tokom svoje karijere usavršavaju svoja znanja i kompetencije (Rothwell et al., 2005: 122-124).

U postizanju strateških ciljeva organizacije veoma važnu ulogu ima HRIS –(engl. Informacioni sistemi ljudskih resursa). To je softver koji predstavlja skup postupaka koji prikupljaju, čuvaju, obrađuju i održavaju podatke vezane za potrebe ljudskih resursa i kadrovske aktivnosti. Neki od vodećih kompanija za razvoj softvera su opisani u dole nizu (Nikolić et al., 2019).

1. Atlas Business Solutions, Inc. – (ABS) je vodeći proizvođač upravljačkih poslovnih softvera koji su laki za učenje i korišćenje. Rešenja ovog softvera čuvaju vreme i unapređuju poslovne procese u oblasti ljudskih resursa. Njegovi softveri sadrže osnovne informacije, informacije o zaradi, hitne informacije, podsetnike, evaluatore, informacije o beleškama kupaca, dokumenta i fotografije.

2. HRSOFT- ovaj softver kao jedan od vodećih poslovnih sistema, rešenja nudi na takav način da je moguće generisati širok spektar profila zaposlenih kao i izveštaja i izvršava identifikaciju adekvatnih pojedinaca za određene promotivne aktivnosti.
3. Human Resource MicroSystems je poslovni sistem osnovan u San Francisku. Bavi se dizajniranjem razvojem i implementacijom HRIS proizvoda i obezbeđuje tehnološku ekspertizu za klijente. To podrazumeva obezbeđenje rešenja za administraciju, zapošljavanje, plate, naknade i sl.
4. SAP-softverska korporacija koja je poznata kao svetski lider u poslovnim aplikativnim softverima. Deluju na globalnom nivou. Ovaj sistem se sastoji od velikog broja modula koji pomažu u upravljanju u ljudskim resursima.

4. ZAKLJUČAK

Svaka vrsta informacionog sistema i informaciona tehnologija na određeni način doprinose upravljanju ljudskim resursima u hotelijerstvu. Neki sistemi to čine u jednom domenu više a u drugom manje, a drugi sistemi takođe imaju svoje dominantno delovanje. Raspoloživost informacionog kapitala u upravljanju ljudskim resursima može se meriti nivoom razvijenosti online sistema. Razvoj informacionih tehnologija i informacionih sistema promenio je upravljanje ljudskim resursima i transformisao tradicionalni pristup u digitalizovane online procese. Činjenica da su ljudski resursi najdragoceniji potencijal organizacije ukazuje na to da je upravljanje ljudskim resursima ključna i najteža funkcija menadžmenta. Upravljanje ljudskim resursima u sferi modernog menadžmenta sve više je stratejsko. Organizacije i menadžeri nastoje da u svom poslovanju što više unaprede i usavrše ljudske resurse. To im omogućava održavanje konkurentске prednosti ali i zaposleni moraju da se kontinuirano usavršavaju i da unapređuju svoja znanja i veštine da bi pratili razvoj tehnologije. Na menadžerima je velika odgovornost koja između ostalog uključuje prepoznavanje značaja ulaganja u zaposlene jer su oni jedan od osnovnih resursa i ključ uspeha svake organizacije. Informacione tehnologije povezuju menadžment ljudskih resursa i digitalizaciju u svakom segmentu poslovanja. Proces se odvija sa ciljem što efikasnijeg sprovođenja zacrtane poslovne strategije. Na putu ka digitalizaciji HR menadžerima su potrebna nova znanja i veštine i potpuna podrška organizacije. Cilj ovog rada je da se ukaže na bitnu vezu između ljudskih resursa i informacionih tehnologija. Korišćenje informacionih tehnologija i digitalizacijom procesa, omogućava se brzina i efikasnost u rešavanju svakodnevnih izazova koji se javljaju u sektoru ljudskih resursa u hotelijerstvu. U svetu ubrzanog razvoja informacionih tehnologija i konstantnog unapređenja poslovanja koje uključuje njihovu primenu, može se reći da su sve kompanije koje se bave na ozbiljan način svojim poslovnim procesima izvršile digitalizaciju HRM. Ipak postoji određeni broj hotelskih organizacija koje i dalje primenjuju klasične metode. Svesni da na individualnom nivou ne možemo izvršiti velike promene ipak ovde se ukazuje na važnost digitalizacije u hotelijerstvu.

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PROFITABILITY OF COMPANIES FROM BELEX-LINE AND MONEX INDICES – DOES EFFECTIVE TAX RATE MAKE DIFFERENCE?

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ABSTRACT:

The profitability of companies from both developed and developing countries has been examined from various aspects and previous research showed numerous profitability determinants. The Republic of Serbia and the Republic of Montenegro are two developing countries with relatively low statutory income tax rates in comparison with vast majority of European countries. Statutory income tax rate in the Republic of Serbia is 15%, whereas in the Republic of Montenegro was 9% ending with 2021, but starting from 2022 is progressive (9%, 12% or 15%). The objective of the paper is to examine whether the profitability of companies included in BELEXline and MONEX stock exchange indices differs depending on whether the effective tax rate is lower or higher than the statutory income tax rate. The subject of the paper are profitability indicators and effective tax rates of mentioned companies and the research is based on the individual financial statements available at the internet sites of Belgrade Stock Exchange and Montenegro Stock Exchange. The profitability of companies is measured by return on sales, return on equity and return on (total) assets, while effective tax rate is calculated as a relation between current tax expense and profit before tax. We find that return on sales, return on equity and return on assets generally do not differ statistically depending on whether the effective tax rate is lower or higher than the statutory income tax rate, both on the sample and country level. However, average and median values of mentioned profitability indicators are mostly higher in companies with lower effective tax rate than the statutory income tax rate.

Keywords: profitability, effective tax rate, BELEXline Index Basket, MONEX Index Basket

1. INTRODUCTION

Corporate tax systems of the Republic of Serbia (SRB) and the Republic of Montenegro (MNE) have many similarities, due to the fact that both countries were part of the former Yugoslavia. In addition, as governments of both countries strive for the European Union (EU) membership, corporate tax systems of both countries are continuously adjusted in line with the EU regulation. During the sampled period in this paper (2020 and 2021), both

countries implemented flat corporate tax systems with proportional statutory tax rates (STR) of 15% in SRB and 9% in MNE. However, it should be noted that MNE implements progressive tax system from 2022 with STRs ranging from 9% to 15%, depending on the amount of taxable profit. Taxable profit in both countries is calculated after the reconciliation of the profit before tax from the income statement. In this regard, revenues and expenses are adjusted according to the Corporate Income Tax Law provisions. There are many similarities between such adjustments in SRB and MNE. For instance, non-documented expenses, default interest paid, fines and penalties are not tax-deductible in both countries. On the other hand, there are also some differences - for instance, representation cost are tax-deductible only up to the 0.5% of total company revenue in SRB and up to the 1% of it in MNE. Standard taxable period in both countries is one year.

SRB and MNE enable companies to carry forward the tax losses. They may be carried forward to reduce the corporate tax burden in the next five years in both countries. Like most European countries, both countries do not offer companies to use tax loss carryback. Both countries offer group taxation (tax consolidation) possibilities. The regulation on group taxation is similar in both countries as parent entity should own at least 75% of the subsidiary's equity in order to be eligible for the group taxation. This taxation method is chosen on the voluntary basis and, once chosen, it should be implemented in at least five years. Probably the biggest differences between corporate tax systems of SRB and MNE may be found in the tax incentives. In this regard, SRB offers important tax incentives for companies that invest in certain non-current assets more than one billion Serbian dinars and employ a hundred workers on a permanent basis. On the other hand, MNE offers eight-year tax exemption for the newly established companies that perform business activities in undeveloped municipalities.

The objective of this paper is to examine whether the profitability of companies included in *BELEXline* and *MONEX* stock exchange indices differs depending on whether the effective tax rate (ETR) is lower or higher than the STR. The subject of the paper are profitability indicators and the ETRs of mentioned companies. The next section of the paper reviews the literature regarding the ETR and profitability. Thereafter, the research sample, methodology, and results of empirical research are presented and discussed.

2. LITERATURE REVIEW

The significance of the corporate income tax has grown in the last few decades both from the microeconomic and macroeconomic aspect. Namely, successful management of corporate income tax became the factor of the corporation competitiveness, so corporations started to compare tax burden among themselves (Dyrenge et al., 2010). Therefore, corporations strive to ensure compliance with the corporate income tax regulation, but also to minimize the tax burden as much as possible. Since STR does not capture the effects of tax planning (those prescribed by the tax law) and tax avoidance (those based on using the tax loopholes), tax researchers developed several corporate

income tax measures (see more in: Vržina & Karapavlović, 2022, 81), whereby the most popular and the most widely used measure is ETR (Hanlon & Heitzman, 2010). However, several variations of ETR exist in tax theory and practice (see more in: Vržina & Karapavlović, 2022, 81-82), because the consensus regarding the indicators employed in numerator and denominator is yet to be reached (Vržina et al., 2023). ETR does not have any standard absolute value that should be used for comparison. However, ETR should be interpreted bearing in mind STR as a reference. In this regard, researchers usually employ the following logic (Vržina & Karapavlović, 2022, 82):

- if $ETR < STR$, the corporation is successful in managing its corporate income tax burden;
- if $ETR = STR$, the corporation has corporate income tax burden as prescribed by the tax law and
- if $ETR > STR$, the corporation is not enough successful in managing its corporate income tax burden.

According to the research conducted on the sample of 10 manufacturing companies listed on the Ghana Stock Exchange from 2005 to 2012, Gatsi et al. (2013) revealed that there is a significant negative relation between corporate income tax, measured as income tax divided by operating income, and financial performance, measured by Return on Assets (ROA). It means that whenever tax burden decrease, the ROA increase and vice versa. Assidi et al. (2016) found negative relationship between ETR (tax income divided by income before tax) and ROA. They have used a sample of Tunisian listed and non-listed companies for a period from 2000 to 2010. They excluded companies belonging to the financial and real estate firms because of their accounting and tax specificities and also companies which exported totally, because they were required to submit to a particular tax regime such as income tax exemption. Among other results, Blaylock (2016) found that increase in difference between income before tax and tax income results in profitability increase of U.S. companies. He measured profitability by ROA (income before extraordinary items divided by lagged total assets) and CFROA (cash from operations divided by lagged total assets) and his sample consists of 12,396 company-year observations. Khuong et al. (2020) examined the link between corporate tax avoidance and company performance using a sample of Vietnamese listed companies over the period from 2010 to 2016. They measured corporate tax avoidance by using the current ETR and cash ETR. Their results show that ROA, Return on Equity (ROE) and Tobin Q are negatively correlated with current ETR. However, ROA and ROE are positively correlated with cash ETR.

Al-Jafari & Al Samman (2015) examined the determinants of profitability for 17 industrial companies from Oman, which are listed on Muscat securities market. Observation period was from 2006 to 2013. In addition to other research results, they found that average tax rate have negative and insignificant relationship with profitability measured by Return on Sales (ROS) and ROA. Vintila & Nenu (2016) conducted liquidity and profitability analysis of the 50 companies listed on the Bucharest Stock Exchange. Data were collected

for a period from 2005 to 2014. They did not find statistical significant influence of ETR on ROA and ROE. However, Pitulice et al. (2016) examined impact of corporate tax on financial performance of companies also listed on Bucharest Stock Exchange and found that the ETR passes the tests of significance and influences the performance indicators in a negative way.

Vržina (2018) examined whether corporate income tax planning significantly influences company profitability and market value. He used current ETR as the measure of corporate income tax planning. His research was based on the non-financial public stock companies listed on the Belgrade Stock Exchange between 2014 and 2016 and concentrates on companies whose stocks are (or were) included in *BELEXline* index basket (79 company-year observations). Among other, results of his research showed that there is significant influence of corporate income tax planning on company profitability measured by ROA and ROE, whereby profitability increases with decrease in ETR. Vržina & Dimitrijević (2020) examined profitability determinants of 50 agricultural companies in Vojvodina in the period between 2013 and 2016. They were focused on the impact of corporate income tax on company profitability. Corporate income tax burden has been proxied with current ETR and cash ETR, while profitability has been proxied with ROA, ROE and ROS. They conducted panel regression whose results showed that reduction of ETR increase the profitability of observed companies, though this impact is relatively weak.

Starting from the literature review, we have formulated the research hypothesis as follows: Profitability of companies with ETR lower than STR is higher than in the companies with ETR higher than STR.

3. RESEARCH SAMPLE AND METHODOLOGY

Our sample initially comprised 61 stock companies of different prevailing activity (financial and non-financial) – 31 stock companies included in *BELEXline* index and 30 stock companies included in *MONEX* index. The research is based on the individual financial statements available at the official websites of Belgrade Stock Exchange (BSE) and Montenegro Stock Exchanges (MSE). For companies from BSE, financial statements are available at annual reports, whereas for companies from MSE, financial statements are available at audit reports. The research relies on hand-collected data from Statements of Financial Position and Income Statements. The reporting period of all observed companies is a calendar year. We have used the income statements for 2021, which contain comparative information for 2020, and the statements of financial position on 31 December 2021, which contain comparative information for 31 December 2020. In addition, we have used the statements of financial position on 31 December 2020, because we need information on total assets and equity at the end of 2019 (beginning of 2020). It means that we relied on comparative information presented in financial statements, because „comparative amounts are more reliable than the original ones“ (Obradović & Karapavlović, 2020, 295). Observed companies from both countries are required to follow

the full version of International Financial Reporting Standards (IFRS). We believe that information presented in financial statements are generally comparable on cross-national level.

In the process of sample selection, we identified some financial statements with an adverse audit opinion (one company from *BELEXline* index and one company from *MONEX* index) and with disclaimer of opinion (two companies from *MONEX* index), and we excluded companies with such financial statements from our sample. For six companies from *MONEX* index, audit report was not available and that companies were also excluded. It means that sample now comprised 51 companies. However, observations with negative profit before tax in both 2021 and 2020 (five companies from *BELEXline* index and six companies from *MONEX* index) are eliminated as they do not have clear economic meaning (Hanlon & Heitzman, 2010). Observations with negative profit before tax in one of the observed periods (2020 or 2021) are subsequently eliminated. Finally, structure of the sample is shown in Table 1.

Table 1. Sample structure

BELEXline		MONEX	
<i>Sector name</i>	<i>Number of companies</i>	<i>Sector name</i>	<i>Number of companies</i>
C – Manufacturing	9	Industrial transport	3
K – Financial and insurance activities	5	Electricity	2
F – Construction	5	Financial services	2
B – Mining	1	Travel and tourism	2
D – Electricity, gas and steam supply	1	Fixed telecommunications	1
H – Transportation and storage	1	Oil and gas production	1
M – Professional, scientific and technical activities	1	Construction and raw materials	1
A – Agriculture, forestry and fishing	1	Banking	1
G – Wholesale and retail trade	1	Health care equipment and services	1
<i>Total:</i>	25	Computer software and services	1
		<i>Total:</i>	15

Source: Authors' calculation

We have opted to use current ETR – relation between current tax expense and profit before tax, because the reliability of reported deferred tax expense may be dubious (Brouwer & Naarding, 2018). In addition, profit before tax, used in the denominator of current ETR, may be considered as the nearest approximation of taxable profit. The profitability of observed companies is measured by ROS, ROE and ROA. We have calculated ROS as net income (profit or loss) divided by sales revenue multiplied by 100. ROE is calculated as net income divided by the average equity multiplied by 100. The average equity equals the beginning balance plus the ending balance divided by two. We have opted for basic variant of ROA (Robinson, et al., 2004, 244). It means that we have calculated ROA as net income divided by the average total assets multiplied by 100. Average total assets equal the beginning balance plus the ending balance divided by two.

Sampled companies are divided into two groups. The first group includes companies in which the ETR is lower than STR, whereas the second group consists of companies with ETR higher than STR. In that sense, we have used Mann-Whitney U test. Our choice to use Mann-Whitney U test is also supported by the fact that our variables do not have normal distribution. We use the 0.05 level (α) to determine statistical significance. The data collected is processed by using IBM® SPSS® Statistics 26 software package and Microsoft Excel program.

4. RESEARCH RESULTS

We have identified 21 companies with ETR lower than STR (8 from MNE and 13 from SRB) and 15 companies with ETR higher than STR (6 from MNE and 9 from SRB) in 2020.

Table 2. Mean and median of profitability indicators
depending the relation between ETR and STR

	Mean		Median	
	ETR < STR	ETR > STR	ETR < STR	ETR > STR
<i>Total sample</i>				
ROS ₂₀₂₀	10.3444	5.4507	11.2950	2.7250
ROE ₂₀₂₀	4.0754	3.5679	3.0759	2.7054
ROA ₂₀₂₀	2.5315	1.8656	1.5160	0.9966
ROS ₂₀₂₁	12.4550	8.6440	7.9450	6.4200
ROE ₂₀₂₁	8.3691	5.1450	7.2388	4.5628
ROA ₂₀₂₁	4.0780	3.3831	3.7299	2.2979
<i>BELEXline</i>				
ROS ₂₀₂₀	7.6090	3.9744	2.6450	1.6800
ROE ₂₀₂₀	3.4497	4.3226	2.5079	2.7824
ROA ₂₀₂₀	2.3794	2.2284	1.2419	0.9966
ROS ₂₀₂₁	8.1692	6.1422	4.7250	2.0300
ROE ₂₀₂₁	9.4504	6.1460	10.4732	4.8214
ROA ₂₀₂₁	4.4079	4.1493	4.2699	3.9386

<i>MONEX</i>				
ROS ₂₀₂₀	14.9033	8.1080	16.9100	5.3000
ROE ₂₀₂₀	4.9692	2.5617	5.2585	2.1513
ROA ₂₀₂₀	2.7217	1.3820	1.8437	1.1174
ROS ₂₀₂₁	21.0267	12.3967	20.3350	9.8500
ROE ₂₀₂₁	5.6659	4.0190	6.4198	3.3995
ROA ₂₀₂₁	3.2533	2.5212	2.5271	1.4815

Source: Authors' calculation

In 2021, we have also identified more companies with ETR lower than STR (21 companies – 6 from MNE and 15 from SRB) than companies with ETR higher than STR (17 companies – 8 from MNE and 9 from SRB). Companies with negative profit before tax in one of the observed periods (4 companies in 2020 (1 company from MNE and 3 companies from SRB) and 2 companies in 2021 (one from each country)) are eliminated as we have previously enounced.

Table 3. Results of Mann-Whitney U tests

	Mann-Whitney U	Z	Sig.	r (effect size statistics)
<i>Total sample</i>				
ROS ₂₀₂₀	84.000	-1.164	0.244	0.21
ROE ₂₀₂₀	99.000	-0.794	0.427	0.14
ROA ₂₀₂₀	106.000	-0.760	0.447	0.13
ROS ₂₀₂₁	111.000	-0.868	0.386	0.15
ROE ₂₀₂₁	128.000	-1.483	0.138	0.24
ROA ₂₀₂₁	154.000	-0.719	0.472	0.12
<i>BELEXline</i>				
ROS ₂₀₂₀	35.000	-0.816	0.414	0.19
ROE ₂₀₂₀	34.000	-0.533	0.594	0.13
ROA ₂₀₂₀	38.000	-0.178	0.859	0.04
ROS ₂₀₂₁	40.000	-0.995	0.320	0.22
ROE ₂₀₂₁	51.000	-0.984	0.325	0.20
ROA ₂₀₂₁	63.000	-0.268	0.788	0.05
<i>MONEX</i>				
ROS ₂₀₂₀	9.000	-1.095	0.273	0.33
ROE ₂₀₂₀	7.000	-2.000	0.046	0.55
ROA ₂₀₂₀	14.000	-1.291	0.197	0.33
ROS ₂₀₂₁	10.000	-1.281	0.200	0.37
ROE ₂₀₂₁	14.000	-1.291	0.197	0.34
ROA ₂₀₂₁	17.000	-0.904	0.366	0.24

Source: Authors' calculation

In the Table 2, we see that mean and median values of profitability indicators are higher in the first group of sampled companies ($ETR < STR$) than in the second group ($ETR > STR$). Table 3 shows that ROS, ROE and ROA of sampled companies generally do not differ statistically depending on whether the ETR is lower or higher than the STR. According to the Cohen's criteria (Pallant, 2011, 231), the difference between these profitability indicators of two group of companies measured by effect size statistics (r) is small.

Difference between ROS, ROE and ROA between two group of companies on the stock exchange level also is not statistically significant, except in the case of ROE in 2020 for companies included in *MONEX*. In that case, there is statistically significant difference ($\alpha < 0.05$) between the companies with $ETR < STR$ (mean and median ROE are 4.9692 and 5.2585, respectively) and companies with $ETR > STR$ (mean and median ROE are 2.5617 and 2.1513, respectively). According to the Cohen's criteria (Pallant, 2011, 231), the difference between ROE of two group *MONEX* companies is middle-sized. It is interesting that ROE in 2020 for *BELEXline* companies (mean and median values) is lower for companies with $ETR < STR$ than in the case of companies with $ETR > STR$, but this difference is not statistically significant. In the all the rest cases mean and median values of observed profitability indicators are higher in the companies with $ETR < STR$ than in the companies with $ETR > STR$.

5. CONCLUSION

Previous research regarding relationship between corporate tax avoidance and profitability are almost always carried out on companies from only one country. Contribution of this paper is fact that our sample comprised stock companies from two developing countries – SRB and MNE. In 2020 and 2021 there are more companies with $ETR < STR$ than companies with $ETR > STR$. We examined whether the profitability of companies included in *BELEXline* and *MONEX* stock exchange indices differs depending on whether the ETR is lower or higher than the STR. We find that ROS, ROE and ROA generally do not differ statistically depending on whether the ETR is lower or higher than the STR, both on the sample and country level. However, average and median values of mentioned profitability indicators are mostly higher in companies with lower ETR than the STR. In that sense, we cannot reject the research hypothesis.

Corporate tax burden is usually measured at the annual level, by using some variation of ETR. ETR is not ideal (Schwab et al., 2022), but is the most widely used measure of corporate tax burden. Future research should focus on long-run ETRs, developed by Dyreng et al. (2008), as many tax planning and tax avoidance strategies are implemented in the long-run. Although information presented in financial statements of observed companies are generally comparable on cross-national level, because those companies are required to follow the full version of IFRS, it does not necessarily mean that information

are fully comparable. IFRS are flexible financial reporting standards and offers considerable scope for companies to choose accounting policies (Nobes, 2011, 267; Obradović, 2014, 233-236; Spasić et al., 2021, 153). Next limitation of this research is sample size. Some future research should include all companies from BSE and MSE and also from stock exchanges operating in the other countries which were part of the former Yugoslavia.

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THE IMPORTANCE OF USING E-BANKING IN COSTUMER SATISFACTION

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ABSTRACT:

The purpose of this study is to show what the impact of e-banking has on customer service and customer satisfaction compared to traditional services where we are used to deliver cures to banks. In recent years in Kosovo the banking system has begun to massively provide various e-banking services and I believe that most of us also have the chance to see ads and brochures within branches regarding this e-banking service. NLB Bank and Raiffesien Bank need to build as much confidence in its customers as to be safe and comfortable. I have always had to be more open with technology and closer to the customers and fulfill their satisfaction. In order to carry out this research I have surveyed the questionnaire for the customers of NLB Banks and Raiffeisen Bank, all of whom were from Prishtina, Drenas, Lipjan and Podujeva. What has been analyzed by which consumers' satisfaction with these two banks is influenced were: how often do they use e-banking; how confident they are in the e-banking service; how much does e-banking know; Does the three-day impact on banking services and e-banking deficiencies.

Keywords: E-Banking, Customer Satisfaction, Banking Services, Tradition.

1. INTRODUCTION

Today, the Internet has become a symbol of a new era in the banking services industry. Not only that, the Internet, as a technology that has spread faster than any other technology, has undoubtedly become a locomotive of socio-economic developments. Faced with these developments, the world banking environment is undergoing a major global transformation.

Satisfactory customer service is a measure of how well a company manages to meet customer expectations through the services it provides. Information services have become a very important subject for banking systems, causing drastic changes that require banks to adopt these services in order to survive in this market where technology is playing the main role.

Kosovo is considered a small but successful example of the rapid growth of the use of information technology, regardless of the fact that 20 years ago, Kosovo was considered a technologically backward country. Today, it is possible to access personal bank accounts

and conduct banking transactions without writing at the bank counters. All this is achieved through online access to bank accounts using the e-Banking system. What should be noted is that these two banks are the most popular in Kosovo. By means of this questionnaire, they come to the conclusion of how e-banking affects customer satisfaction. During this complaint of the consumers of NLB bank and RAIFFEISEN Bank we see that e-banking helps them in realizing and fulfilling their requirements.

If a Bank fails to fulfill the demands of consumers, then that bank will lose its trust and will be completely bankrupt. Consumers are always in the first place to fulfill their demands and those demands are more open with time and as much as they feel suitable with the adaptation of technology.

2. STUDY OBJECTIVES AND RESEARCH QUESTIONS

The purpose of this paper is to analyze mainly how e-banking affects the satisfaction of consumers, the importance of the decisive role of their age in influencing satisfaction, as well as for consumers to have information about the level of security of e-banking. This research will be conducted by specifically examining the e-banking of two banks, NLB Bank and RAIFFEISEN Bank, how difficult it is for them to use and whether they can fulfill all customer requirements, as well as what percentage of consumers use e-banking.

Research Questions:

1. How does E-banking affect customer satisfaction?
2. Does the e-banking service of NLB Bank and RAIFFEISEN Bank adequately meet the needs of consumers?
3. Does age affect the use of e-banking?
4. Does it affect the increase in the use of e-banking if bank customers had more information about the security system?

hypotheses:

H1: E-banking positively affects customer satisfaction.

H2: NLB Bank and RAIFFEISEN Bank meet the needs of consumers.

H3: Age has a positive effect on the use of e-banking.

H4: Security has a positive effect on the use of the e-banking system

3. BRIEF HISTORY OF E-BANKING IN THE WORLD AND KOSOVO

Since their inception, banks have been about keeping our money safe. While they keep our money safe, they also allow us to earn an interest on the money deposited. Traditional banks have been doing this for centuries now, and today's banks are continuing in the same direction, offering traditional services as well as new services, in different ways. The spread of information and communication technologies, the increase in the use of personal computers, the ease of connection to the Internet, as well as the wide spread of mobile phones, have drawn the attention of banks to the possibility of Internet banking. Another

reason that made the use of this channel useful was the need to minimize costs and, at the same time, to increase the efficiency of banking services.

In this way, banks took advantage of the main characteristic of the Internet, interoperability, by developing the structure of the distribution of banking services to meet the growing needs of their customers and, at the same time, to increase their income. The harbinger of modern Internet home banking was remote banking over electronic media from the early 1980s.

The term 'online' became popular in the late 80s and referred to the use of a terminal, keyboard and TV (or monitor), to access the banking system using a telephone line. "Home Banking" can also refer to the use of a numeric keypad to send tones down a telephone line with instructions for banking. Online services began in New York in 1981, when four of the city's largest banks (Citibank, Chase Manhattan, Chemical and Manufacturers Hanover) offered home banking services using the videotex system. Due to the commercial failure of videotex these banking services never became popular, except in France, where the use of videotex (minitel) was subsidized by the telecom provider and Great Britain, where the Prestel system was used. Internet banking has been in circulation for a few years. Initially, it was introduced in the 80s, however, it was only in the mid-90s that it became widespread and since then, it has progressed a lot. Over the past decade, electronic banking transactions have grown exponentially. The attraction of banks for online banking are quite obvious: reduced transaction costs, easier integration of services, interactive marketing capabilities, as well as other benefits that increase customer lists and profit margins. A wave of mergers and acquisitions swept the financial industries in the mid-1990s, and in the end, greatly expanded the customer base of banks. Over the past decade, electronic banking transactions have grown exponentially. The attraction of banks for online banking are quite obvious: reduced transaction costs, easier integration of services, interactive marketing capabilities, as well as other benefits that increase customer lists and profit margins. A wave of mergers and acquisitions swept the financial industries in the mid-1990s, and in the end, greatly expanded the customer base of banks. Over the past decade, electronic banking transactions have grown exponentially. The attraction of banks for online banking are quite obvious: reduced transaction costs, easier integration of services, interactive marketing capabilities, as well as other benefits that increase customer lists and profit margins. A wave of mergers and acquisitions swept the financial industries in the mid-1990s, and in the end, greatly expanded the customer base of banks.

4. HOW E-BANKING WORKS IN KOSOVO

Global developments in the banking sector and trends in the development of technological innovations have had their effects on the strategies of Kosovar banks to offer banking services in step with those of developed countries.

Driven by the increase in competition, customer demand for new services and the great penetration of the Internet in Kosovo, Kosovar banks, starting in 2006, have launched their services on the market through the Internet. According to the data of the Central Bank of Kosovo (CBK), the number and value of e-Banking transfers is constantly increasing,

from year to year. However, this service has not yet managed to find widespread use by users due to many socio-economic factors that influence its acceptance and use. E-banking bank accounts in Kosovo, through which banking services are performed 'online', have continued to grow. In June 2017, the total number of E-banking accounts was 288.0 thousand, marking an annual increase of 33.8 percent. As well, the number and volume of transactions through the E-banking service has increased. The number of total transactions carried out through Ebanking accounts until June 2017 reached 1.58 million, which corresponds to an annual increase of 18.2 percent, while the value of total transactions carried out through E-banking accounts reached 3.84 billion euros, which represents an annual increase of 37.1 percent (CBK, December, 2017).

According to these rates and the ever-increasing trend of the use of 'e-Banking', it can be concluded that in a relatively short period of time, Kosovo will be close to the average level in the region in terms of the use of e-Banking. The growth of electronic payments proves the continuous decrease of cash payments. This results in a much lower cost for providing banking services. Therefore, Kosovar banks constantly promote their electronic platforms in order to reduce costs, increasing income and performance on the one hand and meeting the ever-growing needs of consumers on the other. In this regard, the challenges are also great since banks have to invest a lot in updating their online systems, in technology,

4.1. Banks and e-banking

Banking Science is an integral part of the science of finance, therefore its development is closely related to the development of this science. Banking science begins with the appearance and development of banking jobs, which were characteristic of the economic-social development reports of a region or a country in different regions of the world. In the Middle Ages (especially from the 13th-14th century), the exchange business was dominant, while they were constantly faced with the phenomenon of counterfeit coins. In this period, there are frequent cases of changes in the weight of the metal money.

Credit works were increasingly carried out in commercial transactions, bypassing in most cases loans of natural form (goods). It is characteristic that at this time of the development of banking science, the promissory note, which was the main instrument of payment, is also presented, especially in international trade reports. The development of banking institutions was done alongside the development and concentration of productive and commercial capital. Banking institutions have concentrated the financial capital and mobilized it very efficiently, as well as influenced the development of intermediary work, especially money circulation work.

In a more advanced concept, internet banking refers to accessing accounts, transferring funds and other online services. *E-Banking is an electronic banking service, which through the Internet enables access to the bank account and the performance of banking services 24 hours a day, 7 days a week.* In other words, we can define 'e-Banking' as one of the remote servicethrough electronic channels - the Internet. However, it should be noted that 'e-Banking' cannot function separately from traditional banking. It stands together with a

set of channels, ranging from traditional ones (such as branch counters) to automatic ones (such as ATMs, POS terminals, etc.), in order to strengthen customer-bank relations. To use e-Banking, a user must have a personal computer, internet access, browser and e-Banking account. If these conditions are met, internet banking can be done in any place and at any time. Thus, e-Banking allows direct access to account data, enabling fund transfers, bill payments, and a variety of other banking transactions.

5. COMPARATIVE ANALYSIS ON NLB BANK AND RAIFFEISEN BANK

These two banks are the most famous banks in Kosovo, and according to the statistics of the CBK, they are among the two banks that have a large number of customers. But what I have achieved is that, through this research, I can draw a conclusion that these banks are able to fulfill the demands of customers, as well as how they affect the satisfaction of their customers.

NLB Bank, one of the most successful banks in Kosovo, through extensive experience and knowledge, is playing an essential role in the development of the banking sector. Mission of NLB Bank: Our success is based on our strong commitment to provide quality services, products various banking services created based on customer needs, as well as creating and maintaining a special relationship and care towards our individual and business customers. Being part of the NLB Group, the most powerful banking group in the region, NLB Bank is in the position excellent at helping their clients achieve their visions.

This bank offers several products to its customers: Accounts, Credit cards, Debit cards, Packages, Loans, Instructions for online payments, 3D secure - online security, Transfers, Insurance.

Accounts are divided into: current account, savings account, savings account for children, time deposit accounts. The credit cards are: Contactless cards, visa classic revolving, master card, comfort card, TDA mastercard.

Debit cards are: visa personal banking, visa classic debit, maestro trust, visa student, visa electron pensioner, and maestro. The packages are: business package, student package, personal package and super package. The loans are: current loans: personal loans, vacation loans, loans covered by a deposit, loans for the purchase of an apartment, house or land, loans for education, loans within 24 hours, current campaign - loans up to 10 years without a mortgage, eco loans, loan for renovation, loan for car purchase, overdraft personal loan. Instructions for online payments - provides instructions on how to go about making online payments, where it is enabled 24 hours a day. Where this payment is made through the 3DS form, in which you have registered where you used google chrome.

3D Secure- is an automatic Internet security service that is designed to help protect NLB Bank Credit and Debit cards against unauthorized use on the Internet. The 3D secure service works by using a one-time password that the Bank sends you via SMS to your mobile phone and serves as your unique identifier for online purchases. You must then use the 3D secure one-time password to authenticate the online transaction with the online

vendors you transact with. This helps protect you from unauthorized use when you transact online.

The transfers made by NLB bank are: local and international transfers.

Insurances this bank is insured by CBK Central Bank of Kosovo. This bank provides the following insurances: 1. Personal accident insurance 2. Casco insurance 3. Auto liability insurance TPL, TPL Kosova Plus 4. Home insurance.

Raiffeisen Bank in Kosovo is a branch of Raiffeisen Bank International AG (RBI). RBI came to Kosovo at the end of 2002 by buying most of the shares of the American Bank of Kosovo. In June 2003, the Bank was renamed as Raiffeisen Bank in Kosovo. RBI offers banking and investment services and products for Austrian and international companies, a wide network of banking and leasing units in Central and Eastern Europe for corporations and retail. In addition, the Group consists of many financial services companies, for example in the field of leasing, asset management as well as in the field of acquisitions and mergers.

According to the balance sheet dated September 30, 2017, the total assets of Raiffeisen Bank in Kosovo were 887 million Euros; customer deposits 733 million Euros, while the loan portfolio was 515 million Euros. Raiffeisen Bank has a capital of 63 million Euros.

Raiffeisen Bank offers a wide range of banking services and products for all customers: individuals, small and medium enterprises and corporations. Since the beginning of its work in Kosovo, Raiffeisen Bank has been very successful supporting the development of all segments with various products, including loans and deposits.

In order to support business activities and provide high-quality services to customers through the latest technology, Raiffeisen Bank has continued to invest in information technology and operations. In recognition of this, Raiffeisen Bank managed to become the first company in the region certified for ISO 20000 by Registered Quality Assurance (LRQA).

Products and services offered by Raiffeisen Bank: Operations, Cards, Savings and investments, unsecured loans, secured loans, online services,

Operations: Current accounts, Packages for individual customers, Bank Transfers.

Cards:Credit Cards, Debit Cards, Mastercard Debit, Contactless, 3D Security Service, ATM Deposit

Savings and Investments:Time deposits, Fixed income, Custodial service

Unsecured loans:Border Loans, Personal Loans, Deposit Loans, Quick Loans, RSF Express Loans, Secured Loans: Home Purchase Loans, Consumer Loans with Mortgages, My Home Application, Online Services: Raiffeisen Digital Platform, ON, MPAY.

Raiffeisen Bank is the largest bank in the country, has many clients who access its systems, perform many services and all of them are satisfied with them. This bank has its customers as a priority for the highest quality services.

Through e-Banking, Raiffeisen Bank offers services that enable: - Checking the account balance; - Viewing and printing the account balance; - Execution of local and international payments for previously defined beneficiaries; - Review of the account balance together with the transactions carried out in your account; - Printing information from saved payments; - Execution of tax payments and pension contributions; - Execution of

municipal payments; - Exchange of electronic messages with the Bank; - Information on the loans you have in Raiffeisen bank; - Information on products and campaigns.

Likewise, NLB Banka I have its own priorities that take care of its customers and enable access to services 24/7 hours. These banks have worked hard that customer services should be clear and understandable for them.

Nlb Bank offers the following services to clients:

- Checking the account balance
- Deposit of money
- Lending based on monetary values
- Payments for various bills such as energy, water, etc.
- Information on the bank
- Information on the products you own
- Review of the balance together with the completed transactions

6. CONCLUSION

From what I have understood during the research as well as the experience in the bank with the sale of e-banking accounts e-banking is an important source of connection between the client and the bank and vice versa, thus bringing relief and reduction from the bank's side of operating costs, also increasing customer satisfaction, which is also one of the main goals of the bank, as well as saving time, expenses, and increasing the level of information about the products that the customer owns, thus pushing the banking system into a completely different level from what we are used to seeing. However, this whole connection is not an easy way to reach and there are many reasons from citizens for using or not using these banking programs. Banks must be taught to accept their mistakes and shortcomings in order to achieve a positive result without harming either party. Although, the big changes take a long time to achieve, the possibility of the operation of the e-banking product in Kosovo, considering that Kosovo is a country with an average young population in terms of age, for banks represents a good opportunity for introducing this product into the hands of the majority of the population, but as a bank, other measures should be taken in addition to price increases in bank branches because in this way customers are harmed by paying expensive services without having any idea about why these changes. According to the analyzes we have done for the customer WT of the banks NLB Banka and Raiffeisen Bank, I came to the conclusion that age and gender influence the use of e-banking. Age is a big influencer of the e-banking system, it turns out that middle age has a lot of influence, 26-35 years old use e-banking more. Likewise, the male gender has more participation than the female gender, where more than half are men with a percentage of 58% of them. This one had more dogsethat women are more unemployed than the male gender and therefore they cannot access e-banking and cannot have a lot of information.

During this research we have come to the conclusion that customers are more valuable than anything else for banks. Banks should offer services and their products have credibility and security so that they are as satisfied as possible. NLB Banka and Raiffeisen

Bank should provide consumers with as much information as possible on e-Banking, provide them with speed and security. The more information these consumers have, the greater their trustworthiness and security will be. They should also provide fast and high-quality e-banking systems.

Despite the advantages of online banking being certain, there are certain concerns and concerns where banks should take necessary steps to minimize these concerns in order to improve customer satisfaction. Therefore, banks should closely nurture and maintain a long relationship with their customers in a way that increases the customer's trust in the bank. The bank can provide formal customer training to increase customer awareness of e-banking especially to inform customers of the existence of e-banking service charges. An important dimension of service quality is the efficiency and ease of use of this service. Using a bank's electronic services offers customers an opportunity to be cost-effective in conducting transactions, not only saving money but also saving time. Timely responsiveness and effective communication, which may be essential for customers facing issues with E-Banking services, appear to influence customer satisfaction. NLB Banka and Raiffeisen Bank to increase trust towards their customers, increase security in terms of the e-banking system.

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THE APPLICATION OF ELECTRONIC COMMERCE TO SMES IN KOSOVO

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ABSTRACT:

E-commerce has enabled a competitive market, for this reason many companies are considering changing the model of doing business, in order to be as competitive as possible in the market.

In fact in a very short time e-commerce has had a very large increase. An increasing number of businesses are already offering products and services as well as communicating with their customers and suppliers via the Internet.

In developing countries, e-commerce can be seen as an opportunity for SMEs to compete with more businesses. large, as well as to have access to the identification of lower cost resources in the international market.

The purpose of this paper is to show the theoretical and practical experiences of applying e-commerce to small and medium enterprises in Kosovo.

At the beginning of this paper are presented some research questions and hypotheses which I will try to confirm at the end of the paper.

The second part presents the theoretical part of e-commerce, types of characteristics, stages, advantages and risks, while the third part presents the theoretical part of SMEs, characteristics, forms of engagement, importance and acceptance of technology by SMEs. The fourth part presents some parts from the theory of e-commerce use to SMEs in Kosovo and their importance, as well as some aspects of how E-commerce was used during the pandemic.

The results of the paper provide important information for SME development policy makers and their managers to promote the adoption of new technologies.

Keywords: *Electronic Commerce, SME, COVID-19, Internet, Customers.*

1. INTRODUCTION

The Internet is one of the greatest discoveries that changed people's lives. Nowadays, the Internet is the key technology that enables businesses, especially small and medium-sized enterprises, to improve their performance.

So, Electronic Commerce has had a very big impact on doing business recently, so that businesses can be as competitive as possible in the market.

E-commerce or as we know it as electronic trade or trade through the Internet refers to the purchase and sale of goods and services that use the Internet and the transfer of money and data for the successful execution of the transaction and the acceptance of the products to the final consumer.

Electronic Commerce has begun to be present in Kosovo as well, where most businesses have begun to offer electronic products and services and develop business communication via the Internet. So, whenever you buy and deliver something using the internet, then you are involved in e-commerce. Now even small businesses have begun to use e-Commerce, believing that it will help them to have an increase in the way they do business and benefit as many consumers as possible.

This study is based on the use of scientific literature from various fields such as: e-commerce, small and medium enterprises, information technology. The main purpose of this study is to analyze whether electronic commerce is being applied to small and medium enterprises. In summary, the scientific paper that we present will include: to present some theoretical aspects of electronic commerce and small and medium-sized enterprises from different authors, to identify the advantages, risks and difficulties of electronic commerce and SMEs, to identify the stages of electronic commerce, types, characteristics, and benefits from electronic commerce, to develop an empirical research regarding the use of electronic commerce in small and medium businesses in the Municipality of Prishtina;

2. ELECTRONIC COMMERCE CONCEPTS

E-Commerce at its root level can be described as an electronic method of doing business, usually or within a company, communication between the Internet. However, broadly defined, "Electronic commerce is a modern business methodology that addresses the needs of organizations, merchants, and consumers to reduce costs by improving the quality of goods and services, and increasing the speed of service delivery." (Kalakota & Whinston, 1997). One of the common definitions of e-commerce: is the buying and selling of goods and services on the Internet.(Shim, Pendyala, Gao, & Sundara, 2000).

E-Commerce is not only about buying and selling on the Internet, but also includes all forms of business activities that take place over the Internet (eg, business-to-business information flow between business enterprises, online advertising , etc.).(Learthat, 2004). E-commerce can be defined as a modern business methodology that addresses the needs of organizations, merchants and consumers to reduce costs while improving the quality of goods and services and increasing the speed of service delivery, using the Internet.(Goel, 2007) . "Electronic commerce is the conduct of business activities that lead to an exchange of value over telecommunications networks."(European Information Technology Observatory) . E-commerce, simply defined, is the commercial transaction of services in an electronic format. (Transatlantic Business Dialogue Electronic Commerce White Paper, 1997). "Electronic commerce refers broadly to all forms of transactions related to commercial activities, including organizations and individuals, which are based on the processing and transmission of digitized data, including text, sounds and visual images." (Measuring Electronic Commerce, 1997).

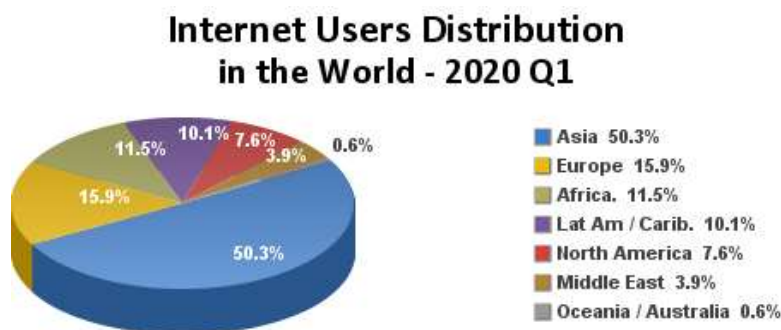
2.1. Theoretical Aspects of Electronic Commerce

The Internet has changed the way we live our lives. Every minute of our life added by using it to share our view, virtual engagement on social networking sites, digital entertainment, marketing and even buying and selling. If organizations want to take advantage of the latest Internet technologies, then they must take the strategic initiative. One of the most significant areas where the company can focus is E-commerce.

Revolutionary era - E-commerce is one that grows and continues to constantly change the way business is run. Moreover, it becomes the basis for a new form of business all over the world. Moreover, the industry's value chain has been redefined by E-Commerce and poses challenges for the new complex competitive environment. When we think of e-commerce, the first thing that comes to mind is Amazon, Flipkart, an online shopping website for retail goods. In simple words as e-commerce means buying and selling online. The definition of electronic commerce in modern times means that a transaction qualifies as electronic commerce if it typically uses the World Wide Web, at least at every point of the transaction. Despite the fact that e-commerce is one of the most used terms in the Internet age, the word can mean different things to different people.

Products and structures: direct provision of commercial services to consumers and business partners, inter-organizational information exchange and collaboration, and organization of electronic markets and supply chains.

The chart below summarizes the main statistics up to March 2020 on internet usage by main continent.



Source: Internet World Stats - www.internetworldstats.com/stats.htm
Basis: 4,574,150,134 Internet users in March 3, 2020
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Graph.1. Internet usage by major continents(Source, Author).

The development of the Internet has influenced the economic development of each of the countries, accelerating the development of the industry based on information. In this way,

the spread of Internet technology in business has influenced the way it is carried out, considering that the number of Internet users has increased at high rates. These developments have affected the progress of businesses, not only in developing countries but in every country.

2.2 Advantages, difficulties and risks of Electronic Commerce

Advantages of e-commerce Firms are interested in e-commerce because it can simply help increase profits. All the advantages of e-commerce for businesses can be summed up in one statement: e-commerce can increase forgiveness and reduce costs. Well-done Web advertising can get even a small firm's promotional message out to potential customers worldwide. A firm can use e-commerce to reach small groups of customers that are geographically dispersed. The Web is particularly useful in creating virtual communities that become ideal target markets for specific types of products or services. A virtual community is a collection of people who share a common interest,

2.3. Disadvantages of Electronic Commerce

Some business processes can never be borrowed in e-commerce. For example, perishable foods and high-cost unique items such as custom-designed jewelry may be impossible to adequately inspect from a remote location, regardless of technologies that may be invented in the future. However, most of the disadvantages of e-commerce stem from the novelty and rapid pace of development of the underlying technologies. These disadvantages will disappear as e-commerce matures and becomes more available and accepted by the general population. Limitations of e-commerce can be classified as technological and non-technological.

Technological limitations: For the e-commerce system itself, there is no universally accepted standard for quality, security and reliability. E-commerce development tools software is always evolving, and there are difficulties in integrating Internet and e-commerce software with parts of existing applications and databases.

Non-technological limitations: Lack of trust is one of the main reasons why customers are unwilling to accept electronic subscription due to privacy and security concerns. Some C2C action organizations are under an undisputed payment environment, in which a customer's number can be stolen in the payment process. However, the latest payment systems can solve this kind of problem. The risk of hackers accessing customer files and corrupting accounts is also related to privacy and legal issues.

3. THEORETICAL ASPECTS OF SMALL AND MEDIUM BUSINESSES

There is no single globally accepted definition of SMEs. Of course, identifying the "size" of firms is complicated by the lack of a generally accepted definition of an "SME". Strictly defining SMEs has always been difficult. Stakeholders have used specific criteria to

operationalize SMEs such as an added construction value, asset value, annual sales and number of employees.

In such a society, to be successful, SMEs would need high quality information and should always offer superior value, better than competitors, when it comes to quality, price and services [Pollard , 2006].

SMEs are often seen as vital to the growth and innovation of economies and the length of economic development of countries depends on the promotion of the SME sector (Ramsey, 2003).

For a growing number of researchers and reporting organizations, SMEs are generally considered to employ no more than 250 people and have annual sales of less than 50 million.

According to (Preston, 1986) an SME is one that is independently owned and operated and that is not dominant in its field of operation. Although the term small and medium enterprises (SMEs) is perceived by many authors as a vague parameter that does not lend itself to a simple definition, the definition of an SME is necessary to avoid misunderstanding the term.

A small and medium-sized enterprise (SME), we refer to an enterprise that carries out small and medium-sized production, employing less than 250 employees. (Norwegian Trade Council, 2002).

3.1. The importance of small and medium businesses

Small and medium-sized enterprises (SMEs) have a very important economic and social role, due to their contribution to the operation of the economic network and to the creation of jobs. The development of SMEs offers many employment opportunities, which can help reduce the level of unemployment and face the demographic challenges of these populations, which are growing rapidly.

SMEs make special contributions to developing economies - in growth, employment, productivity and investment and therefore deserve special support. However, the literature does not provide conclusive evidence of a greater contribution of SMEs than large firms to growth and employment in developing country contexts, and there are significant gaps in knowledge.

4. APPLICATION OF ELECTRONIC COMMERCE IN KOSOVO

In the latter part of the twentieth century and the beginning of the twenty-first century, the Internet and mobile phones not only changed the face of communication, but also gave impetus to economic growth. Information technology is playing a critical role in contemporary society. It has transformed the whole world into a global village with a global economy. Information technology, which includes information and communication technology (ICT), affects organizations in different ways. The use of information technology in SMEs in Kosovo is finding rapid use due to many advantages such as cost reduction, effective and rational promotion, faster communication, faster realization of products and services, etc. For more,

The Internet is one of the greatest discoveries that changed people's lives. Nowadays, the Internet is the key technology that enables businesses, especially SMEs, to be adopted internationally to improve their performance. The history of the Internet and the digital future show the history of the development of the Internet from the 1950s to the present day, (Ramaj.V, 2016)

The use of new technology in SMEs in Kosovo, under the new economy and globalization, has increasingly expanded in business cooperation between business partners and customers. Small and medium-sized enterprises in Kosovo began their development in the early 1990s. However, due to constant pressure from the regime, they do not mark a significant development.

Their rapid development started only after 1999 when it also started to become the main generator of employment and general economic development of the country.

Internet penetration and use in Kosovo is comparable to developed countries. There are many factors that contribute to these high levels, some of them are related to the average middle-aged population of Kosovo, many families that have relatives living abroad (diaspora), the general culture, the political orientation of the country, the geographical position of Kosovo, etc.

The Internet is used by everyone. Most of the population of Kosovo (81%) use the Internet every day. And the Internet is used by the absolute majority (96%) of the population of Kosovo at least in some cases. Only 3% of respondents stated that they never use the Internet.

4.1 Application of electronic commerce to small and medium businesses in Kosovo

Overall, new technologies had a major impact on all aspects of life, and global society and the economy are undergoing a fundamental transformation. The current society is changing and becoming a "knowledge society". It depends more on new technologies, with a new economy or "knowledge economy", where knowledge and information are essential and the main factor of production. Information technology will continue to be of prime importance in the development of countries, economies and enterprises.

Today, new technologies, especially Internet technology, are changing the global flow of information, trade and investment and the competitive advantage of industries, services and regions.

These changes require all enterprises, regardless of their size, to invest in the adoption of a new technology.

The ability to survive in an increasingly competitive and global environment is largely influenced by their ability to access information as a resource and use new technologies. Greater use of these technologies is often associated with improved information availability, quality of work, effectiveness and efficiency in accomplishing tasks.

Considering the full potential of these technologies, they can also play an important role in the future.

Many governments have an active policy of intervention to promote the adoption of the Internet in SMEs, so knowing the importance of the Internet, the government of Kosovo

is paying attention to supporting SMEs in terms of the necessary technical infrastructure. SMEs are generally willing to develop e-commerce systems or change current business models. In this knowledge society, firms must develop competitive advantages based on an adequate and intensive use of information and communication technologies (ICT), which is an essential element of success in today's market.

This fact is particularly important for enterprises. small and medium-sized enterprises (SMEs), whose survival depends, among other factors, on the use of ICT to develop new organizational models.

5. EMPIRICAL ANALYSIS OF THE WORK

The data collected for conducting the research include various businesses with scope in Kosovo, respectively 100 questionnaires were completed by the businesses. The data were collected in a period of one month due to the challenges of the reluctance of businesses to complete the questionnaire. The data has been carefully analyzed by compiling a database with all the answers of the questions. To carry out the empirical part of the study that gives us the answer to the research questions and hypotheses, we used different analyzes with the SPSS program. The variables are defined depending on what was analyzed as the hypotheses were defined so that the dependent variable is not always the same question. To perform the necessary empirical analysis, we used the statistical program SPSS 23. The data processing process in this program went through a series of stages. Initially, the data were prepared in SPSS, where the variables were codified. The data were then checked to identify possible errors, then continued with the measurement of variables, the calculation of descriptive statistics, and finally, through linear regression analysis, the main findings and results of the study were established. This case study was done through 100 questionnaires in 15 companies, in the municipality of Prishtina. The fortunes of these companies were different. I made the selection of companies in a spontaneous way in some companies that used electronic commerce in the municipality of Prishtina. For each question I will draw my conclusions based on the respondents' answers. The Linear Regression Model defines the dependent variable and the explanatory variables that are included in the analysis. The study uses different questionnaire questions as variables so that the study gives the desired and most accurate results. Three of the questions in the study are presented as dependent variables that depend on the independent variables obtained in the same questionnaire since the entire analysis is used to show the importance of the use of e-commerce by businesses.

6. CONCLUSIONS AND RECOMMENDATIONS

The development of electronic commerce has influenced the change of the model of doing business. The business can be contacted directly by customers, eliminating several links. Also, customers can be more informed about the products that are offered, by accessing electronically on the website approved by the business. Relevant contact methods include: email, website, various programs to complete the purchase, etc.

Meanwhile, from the analyzes identified in the relevant reports, it is identified that the highest percentage of businesses in Kosovo is made up of individual businesses. An important aspect in Kosovo is the increase in the number of Internet and computer users. Meanwhile, in relation to the rate of demographic spread of the Internet, the corresponding percentage reaches about 93% of the population.

Most of the SMEs in Kosovo were characterized by small investments in the field of innovation. These show that the sector of small and medium enterprises is in the first stages of development, also influenced by the transition period that characterizes the state of Kosovo. However, the situation is different during the last years, due to the incentives received by the business for the possibility of its development.

While, in relation to the results obtained in the questionnaire, they see that with the gender of the head of the business, it is noted that in about 65% male heads are identified, while 35% of the female heads, where they see that mostly businesses are led by male heads, but with an increase from time to time also of the female gender, we mainly see that the most interviewed were the owners of businesses that had a smaller number of workers.

These companies were operating in the market more in the last years, i.e. 1 to 6 years, and were companies that offered more services, and where we see a large number of these businesses had access to the Internet and were owners of Web pages, and that for a period of 1-3 years were users of E-commerce and most had adopted e-commerce voluntarily, i.e. 64%, but a percentage of 36% was referred to as a consequence of external pressures referring to the competition.

Questionnaire research identified the need for business to show more interest in consumer demands. They should present and receive more information about consumer behavior, with the aim of identifying emerging needs and orienting the business towards meeting them. Businesses need to advertise more relevant products by identifying an appropriate marketing strategy, which is different for different categories of consumers.

E-commerce constitutes a new way of developing the purchasing process, which has an impact on all people across the country. It has helped create a new way of behaving and interacting with the product. In this way, individuals can have access to the phone or computer to be able to buy the relevant products, having the possibility of paying them immediately electronically.

The development of electronic commerce is influenced by the development of technology, which has influenced the change in the shopping process. Improving the technology first requires that it be understood by all individuals, before they engage in the concrete actions of the purchase process. Knowing the respective advantages and disadvantages will help to reduce various errors on the Internet, which also affect the following reliability towards them.

Small and medium-sized businesses must change their business structure or strategy, in order to be able to respond to the demands of customers, who are being oriented by online services. They should carefully study the market where they will operate and build a business model that is suitable for electronic commerce.

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THE ROLE OF MOTIVATION IN THE MANAGEMENT OF HUMAN RESOURCES IN THE PRIVATE SECTOR

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ABSTRACT:

Kosovar businesses are not paying enough attention to the issue of human resources management. The dominance of micro and small enterprises with few levels of organization in Kosovo also dictates that there is no space for the HR department in the organizational structure of the enterprise. Most of the owners are also managers of the enterprises, and they manage the work and human resources with as much skill and knowledge as they have.

In this study, we have presented the importance of good human resource management in employee motivation with particular emphasis on the private sector, what human resource management actually is, what motivates employees to perform work, and how the elements influence of management in their motivation.

It is noted that in very few enterprises in the private sector the HR department is present, the Labor Law is not properly implemented and the current motivation of employees does not provide stability of the labor force in Kosovo. Recent flows to the outside world are the best indicator of their satisfaction with the job offer. Who is to blame? Most of the blame lies with the management of the enterprises, which is not seeing the employees as a competitive advantage, as the most valuable asset of the enterprise and is not appreciating their work, but a large part of the blame is also with the government of which, despite the existence of adequate Laws, is not properly using its instruments for the implementation of these laws. The management of Kosovar businesses must take care to create, preserve and advance the human values of employees through the use of different forms of motivation, and respect for the Law.

Keywords: *Management, human resources, motivation, employees, private sector,*

1. INTRODUCTION

This paper is focused on the role of motivation in the field of human resources management in the private sector. Nowadays, with pronounced trends towards globalization, when innovation has become a dominant element in the context of economic-social developments, businesses face new challenges related to the management of their resources. It is important for everyone, and especially for managers, to understand

these challenges well in order to increase the chances of success through more effective responses. Achieving challenging changes, economic growth, global stability and business success will increasingly depend on innovative management and leadership. As is well known, the environment in which organizations operate today is constantly changing, and is becoming increasingly unpredictable. private sector, in the Albanian economy, it is expanding day by day, and the public sector uses more and more competitive management practices with those of the private sector. During this process, many enterprises are closed, privatized and restructured, affecting the level of employment throughout the country. Although the unemployment rate continues to remain relatively high, which makes it easier to find labor in the labor market, Kosovar organizations are becoming increasingly aware of the necessity of recruiting employees with the necessary skills and motivation. properly. In developed countries, well-selected and motivated human resources are today considered a competitive advantage for companies. During this process, many enterprises are closed, privatized and restructured, affecting the level of employment throughout the country. Although the unemployment rate continues to remain relatively high, which makes it easier to find labor in the labor market, Kosovar organizations are becoming increasingly aware of the necessity of recruiting employees with the necessary skills and motivation. properly. In developed countries, well-selected and motivated human resources are today considered a competitive advantage for companies. During this process, many enterprises are closed, privatized and restructured, affecting the level of employment throughout the country. Although the unemployment rate continues to remain relatively high, which makes it easier to find labor in the labor market, Kosovar organizations are becoming increasingly aware of the necessity of recruiting employees with the necessary skills and the right motivation. In developed countries, well-selected and motivated human resources are today considered a competitive advantage for companies. Kosovar organizations are becoming more and more aware of the necessity of recruiting employees with the necessary skills and the right motivation. In developed countries, well-selected and motivated human resources are today considered a competitive advantage for companies. Kosovar organizations are becoming more and more aware of the necessity of recruiting employees with the necessary skills and the right motivation. In developed countries, well-selected and motivated human resources are today considered a competitive advantage for companies.

2. HUMAN RESOURCES MANAGEMENT THEORETICAL TREATMENT

The greatest asset value worldwide is precisely human capital. Therefore, the management of human resources plays a decisive role in the process of increasing the effectiveness of companies. One of the most important functions of HRM is motivation. The importance of motivating people at work is evident at all levels of the organization. Starting with managers who need to be aware of the factors that motivate their subordinates to make them perform better. In this way, companies need motivated employees and without any doubt we say that motivation is an important aspect of HRM. However, due to the inherent complexity of human behavior, motivation is not easy to understand and use. Despite

many studies on this topic, managers today are not able to understand and use this. Many companies in the first half of the century (Kovach, 2018) have used money as a powerful monetary incentive to motivate employees. Performance related to pay definitely became the slogan that has been used by many companies. The question that has arisen is if there are other options for employee motivation to be effective?

The literature on motivation shows that there are several other ways to motivate employees. This is also evidenced by the frequently cited theories, which can be divided into two categories: content theories and process theories. The first group is focused on what motivates people. The main representatives of these theories are authors such as: Maslow, McClelland and Herzberg, who are known by almost everyone who has read about motivation. The second category includes process theories, which try to find out how motivation occurs. The main representatives are authors such as: Vroom, Adams, Locke and Latham. The views presented by these authors of these theories are in some aspects complementary, but in others they are completely opposite. This was perhaps the reason for the inspiration for other researchers to conduct their own studies on motivation. This resulted in a large number of suggestions about motivational elements, which can play a decisive role in increasing employee performance. Some authors (Oldham & Hackman, 2010) show that work design plays an important role in the formation of employees. While others (Roche & MakKinon, 1970; Allender & Allender, 1998; Lu, 1999; Tharenou, 1993; Mayfield, Mayfield, & Kopf, 1998) suggest that leadership style and the freedom given to employees are crucial in their motivation. Another group of researchers (Luthans & Stajkovic, 2000; Armstrong & Murlis, 2004) try to prove that evaluation can be used to motivate people to perform jobs better. With all these possible options it is not easy to answer the question – what really motivates employees. The easiest way to find this out is to simply ask them. Employees are often asked to rank the importance of motivational factors. Some researchers have studied the responses of employees. In their studies they compared responses from employees coming from different cultures, age groups, levels of organization. Their results showed that the importance of motivational factors may differ for specific groups of people. However, there are some motivational factors that are very often ranked high. Most of the studies have analyzed the importance of motivation factors in people who have already tried the work experience. answered the question - what really motivates employees. The easiest way to find this out is to simply ask them. Employees are often asked to rank the importance of motivational factors. Some researchers have studied the responses of employees. In their studies they compared responses from employees coming from different cultures, age groups, levels of organization. Their results showed that the importance of motivational factors may differ for specific groups of people.

2.1. Concepts of human resources

According to a basic definition, by resource we mean anything that has a value, that is available and is useful for the production of other resources.

The definition of resources, in addition to availability, also considers validity and usefulness. According to Barney (1991), resources lead to a competitive advantage when they are:

- precious,
- rare,
- inimitable and
- irreplaceable.

The value and usefulness of a resource can change as people's needs do not stay the same over time. In the continuation of the paper, we will learn how the meaning and purpose of human resources has changed throughout different periods of time in the history of business.

2.2. The importance of the human resources department

The rapid changes that occurred in Kosovo after 1999 are the result of the political changes that followed the economic changes. In this context, engaging in economic studies in the entirety of the problems that include them is a necessity. One of the directions of very delicate research work is the management of human resources.

The economy and society are experiencing very rapid changes in recent decades. For this reason, enterprises and businesses in general are faced with great challenges to maintain their existence, growth, development and their competitive level. This requires businesses in general to be constantly adapting to the conditions. The dynamics of adaptability is also conditioned by the state and developments of human resources. Human resource management problems in their entirety help businesses to be competitive through value creation. Traditionally, value has been considered and treated only from the point of view of material value. With the birth and development of Human Resource Management as a science, value was also addressed from the perspective of human value. From this point of view,

In a complex, dynamic situation and in a very difficult economic environment, the Human Resources of the enterprise are evaluated as a strategic factor of the enterprise's success. This is not simply justified by the fact that qualified collaborators are difficult to secure, and access to their professional skills and knowledge requires a special skill. These developments position HRM at the center of the company's tasks and functions. The co-worker as a person at the center of the entrepreneurial performance process, is the main actor in the work process, therefore it is in the interest of the analysis to find the essential characteristics that identify the co-worker with the enterprise (Pareti, 2-05).

Increasing human productivity as an organizational element can be closely related to the willingness to work, the ability to work and the opportunity to work. Since people voluntarily are "elements" of an organizational system, they can be managed because people are willing to contribute. The relationship between ability and willingness to contribute at work is complex. Co-workers who are satisfied with their work are more committed to their work than unsatisfied co-workers. Co-workers' social support has a major impact on motivation. In developed countries, cooperation between enterprise and

social instruments are finding more and more use. Here in most cases, from the point of view of the enterprise,

3. MOTIVATION OF EMPLOYEES THEORETICAL TREATMENT

The term motivation is usually explained as the desires, needs, emotions or indications that make someone do something. Following this definition, motivation is the state of being driven to action. When we consider work, we also refer to the environment within which we work. Typically, this refers to company engagement, collaboration, etc. Of course, this definition from the International Encyclopedia of Organizational Studies (ed. Bailey & Clegg, 2008) is only one example from the large number of definitions of motivation at work. Some authors define it as "a psychological process resulting from the mutual interaction between individuals and the environment that affects a person's choice (Latham & Ernst, 2006). In other definitions, motivation at work is related to goal achievement. People are motivated to do something if they believe it is likely that it will bring about the desired result (Armstrong, 2000). People who are motivated expect to achieve their clearly defined goals (Armstrong, 2007). Kanfer (1990, cited as in Bjorklund, 2001) emphasized that motivation is a phenomenon that cannot be seen directly, but we can analyze the causes of these behaviors to understand it better. There are many definitions of motivation. However, there are some characteristics of motivation that are common to most definitions. This can be seen from the examples presented above that when the authors describe motivation they mention a specific and consistent action or behavior as a result of motivation.

"Motivation at work is a set of energetic forces that originate both within and beyond the being of an individual, to initiate work related behavior, and to determine its form, direction, intensity and duration".

Pinder (1998) believes that the presented definition has several characteristics that make it better than others. First, it is not general, like many other definitions, it presents motivation in a close connection with work and career. Its definition is intended to apply behaviors such as joining or leaving the company, being punctual, respecting or disobeying the superior's orders, inventing ways according to him that are best for doing a job and accepting relocation to another place. According to Pinder, a key element that is important in determining motivation is a concept of strength. This not only makes the definition consistent with that of other authors, but also allows the level of motivation to be weak or strong depending on the circumstances. The idea of force suggests that motivation is related to an effort. Pinder believes that effort is a consequence and an indicator of motivation rather than the same phenomenon. The important elements of motivation at work according to Pinder are: intensity, direction and duration. The author describes the intensity dimension using two terms coined by Brehm and Vetw (1989): Potential motivation and potential arousal. The first of these two terms is created by the behavioral expectations of performance which affect the final outcome. The second term is dependent on the likely magnitude of motivation occurrence and occurs only to the extent that the behavior in particular is difficult. The intensity of Pinder's opinion is not

affected by the available potential and is defined as the temporary size of motivational elements at a given moment in time. In this regard, it can be understood to which goals the motivation is oriented. Finally, duration suggests that goal attainment may be a potential outcome of work behavior. Finally, but also a very important quality according to Pinder's definition is the fact that motivation is presented as a hypothetical construct which cannot be measured or seen directly, but is treated as an existing psychological process.

4. RESEARCH RESULTS AND DATA PRESENTATION

The main objective of this paper is to assess the current situation of employee motivation and encourage enterprises to pay more attention to motivation as a concept. The object of the study was the motivation of employees, especially those in private enterprises in Kosovo, namely in the municipality of Pristina, due to the fact that the private sector in Kosovo has a very important role due to the fact that it has significant natural and human resources for to be a stable economic sector, but despite this, those resources remain little exploited, while this sector is facing a strong competition from abroad, and therefore, requires a new approach, in order to ensure a deserved place in the Kosovar and regional economy.

Among the decisive factors that affect the performance of the employees is the motivation of the employees for work and thus also the satisfaction at work. In order to increase the motivation of employees for work, some prerequisites must be provided. Among these are mainly the relevant conditions of leadership in the enterprise, which contain qualitative aspects. Even the company's culture contributes to the identification of Human Resources and affects the work atmosphere.

4.1. Analysis of survey results

Through the survey we have collected data from 90 businesses in the municipality of Pristina, in the 99% confidence interval. Mainly, this study is focused on private sector enterprises, due to the fact that in the private sector there are opinions, initially, there is a lack of good management of human resources, and as a result of good management, employee motivation is also lacking. The survey was conducted only with the employees of the enterprises, who were previously informed about the purpose of our survey, and the same agreed to talk about their working conditions under which they perform their work. In order to obtain the most real and comprehensive information, we focused our research on 30 construction companies (construction, plastering, plumbing, electrical installation, ceramics, etc.), 30 hotel service companies. The questionnaire used in the development of the survey was composed of 30 questions, through which we obtained information initially related to the establishment of the employment relationship, the workplace, the issue of vacations, salaries and bonuses and many other related areas. with human resource management and employee motivation. In this case, we obtained structured data, which we then analyzed and compared with the presented hypotheses.

4.2. Survey results

In order to have a better overview of the situation in the field of Human Resources motivation in Kosovo, namely in Pristina, as we mentioned above, the research was conducted in 90 (ninety) construction, service, manufacturing and commercial enterprises, in which are researched the factors that motivate employees from the employer's point of view.

The research conducted with 340 employees points out that Herzberg's two-factor theory, in Kosovo conditions, needs some modifications. According to the research developed by Herzberg, the main hygiene factors, in order, are: company policy, technical competences of the leader, personal relationships with the leader, working conditions, income and so on, while the research done in Kosovo pointed out that the main hygiene factor, in order, are: income, working conditions, company policy, security, status, impact on private life and so on. As for the motivators, the research in Kosovo shows that there is a significant difference where the salary is the second motivator according to the percentage of respondents, but also some other hygienic factors are presented as a significant motivator such as: working conditions, personal relationship with colleagues, security, personal relationship with the leader. According to the research in Kosovo, the technical competencies of the leader do not play a significant role as a motivator.

The individual processing of the data leads to the information that the enterprises which are well positioned in their branch or in general in the Kosovar economy, use in a considered way appropriate motivational instruments as recognition for the work done, appreciate the contribution and success, for the workplace, they offer a professional content of jobs and tasks, to the employees, in addition to asking you for responsibility, they also offer you competences, professional advancement is a follow-up part of the job, advancement in position is applied as a form of meeting the presented needs. Our research is oriented on several elements as follows:

- ✓ Regulation of the employment relationship
- ✓ Work job
- ✓ Working hours
- ✓ Work environment
- ✓ Work in one place or variable
- ✓ Work in the profession or outside it
- ✓ Leadership style and organization
- ✓ wages
- ✓ Special rewards
- ✓ Use of holidays
- ✓ Organized vacation
- ✓ Children's scholarship
- ✓ Professional development

4.3. Research results

Regulation of the labor relationship - as far as the regulation of the labor relationship is concerned, this issue is quite worrisome, especially in the field of construction and hospitality due to the fact that these two activities have taken on a more seasonal nature. Some of the respondents state that although they are paid pension contributions and salary tax by the employer, the declared salary is less than the real salary and they have never signed any written contract on the establishment of the employment relationship nor who enjoy the rights derived from the employment contract. From our survey we received information that still at this time, about 48 percent of respondents work without contracts at all, 25 percent of them have 6-month contracts, 15 percent of them have 1-year contracts, 12 percent contract 1 to 5 years and none of them had a permanent contract. About 18 percent of respondents state that they have submitted applications for work visas in the West and are awaiting processing of those applications.

5. CONCLUSION

- ✚ Enterprise owners and managers are increasingly paying attention to engaged human resources, but there is still a need for improvement.
- ✚ Engaged human resources are increasingly aware of their rights and duties arising from the labor relationship in the market economy.
- ✚ The issue of employee motivation requires a professional approach.
- ✚ Motivation is a problem of a complex nature that is difficult to understand and even more difficult to implement.
- ✚ Business leaders in Kosovo were not fully aware of the impact of motivation on total quality management.
- ✚ The Labor Law is not being implemented properly, especially in areas such as: the establishment of the employment relationship, working hours, use of vacations and other areas, about 48 percent work without a contract and it is dominated by six-month contracts, extended hours of work and about 80 percent work more than 40 hours a week, a very small part enjoy the right to use holidays.
- ✚ The working conditions are assessed as not good, the workplaces are considered moderately satisfactory, the work environment is relatively satisfactory but requires improvement, the work in one workplace dominates, mainly the employees are outside the profession that the workplace requires.
- ✚ It is estimated that the salaries should be higher but they are limited by the possibilities, in most cases monthly salaries are applied, the maximum declared

salary (not according to the official declaration) is 800 euros and the minimum declared is 160 euros.

- ✚ Employers and managers estimate that the main motivator is the salary. Then come important motivators: self-employment, payment regularity and relations with employees.
- ✚ The number of inspectors, especially labor inspectors, is very small compared to the number of businesses, their visits, perhaps due to the small number, are rare and in very few cases they apply penalties for violations of workers' rights by the employer.

Recommendations for this paper are:

- ✓ It is necessary to increase the number of inspectors, especially the work inspectors.
- ✓ It is necessary to work towards the preparation of human resources capable of recognizing, evaluating and implementing efficient forms of motivation.
- ✓ Other forms of motivation should be applied to achieve the best possible results.
- ✓ Greater importance should be given to the development of human resources.
- ✓ Different forms of survey should be applied, in order to better know the opinion and attitude of the employees, as well as the application of valid proposals as well as checking the results obtained from the changes undertaken.
- ✓ The experience of other countries in the region should be recognized in relation to the motivation of employees, the processing industry that uses agricultural products as raw material, special care should be taken because a population that uses healthy food has a good life expectancy perspective but also reducing the expenses of medical care, and with this a great contribution would be made in saving the family and state budgets.
- ✓ The issue of human resource development in the field of processing industry, especially that which uses agricultural products as raw material, should be given special attention, because through this we help the development of agribusiness and agriculture in general and with this we influence the reduction of unemployment .
- ✓ Conducting a complete study on motivation in Kosovo, for reasons already made public, is a necessity.

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THE IMPACT OF MARKETING ON THE RECRUITMENT PROCESS IN THE INFORMATION AND COMMUNICATION TECHNOLOGY SECTOR IN KOSOVO

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ABSTRACT:

There are many job openings in the field of information of communication and technology in Kosovo. ICT companies are growing fast. Most of these companies export their services abroad. In order to grow, companies need a qualified labor force. These companies are competing with each other to attract qualified labor force in the field.

The aim of this study is to explore what marketing communication practices do ICT companies apply, in order to attract the qualified labor force. What are the job attributes of vacant positions, that companies consider to be important in attracting the labor force. How do companies communicate the offer of vacant positions toward their labour market and what are the barriers to this communication.

The method used in this quality research study is Grounded Theory. Empiric data are collected from eleven deep interviews with unstructured questionnaires, done with eleven ICT companies in Kosovo. Data from interviews are coded and have led to building three categories which served in answering the research questions. The three emerged categories from coded material were: Job attributes; Communication; Noise and environment

Salary, culture of company and skills of the candidate emerged as the most stressed attributes of the open job position. Job advertisement – as advertising; recommendation for open job position – as the word of mouth and Head-hunt method- as direct marketing and personal sale, were the most used ways, by ICT companies, in communicating the offer for open job positions to the labor market.

Keywords: *Information and Communication Technology, Kosovo, competition, qualified labor force, marketing communication strategy*

1. INTRODUCTION

No matter how much is talked about the ICT industry (Information and Communication Technology), it will never be possible to say the whole thing. This is because this field has expanded so much and has extended its influence to almost all other fields and industries. It is clear that ICT and the Internet are of vital importance in helping to sustain business

activities, employment, education, provision of basic services to citizens, entertainment, and socialization.(Martin, 2021)

In recent decades, information and communication technology has aided economic growth and social progress.(Doong & Ho, 2012)The latest data shows that in 2021 about 4.9 billion people in the world use the Internet, or 63% of the world's population. This is an increase of 17%, or 800 million people from 2019, who have joined the Internet.(Martin, 2021)

Only when, in 2018, the pandemic engulfed the whole world, even people who were not in the field of ICT managed to understand the true and great importance of technology in general and ICT in particular.

With the development of technology and the possibility of constant communication between people from different parts of the world, the presence of globalization is being observed more than ever.(Hoti, 2018)

With such a large scope of the ICT industry in the world, in addition to the many solutions that this industry offers, there are also some challenges. The main challenges are: the coverage of the world's population with ICT services, the ability of a part of the population to use ICT services and the workforce that this industry needs. Both the coverage of ICT services and the education of the users of these services are directly related to the workforce of this industry.

With the increase in the need for ICT services, the demand for the workforce of this sector has also increased. The disproportion of the demand of the ICT industry with the supply of the labor market also brings problems for ICT companies.

2. MARKETING FUNCTION AND HUMAN RESOURCES

Good marketing is no accident. It is both art and science. It is the result of careful planning and execution through sophisticated tools and techniques. Marketing is about identifying and meeting human and social needs. The American Marketing Association's formal definition of marketing is: marketing is the activity, group of institutions and processes, for the creation, communication, provision and exchange of offers that have value for the consumer, client, partner and society in general.(Kotler & Keller, 2016)

People, as an element of marketing, are increasingly getting the attention of businesses. In the developed world, the number of businesses offering services has increased greatly. In this case human capital is the core of the company. And according to Çeku (2010), an enterprise cannot hope to achieve success, if it does not improve its knowledge. Human capital, according to the Oxford dictionary(Stevenson, 2010), are called the skills, knowledge and experiences of individuals and the population, in terms of value and cost to the organization and the country. While the management of this capital, or the management of human resources, is called the process of ensuring, training, evaluating and compensating workers, adhering to the labor regulations for labor relations, health and safety(Dessler, 2017).

2.1. Integrated marketing communication

Communication is a human activity that brings people together and creates relationships. It is at the heart of what gives meaning not only to marketing but also to other fields such as politics, sociology, economics and psychology. It serves to develop, organize and distribute knowledge.(Duncan & Moriarty, 1998)

One of the four basic elements of the marketing mix is promotion. Promotion further has its own elements that make up the promotion mix. Advertising, sales promotion, personal selling, public relations, are the key elements of promotion. With the development of technology, the nature of communication, gathering information and making purchases has also changed, which have been greatly facilitated through the Internet. Integrated marketing communication is the process of building and strengthening mutually profitable relationships between employees, customers, other actors and the general public, developing and coordinating the strategic program of communications, which enables them to perceive the company/brand, in a way constructive, through different media and contacts.(Weigold & Arens, 2018)

Where Applied Marketing Communication is applied, with access to create synergy between the elements of the promotional mix, a consistency in messages and functions is created. This reduces costs, facilitates working relationships between different departments, enables better use of media and promotion mix, and thus provides greater efficiency and better return on investment.(Kitchen & Burgmann, 2015)

Integrated marketing communications managers have various communication elements at their disposal, but their use depends greatly on the circumstances of the time.

2.2. Human resources and recruitment marketing

If the literature of human resources does not start with what human resources are but with how to manage human resources, from the marketing point of view it turns out to be an essential problem. It is simple logic that without communication human resources cannot be managed. While the first step in the communication process is knowing the audience.(Duke, 2012) .

An organization is a group of people with defined formal roles who work together to achieve the goals of the organization.

The process of human resource management is hiring, training, rewarding and compensating workers taking care of their work relations, safety, health and rights.(Dessler, 2017) .

Human resources as a recruiting department and as a department within companies, sees recruiting from a very different perspective than what might be the perspective of relationship marketing. In the human resources literature when talking about the workplace, the emphasis falls on the conditions that the candidate must meet to win that workplace. When talking about the talent management process, it starts with the recruitment process as a very rigorous process that starts with the analysis of the requirements and tasks that come out of the workplace, with the testing and interviewing of candidates and finally with their selection. When talking about the training,

development and compensation of workers, there is a tendency of one-sided communication.

Recruitment marketing, according to Brandon Hall Group, is all the strategies and activities aimed at building the employer brand, increasing public presence, identifying career opportunities, building relationships with candidates, and managing communications with candidates.(talent.com, 2021)

Similar to what marketing has called the customer value proposition, recently and as a result of the war for talent, the HR department has begun to develop and use its own version of the customer value proposition to attract talent; called the proposed value for the worker, through which the specific attributes of the company are advertised that may appear attractive to the potential worker, with the clear goal - to promise what I can give.(Nagpal, 2012)

The workforce recruitment process is a process with several stages, starting from the identification of the need for workers, the analysis of the assigned position, which means the identification of the basic knowledge and skills that the candidate must possess to perform the necessary tasks, these data are then translated into candidate selection measures. Selection and recruitment are interrelated and play a role in the process of influencing well-qualified candidates to apply. Further, the process continues with the testing of the selected candidates until familiarization with the company in which the candidate is employed.(Gatewood, Feild, & Barrick, 2011)

2.3. Relationship marketing

Relationship marketing is usually defined as the approach to develop long-term relationships and loyal customers in order to generate profit. Whereas according to Gummesson, relationship marketing is the interaction between networks (groups) of relationships.(Gummesson, 2008)

Leonard L. Berry was the first to talk about relationship marketing in 1983. He emphasized the role that internal marketing has in creating the climate in the organization to support external marketing activities.(Christopher, Payne, & Ballantyne, 2002)

Although this explanation by Christopher et.al. seems broad, but it is not all-inclusive.

Gummesson goes by the 30Rs (R-relationships; relationships) of relationship marketing. He divided these 30R into four groups. In classical market relations, special market relations, mega-relationships and nano-relationships. The R (relation, relationship) of 27, which falls into the group of nano-relationships, is the R that has to do with internal marketing; and it says: Internal marketing can be seen as part of relationship marketing, as it provides the indirect support needed for relationships with external customers.(Gummesson, 2008)

A target labor market that can be seen from several perspectives as above increases the complexity of already complex marketing relationships even more, and to communicate effectively, ICT companies need a very delicate communication recipe. integrated marketing.

2.4. Marketing communication in function of recruitment

As mentioned above, the recruitment process is a multi-stage process. One of the important stages of this process is attracting the workforce to apply for vacant positions. Not that communication does not play a role in identifying this interest group, but its role is more emphasized in the communication phase of the offer, including the content and the channel chosen to communicate the job offer. By sources of recruitment is meant the way of reaching and finding potential applicants. Some of the sources of recruitment are: advertisements - in local and national newspapers, in commercial warehouses or on television; agencies and organizations - private employment companies, job fairs, universities. Recruitment sources are also within the organization: former company employees, employee recommendations, company websites, interns; or even other sources such as: word of mouth or job portals (Gatewood, Feild, & Barrick, 2011).

The primary purpose of advertising, as the most distinctive element of the promotional mix, is to inform, persuade, recall and induce purchase. (Duke, 2012). The same is true of the vacancy announcement.

2.5. INFORMATION AND COMMUNICATION TECHNOLOGY IN THE WORLD

We all want more internet. We want dynamic content and personalized services, no matter where we are or what device we're using. We want to have full access and a varied multimedia experience, but we care little about what has to happen in order for us to have these. Fortunately, things happen behind the scenes that make it possible for us to have the services we want, when we want them, and where we need them. (EU Commission, 2010).

World economies cannot be thought of without information technology. Information technology is playing a major role in the development of economies in developing countries. In general, the impact of ICT on the progress of countries' economies goes beyond the direct impact of this field on GDP. ICT has an indirect impact on many other areas and also on small and medium-sized businesses.

Europe's small and medium-sized businesses make up 99% of European business, employing two-thirds of the skilled workforce. Many of the processes within BVM need technological agility. The emergence of technologies such as; the internet of things (IoT), big data, cyber security, are creating a shortage of skilled manpower for the use of these technologies in BVM. On the other hand, these businesses do not have the capacity to compete for IT talent with large companies. For example, for German businesses alone, the lack of IT specialists causes 10 billion in losses per year (Alliance, 2019).

There are many spheres in which the impact of ICT on the economic development of a country can be measured, but only one of them is the contribution that ICT gives to the creation of jobs. Developing countries with the increase of human capacities have started to export ICT services. Being developed, this industry has also created many jobs indirectly. Although the countries that have discovered information technology are the US

and Western countries, they have also recently become the largest importers of ICT services.

2.6. Information and communication technology in Kosovo

In 2013, the ICT industry was officially announced by the government as a priority sector for the country's economic development. Giving importance to this industry is rooted in the goal of structural transformation towards a knowledge-based economy (STICK, 2018). Although a relatively new industry, ICT has a rapid development in Kosovo. The age of the population (70% under the age of 35), the culture similar to the European culture (knowledge of languages) as well as the skilled workforce in this sector, are making Kosovo more and more attractive for foreign buyers of ICT services. .

Association of information and communication technology in Kosovo - STIKK (founded in 2008), is the main source of data for ICT businesses in Kosovo. Since 2014, this association publishes, on an annual basis, the so-called Barometer of ICT in Kosovo. The purpose of this association is to promote the ICT sector, raise human resources to meet the needs of this sector and promote new opportunities for these businesses. STIKK is a pivot and generator of many ICT initiatives in Kosovo. Among them are many events and companies that support these initiatives. Among the well-known companies is the Innovation Center in Kosovo (ICK), which also serves as an incubator for start-up businesses, with an emphasis on ICT. Then the Innovation House (CBC), supported by the European Union with a value of 442,350 euros to help Kosovar tourism through ICT; the Outsource2Kosovo platform that promotes ICT companies for the foreign market, EPS-Export Promotion Service, a project supported by GIZ, etc. Many of these and others, in addition to the Ministry of Economic Development, are also projects supported by foreign organizations and embassies in Kosovo.

STIKK has about 200 members who represent about 90% of the ICT market in Kosovo. "The private ICT sector is characterized by many small companies with less than 5 employees and freelancers.

3. RESEARCH METHODOLOGY

Every day there is more and more talk about the digitization of services. Meanwhile, digitization itself is a sector in itself. With the emergence of the pandemic and the need to maintain social distance, the need for remote work that is realized through technology also increased. Information and communication technology within the service industry has seen very rapid growth in the last ten years. Only in 2020 it has had an increase of 8% at the world level. (WTO, 2021) The growing need for ICT services has increased the need for a well-qualified workforce. Kosovo with an average age under 35 years and with cultural values very similar to western countries, with a special emphasis on the knowledge of foreign languages, has managed to be a very attractive job market for the western world. According to the American Chamber of Commerce in Kosovo, the industry

of selling services abroad is a good opportunity for investment(Hoti, 2018). ICT and customer care services (call centers) are the services that have influenced the growth and employment of young people in Kosovo. According to STIKK, 91.18% of ICT companies export services abroad. The western market is a very large market for the capacities possessed by ICT companies in Kosovo.

Even for ICT companies in Kosovo, among the main challenges is the recruitment of well-qualified workforce and the filling of vacancies. Dozens of vacancies for the ICT sector are published every day on job portals, social media, ICT company websites and various communication channels. Recruitment companies have also increased in number. They are constantly looking for ICT specialists. If, how and to what extent ICT companies manage to communicate the offer of these vacancies to the labor market, I will try, in part, to clarify this paper.

3.1. Research goals

The object of study of this research is the way of communicating the offer for vacancies in the ICT sector to the qualified workforce. In analogy, the ICT workforce is presented as a consumer and vacancies as an offer to them.

The main purpose of the research is:

Identification of marketing communication practices, used by ICT companies in Kosovo, to communicate the offer (vacancies) in the labor market.

Integrated marketing communication is the way of knowing the entire marketing process from the customer's perspective(Kotler, 2003).

In addition to what ICT companies will offer to the labor market, they must also know how they will communicate their offer to the relevant market. For this, and in support of the main purpose of the research, the objectives of the ongoing research emerge.

3.2. Research questions

The research questions of this research are:

- a) What are the attributes of a job vacancy that ICT companies consider important for attracting the workforce.
- b) How ICT companies communicate these attributes of open job positions to the relevant labor market.
- c) How the method of communicating the company's offer changes, depending on the profile and seniority of the targeted workforce.

Research questions enable focus on the area of interest(Bell, Bryman, & Harley, 2019). Although it is thought that the research questions are quite specific, it may happen that, during the research, they will be specified even more, other questions will emerge, or even merge into one another.

3.3. Research methodology

A social phenomenon is anything that affects human beings or is affected by and interacts with human beings (Matthews & Ross, 2010). Such a phenomenon is communication in general, including marketing communication.

The research is qualitative. Primary and secondary data were used in the paper. Secondary data were obtained from the literature, while primary data were obtained through in-depth interviews conducted with unstructured questionnaires, with eleven ICT companies in Kosovo.

The chosen research method is Grounded Theory as one of the six known methods in qualitative research. Based Theory, as a method, is also encountered in mixed research with inductive and deductive approaches; but it is most often used in inductively coupled research. Of all research models, qualitative research methods are the most difficult to describe. In qualitative research, the selection of research methods is limited almost only by the researcher's imagination. Among the reasons that lead to the determination of a qualitative research are also the discovery of areas that have not been researched enough and the discovery of important variables that can be used in the future for quantitative research and to approach the study of the phenomenon from a holistic perspective. and comprehensive. (Corbin & Strauss, 2015)

4. CONCLUSION

The main purpose of this research was: to identify what are the marketing communication practices used by ICT companies in Kosovo, to communicate their offer (vacancy) in the labor market.

This paper has, for the most part, achieved its goal and provided a good insight into how ICT companies use marketing communication to attract the workforce.

From the analysis of all interviews and after coding according to the chosen method - Grounded Theory; three important and representative categories of the interview material emerged. These categories were: 1. Workplace attributes; 2. Communication; 3. Noise and environment.

All three of these categories provided a good overview of the communication environment between ICT companies and their labor market. It was clarified that there is a lack of well-qualified labor in the market. There is a fierce competition among ICT companies for skilled manpower. The rapid development of this sector has created a very dynamic environment. In the case of ICT companies, it seems that the level of globalization greatly affects the activity of competition. And what is more important, which could be the theory raised by this research, companies do not apply genuine integrated marketing communication strategies to build a strong company brand and attract the workforce of this sector. These companies use elements of mixed promotion without an adequate combination of them, not issuing a consistent and distinct voice from the competition.

ICT companies in Kosovo have a great demand for services from the foreign market. The great demand for services from the foreign market has influenced ICT companies in Kosovo to be under time pressure. They need to grow, and grow fast.

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COSTUMER SATISFACTION THROUGH RELATIONSHIP MARKETING

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ABSTRACT:

Marketing and marketing management has one of the many branches to administer tire seam restriction. The prime is to identify and gain consumer markets. Marketing more than any other function I can handle with clients, and its simpler definition of marketing will get better: "Marketing is managing profitable customer relationships"

Information marketing is widely used as a useful tool for satisfying consumer satisfaction. Despite more than my idea there is some marketing research on buying information to customer satisfaction for the banking sector in our country. This study is based on an exploratory marketing search to desire in the banking sector and to better understand the views of a bank's customers against active marketing action to facilitate and satisfy banking sector customer acquisition, more of a distinction between it provide the banks that are activists in the right place and those that wait for the customers and for more than you give them the real offer.

Inductive research conducted over the last year in Kosovo has used semi-structured interviews as the main method of data collection and various observations for a supporting role. Based on primary data, this study sheds light on topics related to the implementation of Relationship Marketing. On the other hand, in-depth interviews were conducted with a number of businesses, bank clients, to find out if they were satisfied with the service. The way the bank is able to use the opportunities that come from the benefits and use of Relationship Marketing is analyzed. Qualitative analysis methods and coding techniques were used to analyze the data.

This study concludes that Banks in our country is able to implement Relationship Marketing from me the difference in strategy this depending on the usage / corporation listed. This study identifies the key factors that provide customer satisfaction. Finally, research confirms that marketing is well-known for having a role sufficient to win the loyalty of customers, businesses, and so on. Against the bank.

Keywords: *Marketing, relationship marketing, customer, satisfaction.*

1. INTRODUCTION

The word marketing is derived from the English word "market", which means market, to which adding the English suffix "ing" gives the term marketing. Marketing is a business

process, which foresees, identifies and efficiently meets the needs of consumers. Marketing is very attractive, it also contains a very broad meaning, however, I have focused on some topics, which I have seen as necessary to be included during the realization of the research. As for marketing functions, marketing notions, elements of the marketing mix, or as they are known, 4P are almost the most important part of the marketing study. The marketing mix is the set of valuable tools for the manager to determine the nature of the service offered to customers, Customer Relationship Marketing, the purpose of which is not to increase sales but to include a process of attracting, maintaining and strengthening the development of relationships with customers and interest groups to realize profit, and in this form the objectives of the parties involved achieved through multilateral exchange and fulfillment of promises (Zineldin, M. and Philipson, S. 2007). His concept can and should be applied to the banking industry, as long as it is becoming fundamentally important. The banking sector can be considered as the main sector that suffers the consequences of economic changes. As a result, there is a need for better strategies in this sector. As a result of continued moves towards deregulation and increased competition, establishing a long-term institutional relationship with corporate clients is of great importance in the banking sector in order for the bank to gain a moderate or significant share of the financial market. In the banking sector, relationship marketing events are very important (Gilbert, DC and Choi, KC (2003)).

3. PURPOSE OF THE RESEARCH

As a very important concept, relationship marketing is part of business and as such it will always be, therefore my main goal is to present the theoretical parts from this concept and compare it in

practice, respectively the way with which banks operating in Kosovo build relationships with their customers and how these customers expect it and how they respond. The collected data as well as the literature review will lead us to the final result of this research. As a result of changes in market strategies that increasingly focus on the customer and the creation of consumer value rather than on the product or service, a new marketing model focuses on the buyer-seller relationship as a method of creating value for both sides. As a result, the scenario leads to the transition from traditional to strategic relationships. Although the literature on relationship marketing is scarce and insufficient in contrast to the Marketing Mix Model that has dominated marketing thought, research, and practice in recent years, data from companies that are driven by relationship marketing will be basis of comparison between two different waves of marketing thought.

Also the aim is to identify why banks use relationship marketing to attract and retain customers. This is accomplished by exploring the advantages and disadvantages of relationship marketing. In the ever-increasing competition in the global financial sector, relationship marketing is recognized as an excellent way to be used by banks to establish a long-term and unique relationship with customers. It will also provide a clear picture of the level of application by banks in Kosovo of marketing to their customer relations over the last years and a picture of whether their strategies are flexible enough to respond to

changes in customer needs over time. . Economic expansion and structural transformation were facilitated by the rapid growth of the banking sector and other financial services in Kosovo. This is clearly reflected in the growth of assets in the financial sector and relationship marketing and customer satisfaction.

In conclusion, through the research project there will be an exploration of the possibility of the existence of a difference between what the banks operating in our country offer and what their customers expect and moreover what they receive. It is important to know if banks really know the needs of their customers and if the efforts they undertake to meet these needs by applying relationship marketing are successful.

The objectives are analyzed as follows:

- The relationship between customer satisfaction and the customer-bank relationship.
- The success of banks using relationship marketing as a factor in customer satisfaction.
- Application of the relationship marketing concept in practice in banks operating in our country.
- How do banks differentiate between sales and relationship marketing?
- Consumers' perspective on relationship marketing?

4. UNDERSTANDING MARKETING

Marketing is onedynamic scientific discipline, which is constantly changing in order to follow the development trends of economic activities, the business environment and society in general (Ukaj.F., 2012). Marketing, through its instruments, provides company managers with information relevant to the needs and demands of consumers. This information helps managers to reduce risks and uncertainties in the market and realize a more successful business (Destani.A, 2010).

We encounter the term marketing more and more in everyday life, starting from media for communication with the public, gatherings and talks of the business profile, in various speeches, up to the social conversations of ordinary people. Often times, the term marketing does not have adequate use in ordinary communication so that misunderstandings and terminological confusions are created, which only mean some dimension of real marketing. If in a social environment we ask someone what marketing is and what he understands by marketing, we can mainly answer that marketing means sales or publicity. This answer actually contains something close to the truth, but it is insufficient, because in reality marketing is a much more dimensional meaning than sales or publicity. Depending on the development and refinement of marketing, even the definitions for marketing are many and undergo changes. Until now, we still cannot come across a definition of the term marketing, which is acceptable and universally accepted. The definition of marketing, first of all, must be adapted to the purpose for which it is used, which is variable, just as the boundaries of scientific disciplines themselves change.

Marketing is a business process that identifies, anticipates and efficiently meets the needs and demands of consumers, realizing profit for the enterprise.

4.1. The marketing function

The role of marketing lies in overcoming divisions and contradictions by harmonizing the heterogeneous demand and supply of producers and consumers. This harmonization is realized thanks to the implementation of the general marketing functions: purchase, sale, transport, storage, standardization and classification, financing, taking over the risk and providing information on the market.

The functions are universal, due to the fact that they must be realized for all marketing systems. To a large extent, through these functions, economic benefit is created. The way in which the functions are implemented and the skills of the people who execute them may vary according to countries and economic systems, but the realization of any good or service remains essential for them. Marketing functions are the following:

- a) Exchange function**
- b) Physical distribution function**
- c) Facility function**

5. MARKETING AND CONSUMER BEHAVIOR

To understand consumer behavior, marketers must understand why consumers buy products and services. In general, consumers buy a product because they can expect more utility from it than from another product, clearly making a cost-benefit ratio for their choices. This chapter will examine aspects of marketing, consumer behavior, product attributes, the decision-making process and brand choice, referring to various authors about the theories and disciplines covered in this study. Understanding customer needs and the buying process is the foundation of successful marketing. Marketers, by understanding the buying process, can gain more information about meeting the needs of buyers. By understanding the different participants in the buying process and the most powerful influences that influence their buying behavior, marketers can develop effective marketing programs to support an attractive offer for the target market (Kotler.P&al.2006). Successful companies focus their marketing efforts on satisfying customer needs that match their core competencies, and a key factor in successful marketing is determining the correct balance of functional and psychological needs that best satisfy the target markets of the company (Greval.D & al, 2006). Today, marketing is understood not in its old sense of "selling", but in its new sense of "satisfying the needs" of the consumer. Marketing begins long before a company has produced a product. The importance of marketing is broader and extends throughout society by helping to introduce new products and gain their acceptance by the people whose lives they have made easier or enriched. Marketing is the inspirer of improvements in existing products, where producers renew and improve their position in the market (Kotler.P, 2006). Successful

companies have one thing in common, they are strongly customer focused and very dedicated to marketing. These companies share a passion to understand and satisfy the needs of customers in their target markets, motivating everyone in the organization to help build lasting customer relationships based on value creation.

5.1 Consumer behavior

Corporate marketers around the world spend billions of dollars trying to influence what, when and how consumers consume products and services. In addition, marketers not only influence consumer behavior, but also study his behavior. Consumer behavior is an applied social science, based on the theories and concepts of the disciplines of psychology, sociology, anthropology, economics and statistics. As a fairly new science, the study of consumer behavior emerged in the late 1940s, when many companies shifted from a production and sales orientation to the study of consumers about the products they wanted and needed. The field of study of consumer behavior has joined marketing strategies, developing in the late 1950s, that's when some marketers began to understand that they could sell more goods and more easily if they produced only those goods that consumers had decided to buy. In recent decades, consumer behavior has changed drastically. Today, consumers can buy many products online. Over the past 15 years, several new ways of selling products and services have been made available to consumers and are the result of digital technologies.

These new ways exist today because they reflect an understanding of consumer needs and consumer behavior. For businesses to have fast and dynamic development, marketers must know everything possible about consumers, what they want, what they think, how they work, how they spend their free time. They must understand the personal and group influences that affect consumer decisions. The study of consumer behavior mainly sheds light on how consumers decide to spend their various resources, such as time, money, etc. on different products, to meet their needs and requirements. Consumer behavior involves the study of what, when, why and where consumers will buy their products. It also focuses on how consumers use products,

6. RELATIONSHIP MARKETING AND CONSUMER SATISFACTION

Relationship marketing has been described as a new paradigm for the study of exchange. However, the current interest in developing relationship marketing programs overlooks the existence of relationship exchange as the dominant form of exchange in many of the world's economies (Berry, L & al., 1998).

Relationship Marketing (RM) is generally defined as an approach to develop long-term loyal customers and thereby increase profitability. Of course, you need at least two parties, who are interacting with each other for a relationship to exist. The two parties that must interact for the marketing relationship to exist are the supplier and the customer. Relationship marketing emerged in the 1980s as an alternative to the prevailing view of marketing as a series of transactions, because it was recognized that many exchanges, especially in the service industry, were of the same nature. Within the context of the retail

banking environment, it defines Relationship Marketing as "the activities carried out by banks in order to attract, engage and retain higher profitability or higher net worth customers". Thus, relationship marketing aims to increase profitability from customers and at the same time provide better service to them.

Understanding consumers' motivations for engaging in relationships with marketers is important for both marketing practitioners and researchers. To develop an effective theory of relationship marketing, it is necessary to understand what motivates consumers to reduce their available market choices and engage in a relationship market behavior by patronizing the same marketer in subsequent market situations. choice. This article draws on the established consumer behavior literature to suggest that consumers engage in market behavior due to personal influences, societal influences, and institutional influences.

They also engage in market relationship behavior due to family and social norms, peer group pressures, government mandates, religious tenets, employer influences, and marketer policies. The willingness and ability of consumers and marketers to engage in relationship marketing will lead to greater marketing productivity, unless consumers or marketers abuse mutual interdependence and cooperation.

The importance of developing and maintaining lasting relationships with customers of service businesses is generally accepted in the marketing literature. A key challenge for researchers is to identify and understand how managerially controlled variables affect important relationship marketing outcomes (eg, customer loyalty and word-of-mouth). Relational benefits, which have a focus on the benefits customers receive in addition to the basic service, and relationship quality, which focuses on the overall nature of the relationship, represent two approaches to understanding customer loyalty and word of mouth. This article integrates these two concepts by positioning customer satisfaction and commitment as dimensions of relationship quality that partially mediate the relationships between three relationship benefits (trust benefits, social benefits, and special treatment benefits) and two outcome variables. The results provide support for the model and show that the concepts of customer satisfaction, commitment, trust benefits and social benefits serve to contribute significantly to relationship marketing outcomes in services.

6.1 Customer satisfaction

"Satisfaction is the consumer's evaluation of the product or service, in terms of whether this product or service meets the consumer's needs and expectations." Satisfaction is a general attitude of the customer towards the service provider, or an emotional reaction to the difference between what the customer expects and what he gets in relation to the fulfillment of some needs, goals and desires." The success or failure of a business depends on how customers feel, satisfied or not (Gustafsson, A., Johnson, M., & Roos, I. (2005). They also explain that customer satisfaction is the measure of a business's service. For this reason, satisfied customers are the ambassadors of a venture, because their satisfaction can influence the word-of-mouth effect for that particular venture, which

ultimately brings more customers to the company. It is necessary for the organization to serve towards informing the customer in order to improve the product and service offered thus increasing satisfaction, loyalty and profitability. Increasingly, researchers have increased their attention to customer satisfaction as a recognized field of study and as an essential tool for financial institutions, which serves to increase customer loyalty and ultimately performance and profitability. the organization. The importance of customer satisfaction should not be overlooked as satisfied customers are like free advertisement for the company. Therefore, the higher the focus on customer satisfaction and retention, the longer the business will be. Customer satisfaction is generally defined as a consumption after evaluative judgment about a particular product or service. It is the result of an evaluative process that contrasts expectations for repurchase with perceptions of performance during and after the consumption experience.

Customer satisfaction can be conceptualized in two directions: as transaction-specific satisfaction and cumulative satisfaction. Many researchers define transaction-specific satisfaction as an evaluation of the customer's experience and reactions to a specific encounter with the company. As they concluded that cumulative satisfaction refers to the overall evolution of the customer from the initial experience until today. While transaction-specific satisfaction can provide specific diagnostic information about a specific product or service provider, cumulative satisfaction is a more fundamental indicator of a firm's past, present, and future performance. This is because consumers evaluate repurchase and make decisions based on their purchases and consumption experience to date. and not just for a particular transaction or episode. Therefore, overall customer ratings are not based on satisfaction or dissatisfaction with a particular service transaction.

6.2 B2B RELATIONSHIP MARKETING

Business-to-business marketing focuses on the functionality of the services offered. B2B businesses sell their products to other businesses. The priority of B2B is the generation of leads. The focus is on relationships, as business depends on cooperation with other businesses. Year-to-year collaborations with other businesses are central to B2B success. Relationship marketing strategies should increase perceived customer benefits such as improved perceived relationships and perceived economic benefits from relationship engagement. Relationship Marketing in the literature belongs to "win-win" relationships where all parties involved benefit from entering into such unions (Tadajewski, M., 2009). In business-to-business (B2B) situations, especially when the benefits outweigh the risks, it is desirable for both the company and the client to maintain a long-term relationship (White, H. & et al, 2009). Especially in the banking sector, whose services are characterized by "intangibility, indivisibility, variability and decay" to resist a relationship "that can withstand the test of time" "a long-term direction towards the consumer is seen as essential" (Roslin, RM, & Melewar, TC 2004).

Why companies want to have relationships with customers in the (B2B) context: The main reason companies want to build relationships with customers is economic. Companies generate better results when they manage their customer base in order to identify, attract,

satisfy and retain profitable customers. These are key objectives for many CRM strategies. There is little value in growing a customer base without a clear goal.

The goal should be to retain existing customers and recruit new customers with future profitable potential or important for strategic purposes. Not all customers are of equal importance. Some customers may not be worth recruiting, eg those who have a high service cost, are debtors, late payers or mixed in the sense that they change suppliers frequently. *Ceteris paribus*, a wider customer base produces better business performance. Similarly, as the retention rate of customers increases (or their churn rate decreases) the average time they stay with the company (tenure) also increases. "Tenure" is a term used to describe the length of time a customer remains a customer. The impact of small improvements in customer retention is very large at high levels of customer retention. Managing customer retention intelligently leads to two main benefits for the company; reduction of marketing costs and better knowledge of them.

7. CONCLUSION AND RECOMMENDATIONS

Nowadays, the banking sector is completely liberalized. The liberalization of banking in Kosovo has facilitated capital financing, led to the emergence of innovative opportunities and new services, and generated the establishment or arrival of many foreign banks. Relationship marketing has become a tool of special interest in the banking sector in our country, since it is the best way to keep customers in such a competitive environment. It still has a long way to go, but the future is very promising and banks cannot afford any delays if they want to maintain their position in a competitive market.

Based on the research done and the results of the surveys we will recommend:

- Banks must understand the attitudes and needs of consumers to serve them in the best possible way, which in the future will lead to an increase in market share.
- It is recommended that banks apply relationship marketing policies in order to retain customers and make them more loyal and increase their sales and profit in a healthy manner.
- The bank should increase the minimum acceptable contribution of its customers by adapting its marketing efforts to manage the value of the relationship.
- Banks must satisfy each group of customers and communicate and offer it to customers of each group.
- Also, the bank should do research not only on the profile of customers, but also on their satisfaction, loyalty to the brand and quality of services.
- Communication networks using Internet service can add value to banking innovation. The communication of information in real time, its distribution, the opportunity to deal with customer relations and their problems, will make banks more innovative and customers more satisfied.
- Banks should focus on web based facilities. In this way, banks will be more innovative and their customers will be even more satisfied and loyal.

- Banks are recommended to review their strategies to take full advantage of relationship marketing policies that can be applied to customers, valuable and reliable businesses.

Banks operating in Kosovo consider the relationship as an attempt to personalize their services. There is evidence that relationship marketing has been attempted by banking institutions in Kosovo. In the banking market in our country, it is obvious that the current financial services offered by banks are of a wide range and with competitive pricing strategies. Apparently, relationship marketing is considered a competitive element. A lot of effort has been used to gain customer loyalty, such as frequent visits to their premises. Differentiations in banking services products are very easily copied and as a result it is difficult for the organization to maintain a competitive advantage through product differentiation. With the appearance of consumers with heterogeneous preferences regarding the banking services provided, the issue of distribution of the service provided has taken on increasing importance for the mindset of strategic competition. And for this, relationship marketing can be a very good weapon.

In addition to the above recommendations, it is the application of a loyalty program which according to relationship marketing can be realized, to strengthen the connection between customers and the bank. Banks should build a loyalty program of some kind. They cannot have a strong customer base simply by relying on customers who come in, buy something, and leave. They should generate a feeling for the environment and have an emotional attachment. The key is customized programs that give corporate clients what they really value. The programs are specifically designed to show that the bank understands and cares about its customers. If the bank can keep them from the day they come into the bank, I can keep them for life if the actions are right. The bank should increase the minimum acceptable contribution of its customers by adapting its marketing efforts to manage the value of the relationship. From the study, it is clear that the digitization of banking services in Kosovo is on the right track, however, this field is constantly rising. For this reason, commercial banks in Kosovo, under the supervision of the Central Bank of the Republic of Kosovo, must continue with the application of achievements in the field of information technology, which further improve the payment system, especially in electronic form;

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TRENDS AFFECTING THE EVOLUTION OF LOGISTICS AND SUPPLY CHAIN SUSTAINABILITY

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ABSTRACT: *The aim of the paper is to identify the following using secondary data sources: (1) business characteristics of green, sustainable, and circular supply chains, and (2) the impact of current trends (e.g. globalization, creation of partnerships between companies and outsourcing, expansive application of digital technologies, time savings, and the development of e-commerce) on the sustainability of logistics and supply chains. The focus of the study is to explore the relationship between corporate environmental strategies and supply chains, on the one hand, and their financial performance and global competitiveness, on the other. The evolution of supply chains in terms of their sustainability is increasingly reliant on the level of integration and digitization of their resources.*

Keywords: *green supply chain, sustainable supply chain, circular supply chain, Industry 4.0 technologies, agile strategy.*

1. INTRODUCTION

Rapid and extensive industrialization and urbanization have created serious environmental problems in recent years, which increasingly burden not only company managers but also national governments. Sustainability issues have become a domain of interest for company and supply chain managers.

Theoretical discussions about sustainable business have been going on for decades. Since the nineteen-seventies, the interest of researchers and practitioners in the effects of economic activities on the environment has been growing. Since the last decade of the 20th century, many authors have proven that sustainable companies and sustainable supply chains have become key participants in the globalization process. They are able to generate profits for their stakeholders while caring for the environment.

Transportation, production, storage and disposal of hazardous materials are often regulated and controlled. In Europe, companies are increasingly required to remove and dispose of the packaging they use for their products. In such circumstances, the role of logistics and supply chain management is complicated, which ultimately increases total costs and decreases price attractiveness of what the company has to offer.

In the last two decades, a large number of papers have addressed green, sustainable and circular supply chains from different standpoints. Authors still do not fully agree on the definition of these concepts. Nevertheless, they share similar views on their characteristics. Thus, a large number of authors state that the concept of a green supply chain implies the implementation of an environmental approach within each phase of a product life cycle, from design to recycling. The green supply chain focuses on environmental and economic goals. However, sustainable supply chains pursue not only environmental and economic but also social goals. Circular supply chains, in relation to green and sustainable supply chains, have a more complex structure and mission. The characteristics of all these supply chains are presented in the first part of the paper.

In the last three decades, certain trends in the business environment have dictated the sustainability of logistics and supply chains. The impacts of five such trends are presented in the second part of the paper.

2. GREEN, SUSTAINABLE AND CIRCULAR SUPPLY CHAINS

Late nineteen-nineties have seen a significant growth of academic interest in various aspects of sustainable development. This interest has sparked a wealth of new research focused on various supply chain activities that have significant environmental consequences (16, pp. 39–47).

Despite the increase in the number of authors and studies on concepts such as green and sustainable supply chains, there are still no universally accepted definitions of these concepts (6, pp. 101–114). However, some authors agree on the goal of green supply chain management – maximizing total environmental profit by respecting the logic of the life cycle during: product design, material selection, production, sales and recycling.

A green supply chain includes partners who encourage environmental cooperation in order to achieve economic and environmental effects. Such a supply chain is characterized by: green product design, green procurement, green production, green distribution and sales, and green after-sales services (2, pp. 156–173). Green supply chain management is de facto based on environmental elements and helps the company on its sustainable development path. Green supply chains include reverse logistics activities. In this way, customers become their active participants.

Building a green supply chain is an environmentally responsible company action that increases its competitiveness. The key goal of such an action is to create satisfied customers, because, as a rule, only they are ready to buy the company's products and services (23, pp. 3772–3779). Customers are increasingly interested in buying products that do not have a negative impact on the environment. The business imperative becomes the so-called green customer satisfaction – which is in line with their environmental, sustainable and green expectations and needs (25, pp. 475–491). Therefore, companies

and supply chains get a new market opportunity: to be green and to implement the concept of green marketing in order to gain benefits.

Many authors prove that sustainability and marketing are in close interaction. Unfortunately, there is still a gap between them and it may be the result of society's lack of trust in the environmental mission of marketing, on the one hand, and the company's lack of potential to adapt to the sustainability trend, on the other. Nevertheless, green marketing is being discussed more and more in relevant literature. From the nineteen-nineties until today, the third phase of the development of green marketing has been going on – the phase of sustainable marketing. Sustainable marketing is focused on sustainable development and a sustainable economy. Green customers and information technologies are some of its main drivers (2, pp. 156–173).

Various frameworks have been established for evaluating green supply chain performance. Performance rating of such a chain involves two steps: (1) identifying segments of the supply chain in which environmental principles are applied and (2) defining quantitative and qualitative indicators to describe performance. Dey and Cheffi propose a unique framework for measuring the performance of green supply chains based on the AHP method (22, pp. 35–43). The basis of their framework is three types of sustainable performance related to green supply chains: (1) environmental performance, (2) economic performance, and (3) operational performance. All these types are observed in terms of: (1) the customer, (2) the focal company and (3) the supplier. By integrating supply chain processes (supplier relationship management, internal supply chain management, and customer relationship management) with organizational decision-making levels (both operational and strategic), Dey and Cheffi give a broader picture, not only of the environmental performance of manufacturing supply chains, but also of their sustainability.

The term “sustainable development” appeared in the 1987 World Commission report on Environment and Development “Our Common Future”. This term includes three goals, which must be achieved simultaneously: (1) environmental quality, (2) economic prosperity and (3) social equality. It also includes a time dimension, as it requires that the previous three goals be achieved without compromising the needs of current and future generations. Sustainable development is often considered the main goal of the circular economy.

A sustainable supply chain fully integrates ethical and environmentally responsible practices into a competitive and successful business model. Transparency of the entire supply chain is critical. Initiatives related to the sustainability of the supply chain must be implemented in all its segments – from the procurement of raw materials, through last mile logistics, to product return and recycling.

Twenty years ago, the term sustainability had almost the same meaning as the term eco-friendliness. Today, sustainability is a holistic term. Green, transparent and circular supply chains are components of a modern sustainable supply chain.

As pointed out in the introduction, in terms of scope, sustainable supply chains are a broader category than green supply chains – they are not only focused on achieving environmental and economic performance, but also social. Managers of sustainable supply chains strive to manage the flows of raw materials, finished products, information and money to increase the profits of the entire chain, while minimizing adverse environmental impacts and maximizing social welfare.

The concept of a linear economy is inferior to the concept of a circular economy, because it assumes that resources are unlimited (14, pp. 551–569). Unlike the linear economy based on short product life, planned obsolescence, economies of scale and growing customer demand for new products, the circular economy is based on a “spinal loop system” that minimizes matter, energy flow and environmental degradation without limiting economic growth and social and technical progress (11, pp. 278–311). Due to numerous limitations in the process of adopting the circular economy concept (lack of environmental culture of the company, lack of capital, ineffective legislation and absence of state support, lack of information, administrative restrictions, lack of technical and technological knowledge, lack of circular economy standards, lack of subsidies for investments in the circular economy and insufficiently developed circular customer culture...), its application is still based only on examples of good practice.

A typical linear supply chain exists in the FMCG sector. It focuses on increasing efficiency, number of customers and responsiveness. Circular supply chains are more complex than the ones mentioned (green and sustainable chains) with an environmental character. First, circular supply chains involve a larger number of participants. Second, in circular chains, relationships between participants change. Customers are given the opportunity to return the product or its waste to any participant in that chain. Thirdly, such chains include other sectors, apart from origin (raw materials, products) (10, pp. 24–59). In circular supply chains, more and more often one participant is responsible for implementing the circular economy. For example, Philips is responsible not only for design, manufacturing, distribution and sales, but also for post-sales processes and the end of the product life cycle (4, pp. 7395–7422).

In a circular supply chain, products are broken down into raw materials that are then processed into products. In this way, companies gain environmental benefits from recycling and reduce costs. This business model is becoming more and more popular, because it is based on a win-win logic. According to Gartner’s 2020 survey, as many as 70% of supply chain leaders plan to invest in the circular economy (26).

3. TRENDS THAT DETERMINE THE SUSTAINABILITY OF LOGISTICS AND SUPPLY CHAINS

Environmental problems increasingly interest and worry managers of globally oriented companies. The transport, production, storage and disposal of hazardous materials are often regulated and controlled. In Europe, companies are increasingly required to reduce

and adequately dispose of packaging materials for their products. These problems complicate logistics and supply chain management (SCM) by increasing costs and limiting companies' competitiveness. Important global trends in logistics and SCM were discussed in the late 20th and early 21st century literature. The sustainability of logistics and supply chains is decisively influenced by the following trends: (1) globalization, (2) partnerships between companies and outsourcing, (3) expansive application of digital technologies, (4) time savings and (5) increasing electronic commerce. What follows is an elaboration of the impact of these trends.

3.1. Globalization

Nineteen-eighties have seen intensification of the globalization process, which, according to Ted Levitt, led to the emergence of global corporations. Globalization has lifted hundreds of millions of people out of poverty, especially in China, India and Latin America. However, the 2008 to 2009 world economic crisis showed that even in rich countries globalization has failed and that it is necessary to further refine the rules of global trade and global investment flows.

Globalization is not only an economic view of things, but also, as Mark Abeles points out (1), an anthropological experience. The human being directly suffers the influence of given circumstances. An integral part of human life is represented by communication technologies, which determine the character, speed of changes and connection of economic and social processes. The development of means of communication accelerates processes such as networking and interaction between countries, companies and people. These processes, together with the flow of people, capital, goods and ideas, became the foundations of globalization.

In the globalized world, geographical, cultural and political borders are fading. The national state is no longer the pillar of human security. The media have "broken" the man's identity and increased the uncertainty of his life. Globalization has relativized individual identity rooted in local culture. It changed not only the way of managing an individual's imagination, but also the focus of companies. According to some estimates (5), there are 333.34 million companies in the world. For those who are globally oriented, Ted Bates' idea "Think globally, act locally" is key.

The interactions between globalization and sustainability are very complex. In the last ten years, the sustainability of globalization has been debated in the relevant literature. In order to determine the sustainability of globalization, it is necessary to identify: (1) the impact of large technological multinational companies on improving sustainability, (2) the impact of globalization on the relationship between green growth and the so-called degrowth, and (3) how the disproportionate impacts of globalization, both positive and negative, can be minimized.

Globalization has been accelerating since the 1970s, primarily due to: the development and increasing use of standard containers in international maritime transport, the liberalization of international trade, the expansion of international transport infrastructure (ports, roads and railways), and differences in production and logistics costs between developed countries and developing countries. Globalization has increased the geographical length of supply chains as well as the accompanying environmental problems – the growth of fuel consumption and the associated emissions of gases that cause the greenhouse effect.

Globalization has had a significant impact on logistics and the functioning of supply chains in the last few decades. For example, due to globalization, in the last two decades, the global maritime transport of goods by twenty-foot equivalent units (TEU) has increased by an average of about five percent per year. In mid-2000s, around 350 million TEU per year were used in this way on various routes in the world (Grant, 2012). In addition, globalization has increased the global demand for smartphones and tablets, which has caused an increase in the volume and cost of air transport. Every fall, when Apple releases new smartphone models, air freight prices rise. Airfreight prices were lowest in the spring and summer of 2015 - around USD 2.50 per kilogram, but rose to USD 11.00 per kilogram in November. During the fourth quarter of 2015, Apple sold 74.4 million smartphones, 40% of which were in the US.

Over 80% of goods included in world trade are transported by means of maritime transport. At the end of 2019, the combined capacity of container ships in the world amounted to 23 million TEU, while at the end of 2025 it reached 25 million TEU (7). In 2021, the global fleet reached 50 million TEU. In 2020, 815.6 million TEU passed through all world ports. At that time, the global turnover of container ports, measured by the number of processed TEU, decreased by 1.2% compared to the previous year.

The COVID-19 pandemic has shown that maritime transport of goods using containers is key to the global economy. From Shanghai to Rotterdam to Los Angeles, the SARS-CoV-2 virus has disrupted supply chains. Due to the spread of this virus, the ports were left without the required number of workers. Restrictive measures by local governments have prevented truck drivers and ship crews from crossing borders. Due to prolonged quarantine, the capacities of supply chains have been reduced. Deliveries of products were delayed while the costs of transporting them rose. In the 18 months since the outbreak of the pandemic, the cost of transporting containers on overseas trade routes has increased sevenfold, while the cost of shipping bulk products has risen even more (12). Rising transport costs are an important driver of global inflation - when they double, global inflation rises by around 0.7%. Such a ratio shows that the increase in transport costs in 2021 could increase global inflation by about 1.5% in 2022.

3.2. Partnerships between companies and outsourcing

Due to the increasingly complex global business environment, there is a growing need to develop partnerships between suppliers, competing manufacturing companies, customers and other stakeholders, which can positively affect sustainability. For example, two competing manufacturing companies may share transportation and storage capacity in order to avoid empty truck runs and enable product returns (reverse logistics).

On the other hand, many companies have outsourced some logistics activities and supply chain management (leaving their execution to 3PL specialists i.e. service providers, as DHL did). 3PL specialists offer a range of services (transportation management, warehousing, distribution, order fulfillment, etc.) that they can adapt to the specific needs of each company. The main reasons why companies use these services are: (1) creating conditions to focus on their core competencies, (2) saving in transportation and storage costs, (3) increasing the level of customer service, (4) expanding into new markets and geographical areas, (5) faster delivery of orders, (6) more efficient reverse logistics and (7) optimization of supply chain processes and activities.

1.1 The value of the global outsourcing (3PL) market is growing. In 2021, the 3PL market was worth \$1.045 trillion and by 2028, it could reach a value of \$1.924 trillion (24). In 2020, it accounted for about one-eighth of the global logistics market, whose value at that time was about 8.6 trillion USD (20).

The growth of the global 3PL market has been influenced by various factors. The first is certainly the growth of the global e-commerce market. The effects of this factor will be presented in part 2.5 of this paper. Another factor is the increasing application of the just-in-time inventory management concept. In this way, companies are pressured to deliver their products faster and more efficiently. 3PL specialists help companies resist this pressure by managing their transportation and warehousing needs. The third factor is the desire of a growing number of companies to find a way to become more sustainable and reduce their impact on the environment. 3PL specialists offer green logistics solutions that can help users reduce their carbon footprint.

In 2017, 81% of domestic and 71% of international transport (“Go” activities) and 69% of storage activities (“stop” activities) was left to external companies (outsourced). This was also the case with 24% of reverse logistics activities, as well as with 26% of other activities such as labelling, packing and assembly of products (27).

Outsourcing can be very profitable for companies, as they can effectively concentrate on their core competencies and achieve many other advantages. In addition, companies can reduce labor costs, allocations for transportation and warehousing infrastructure, and enjoy the expertise and economies of scale of 3PL specialists. However, despite the contract, companies lose control over operations they have outsourced. Therefore, they may also lose control over the sustainability efforts of 3PL specialists.

3.3. Expansive application of digital technologies

Digital technologies are important for modern supply chains because they enable better, faster and more reliable communication between its members. Logistics and supply chain management are related to a wide range of functions and companies, and communication must take place between the central company, its suppliers, customers and other members of the supply chain who may not be directly related to it and its main functions (accounting, marketing and production). Communication is therefore crucial to the effective functioning of any integrated logistics or supply chain system.

The last two decades have seen a significant increase in computer power and data storage capacity. The production technology of global positioning systems, “smart” mobile phones, tablets and iPads has also improved. Due to the increase in the level of digitization, the implementation of such systems has become more complex. However, companies are increasingly using them to effectively track the flow of products, information, money and transportation in all segments of the supply chain.

To speed up the order processing process and improve its accuracy and efficiency, companies are increasingly relying on electronic data interchange (EDI) and electronic funds transfer (EFT). In addition, they use advanced scanning technology, such as radio frequency identification technology (RFID), in order to trace products and monitor their flow throughout the supply chain. Such technologies are available not only to companies but also to end customers. With their help, end customers efficiently acquire basic household products from the point of consumption.

The functioning of modern supply chains is technologically conditioned. They are increasingly influenced by the following technologies of Industry 4.0: (1) Internet of things (IoT), (2) cyber-physical systems (CPS), (3) cloud computing and (4) big data (15).

The term Internet of Things was first used by Kevin Ashton in 1999. These are billions of physical devices with built-in sensors that are connected to the Internet. All these devices can collect and share data. IoT de facto connects physical objects on the Internet by integrating sensors, actuators and other devices that collect, transmit and process data. IoT brings together the physical and digital universes.

In the supply chain, IoT connects business and web applications (such as social media) to machines, devices, products, materials and people, enabling the creation of an intelligent network that spans all factory processes and customers and suppliers. IoT facilitates the exchange of data in the supply chain in real time, without human involvement. In this way, it raises the level of responsiveness and digital intelligence of the supply chain.

Implementing IoT and sensors in retail allows retail chains to improve customer engagement and collect usage data to optimize business goals. By implementing IoT in retail, about 50% of the processes can be automated.

The value of the global Internet of Things market is constantly growing. In 2021, it amounted to 384.7 billion USD, but by 2029 it could reach 2465.26 billion USD (13).

The term cyber-physical systems was first used in 2006 by Helen Gill. CPS emerged in response to the need to develop a conceptual and effective framework for the growing interactions between cyber-computing systems and physical hardware. CPS includes machines, storage systems and production plants that are digitally developed and represent an end-to-end integration based on information and communication technologies.

CPS enable the supply chain to monitor production conditions and logistics activities in real time, and based on this, to perform forecasting, remote diagnosis and control. Also, CPS are becoming increasingly important for digital transformation, flexible planning and control of supply chains.

Cloud computing (cloud for short) has been developing since 2006. It uses a service delivery model known as SPI (Software Platform Infrastructure) and designates three key groups of services provided through the cloud: (1) Software-as-a-Service, (2) Platform-as-a-Service and (3) Infrastructure-as-a-Service.

Cloud computing aims to integrate technologies or architectures to provide a platform or solution over the Internet, which would be available anytime, anywhere, and provide unprecedented visibility and flexibility.

The application of cloud computing in supply chains is still in its infancy. In addition, sales of supply chain management software exceed US\$19 billion.

Hybrid supply chain management is increasingly present, which is the result of the coexistence of cloud-based applications and applications enabled by software installed on premise. Management of information hubs and supplier networks is mostly based on the cloud.

Cloud technology enables supply chain managers to accurately track products throughout their lifecycle, locate shipments during transit, and quickly redirect misdirected shipments.

The term Big Data refers to a large set of data from various sources, both traditional and digital, that can be used to obtain different results through different types of analysis. It is not necessary that all analyses use all data. This term, in addition to a large amount of data, also denotes innovative forms of data processing and processing for the purpose of improving the decision-making process and optimizing business processes of supply chains.

Within the supply chain, big data presents applications that include (15): (1) material flows (related to: production status; process and quality; stock handling; logistics; research and development and collective solutions in procurement and distribution functions), (2) information flows (related to: demand management; supply chain event management - a type of business software for managing events that occur within and between organizations or supply chain partners), supplier negotiations; risk management; problem

identification; automated decision support and customer management)), and (3) financial flows (related to: customer segmentation; demand modeling; new business model design; prices and assortment and the financial aspect of human resources).

3.4. Time savings: the lean vs agile dilemma

Shortening turnaround times in companies and supply chains is a significant trend with environmental implications. Shorter lead times and process times reduce inventory levels and facilitate materials, storage and transportation management. All this increases the efficiency of the entire supply chain.

The competitiveness of companies increasingly depends on the exchange of information with suppliers and customers in real time, and the time of execution of production and logistics operations. Companies, in order to compete more successfully with their rivals, implement strategies to reduce production, inventory and order fulfillment times. For example, many retailers achieve time savings by successfully implementing an effective customer response (ECR) strategy. The basis of this strategy is advanced computer systems (bar coding, electronic scanning of products at the point of sale and electronic data exchange).

In order to produce more efficiently and shorten the execution time of logistics and supply chain operations, two different strategies emerged in the 1990s: 1) lean strategy and (2) agile strategy. The lean strategy is based on the principles of lean production in the automotive sector, where the “value stream” takes place in such a way as to eliminate all waste, including time waste, and ensure an even flow of production.

By implementing the lean strategy, the company strives to minimize component inventories and to approach the just-in-time environment wherever possible. On the contrary, by implementing an agile strategy, the company wants to respond more quickly to changes in customer requirements, both in terms of volume and variety of products. Flexibility and speed are consistently associated with agile manufacturing (18, pp. 100-111), while cost and efficiency are consistently associated with lean manufacturing (17, pp. 440–457).

A lean strategy is best applied in a predictable environment, where there is demand for a large quantity of products with little variety. Agile strategies give good results in less predictable environments where there is demand for very diverse products. Being agile means using market knowledge and information to exploit profitable opportunities in a volatile market environment.

In modern practice, many companies need a hybrid (“leagile”) strategy. It implies not only lean but also agile logistics and supply chain.

Saving time in an agile supply chain, to increase its level of responsiveness and flexibility, can make transportation and storage more harmful to the environment. Such a situation

can be influenced by the decision on the location of transport hubs, ports, warehouses and production facilities.

Representatives of the global shipping sector, responsible for more than 2% of global emissions, are calling on governments of all countries to reach a global agreement on carbon taxation. In July 2021, the European Commission proposed that shipping, for the first time, be included in the system that organizes the emission of harmful gases. It is another step that the European Union is taking in order to become climate neutral by 2050.

A carbon tax would enable the formation of a research and development fund in the shipping sector and encourage ship owners to invest in new technology. However, a carbon tax would cause additional costs for shipping companies, which they would pass on to their customers, which could worsen the position of export-dependent economies. In addition, the tax would further worry governments that more expensive shipping could cause disruptions in supply chains.

Maritime transport has been continuously increasing in the last fifteen years (except in 2009 due to the financial crisis), thanks to the growth of globalization and global trade. Annually, around 11 billion tons of different products are transported by ships in the world. The global shipping industry is responsible for around 90% of world trade (19). About 90,000 sea vessels participate in international maritime transport (over 50,000 of which are merchant ships), which significantly contributes to global climate change.

Particles emitted by ships in international transport, especially those whose diameter is less than or equal to 2.5 μm , are harmful to human health. Research by Annenberg et al. shows that emissions from these ships could be responsible for 60,000 (16%) of the world's premature deaths related to transport in 2015 (3). Far more alarming is research by Sofiev et al. (21, p. 406). They estimate that particles emitted by ships in 2020 could be responsible for the premature death, from lung cancer and cardiovascular diseases, of about a million people around the world.

3.5. Increasing electronic commerce

Since the beginning of the second decade of the 21st century, another trend has emerged that significantly affects the sustainability of logistics and supply chain management. It is the rising electronic commerce, both in B2B and in the B2C and C2C segments. In 2010, global e-commerce was 572 billion USD but in 2019 it reached 26.7 trillion USD (8). By 2027, the global e-commerce market could reach a value of USD 52.06 trillion (9). The value of e-commerce in retail sales alone in 2021 was close to USD 5.2 trillion but could reach USD 8.1 trillion by 2026.

This growth in e-commerce requires more reliable, accurate and expeditious logistics operations and supply chains. E-commerce will increase the need to improve processes such as: (1) product returns, (2) shipment and vehicle tracking, and (3) the use of cloud

services, which enable data sharing necessary to synchronize supply chain activities. All these processes affect the sustainability of transport.

The omnichannel retail model¹ increases the complexity of e-commerce and logistics activities. A successful supply chain requires full visibility of all sales channels and a holistic view of the path to purchase.

4. CONCLUSION

Since the 1980s, sustainability and sustainable development have become unavoidable topics in all business activities. The very relationship between the sustainability and success of companies and supply chains is becoming an important topic of interest for experts in the field of logistics and supply chain management.

The number of companies that, by implementing the green supply chain concept, improve their business performance and minimize the negative impact on the environment is increasing. Companies with a clear environmental position on the market generally belong to the category of successful companies.

The COVID-19 crisis has caused major disruptions in global supply chains. Companies that actively work to protect the environment have the opportunity to increase the capital and brand reputation and thus more easily overcome the consequences of this crisis.

A large number of companies today entrust their logistics activities and the supply chain management process to 3PL specialists. Thanks to this, companies can focus on core competencies, reduce costs and optimize their supply chains.

Today, it is impossible to imagine receiving, checking the status and order fulfilment without using communication technologies. By combining innovation, creativity and modern technologies, companies are developing sustainable solutions to make their supply chains greener, more transparent and more competitive than ever.

Digital technologies (Internet of Things, cyber-physical systems, cloud computing, big data analytics and security tools such as blockchain and RFID sensors) increase the transparency of supply chain processes and activities, as well as managers' responsibility for their execution. By implementing such technologies, companies can reorganize their entire operations in real time and thus create conditions to improve business performance.

By implementing lean and/or agile strategies, companies can increase production efficiency and shorten the execution time of logistics and supply chain operations.

¹ It is focused on customer needs and not on the brand. It implies overcoming the separation of offline and online sales, marketing and customer service, because all channels are mutually synchronized. Customers simultaneously use all sales channels (stores; digital media including computers, mobile phones and tablets; social media; catalogs and call centers) to improve the experience and increase knowledge about the product and the purchase.

Electronic commerce creates a need for more sophisticated logistics solutions. Customers expect fast and reliable delivery, and 3PL specialists have the infrastructure and skills necessary to meet these expectations.

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TRENDOVI KOJI UTIČU NA EVOLUCIJU ODRŽIVOSTI LOGISTIKE I LANACA SNABDEVANJA

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APSTRAKT. Cilj rada je da se, na bazi analiziranih sekundarnih izvora, indentifikuju: (1) poslovne perspektive zelenih, održivih i cirkularnih lanaca snabdevanja, i (2) uslovljenost održivosti logistike i lanaca snabdevanja ključnim trendovima u poslovnom okruženju. Predmetno određenje rada predstavlja interakcija ekoloških strategija kompanija i lanaca snabdevanja, s jedne strane, i njihovih finansijskih performansi i globalne konkurentnosti, s druge strane. Evolucija lanaca snabdevanja u pogledu održivosti sve više zavisi od nivoa integracije i digitalizacije njihovih resursa.

Ključne reči: zeleni lanac snabdevanja, održivi lanac snabdevanja, cirkularni lanac snabdevanja, tehnologije Industrije 4.0, agile strategija.

VENTURE CAPITAL FUNDS AS SOURCE OF ALTERNATIVE FINANCING THE GROWTH AND DEVELOPMENT OF STARTUP COMPANIES IN THE REPUBLIC OF SERBIA

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ABSTRACT:

Startups as economic entities are characterized by a high degree of innovation, the potential for rapid and large growth, but also significant business risk, so investing in startups represents a special kind of challenge. Taking into account the growing potential of the Serbian startup innovation ecosystem and the increasing number of startups, the paper analyzes venture capital funds as effective alternative source of financing the growth and development of startup companies in the Republic of Serbia. The fact that financing is one of the most significant challenges faced by Serbian startups also indicates the importance of venture capital funds for the development and increase of the competitiveness of the domestic startup ecosystem, which was recognized and institutionalized in previous years through state regulation. Their business creates new ways of financing for startups, but also reduces the risk for investors, and with the global success of several Serbian startups, the increasing presence of foreign investors in the form of venture capital funds is more noticeable.

Keywords: *venture capital fund, startup, startup innovative ecosystem, startup financing*

1. INTRODUCTION

In recent years, the Serbian innovation startup ecosystem has been characterized by constant rapid growth, which brings with it economic development and an increase in the number of new employees. Startup companies not only contribute to economic development and unemployment reduction, but with their new ideas, products and services, innovations, knowledge and creativity of company members, contribute to the initiation of technological and economic changes in the national economy of the Republic of Serbia. This exponential growth of the domestic startup innovation ecosystem brings with it great challenges of access to funding, internationalization and expanding business into a new markets and employment staff with adequate skills [1]. Serbian innovation

startup ecosystem is still relatively young, entering a mild phase of scaling, so venture capital funds can play a more serious role to solution of domestic startup's financing challenges than before.

The Republic of Serbia has been taking significant steps to promote entrepreneurship, startup economy and innovation in recent years. The government has introduced several programs and initiatives aimed at attracting foreign investment and supporting local venture capital funds. However, the venture capital industry in Serbia is still in its infancy compared to other European countries.

2. VENTURE CAPITAL FUNDS

The concept of venture capital funds is rooted in the economic theory of risk and return - investors are willing to invest their money in high-risk ventures because they expect to earn a higher return on their investment if the venture is successful. Venture capitalists use this theory to make investments in high-potential startups, hoping to generate exponential returns. Venture capital funds also play a key role in the innovation economy - they are often the first investors in new technologies and business models, providing the necessary funding to commercialize new ideas.

Venture capital represent *the professional asset management activity that by rising money from wealthy individuals and institutional investors invest into new ventures with risky ideas, but also with a high potential to grow* – it's professionally managed pool of capital that is invested in private ventures at various stages in their development [2].

Venture capital has five main characteristics [3]:

1. A venture capital is a financial intermediary, meaning that it takes the investors capital and invests it directly in portfolio companies,
2. A venture capital invests only in private companies, meaning that once the investments are made, the companies cannot be immediately traded on a public exchange,
3. A venture capital takes an active role in monitoring and helping the companies in its portfolio,
4. A venture capitals primary goal is to maximize its financial return by exiting investments through a sale or an initial public offering, and
5. A venture capital invests to fund the internal growth of companies.

The venture capital fund's investment stakes all the risk of business success in the amount of the investment itself – the failure of the startup company means loss of investment for venture capital funds. If the startup company achieves business success the fund usually comes out of the ownership structure through the sale of shares, which makes a profit in the form of investment/profit difference.

The lucrative returns on venture capital funds invested in the past, have created high expectations regarding future investment returns, which has led to great pressure to identify future winners between different startups that can provide quick and high returns. In fact, anywhere from 40% to 75% of the startup companies that received venture capital financing never return monies to their investors [4]. This pushback means that venture capital funds are more selective so it can be difficult for startup companies to use this source of financing.

Due to the size of the investments, venture capital funds are much more actively involved in the development of business concept, have greater management control and very often takes a significant percentage of the company's stake - that's why they have a greater interest in the startup company to continue successfully growth.

Venture capital funds offer not only financial investment, but also valuable intangible assets based on their experience and networks - this aspect of investment is critical, as startups in early stages often lack both financial and intangible resources, including past experience and knowledge, which are necessary for them to develop their business. However, only a limited number of startup companies have been successful in attracting venture capital funds investment and the timing of receiving investments ranges from the initial stage to the later stage of startup growth [5].

3. VENTURE CAPITAL FUNDS IN SERBIA

The venture capital and startup ecosystem in Republic of Serbia are underdeveloped in comparison to the EU member states, which benefit strongly from favorable economic collaboration and supportive policy regulations. However, the economic growth and innovation in the region of Western Balkan seem to expedite during last few years, with many public and government projects that stimulate entrepreneurship and startup economy.

It's very important to be taken into account that the majority of Serbian startups were founded in the last few years, which means that most of them are in the early stages of growth. Main characteristics of Serbian startup innovation ecosystem is a relatively low percentage of startups that are in the later stages of development which indicates that there are smaller number of scale-up companies in the ecosystem that are in a phase of mature growth and potential expansion.

Considering the current economic crisis in Europe and the world and the lack of Serbian startup companies that are in A, B or C funding rounds, it's not surprising that only 8.4% investments in Serbian startups during 2022 came from venture capital funds [1], which is a slight increase compared to the previous year 2021 in which 7,9% investments came from venture capital funding [6]. Another challenge for venture capital funds in Republic

of Serbia is the shortage of experienced entrepreneurs and management teams. Many startup companies lack experienced leaders who can take their businesses to the next level which often leads to difficulties in attracting investors and scaling their businesses.

There is a growing number of highly educated and talented young people in Republic of Serbia who are interested in entrepreneurship, with many individuals that are returning from abroad and bringing new ideas and skills with them. This trend is creating a more favorable environment for startups and venture capital funds. Venture capital funds in the Republic of Serbia can play an important role in future with further development of startup innovation ecosystem, in supporting innovative ideas and technological innovations offering financial support to startups engaged in the development of new innovative products and services.

The growth of venture capital funds market in Republic of Serbia can have a significant impact on the venture capital industry and startup innovative ecosystem itself. The industry would become much more competitive, with more players entering the market increasing pressure to generate high returns from investing in domestic startups companies.

Venture capital funds are recognized in the state legislation of the Republic of Serbia in the past few years. According to the Law on alternative investment funds **Venture capital funds** are *alternative investments funds with a private offer whose assets, in accordance with the alternative investments fund's business rules, are mainly invested in business entities that are newly founded or are in the initial stages of business, and show potential for growth and business expansion*. [7] At least 70% of venture capital fund assets must be invested in this type of companies, while up to 30% of its assets can be invested in other properties, in accordance with the investment policy.

The Republic of Serbia has also recognized the importance and possible impact of venture capital funds and supported their establishment and development through state's Innovation fund. *Serbia Ventures* program is designed to incentivize private investors, high net worth individuals and institutions to engage in financing startup companies with high growth potential by incorporating venture capital funds. Through this program, the Innovation Fund invest into newly established venture capital funds in Republic of Serbia in the role of a limited partner and help these funds generate a significant market impact on Serbia's startup innovation ecosystem. Amount of financing is up to 5 million EUR per each individual venture capital fund, provided the mandatory precondition that the selected venture capital fund has already raised or has generated commitments from its limited partners/investors to raise at least the same amount of capital within 12 months of achieving its first close [8].

First corporate venture capital fund in this part of Europe was established in 2021 by Serbian state-owned telecommunications operator Telekom Srbija with primary goal to support and invest in technological and business solutions, which due to their innovation in the market can lead to rapid and major transformations [9]. *TS Ventures* with yearly budget worth 5 million EUR, help domestic startups in the pre-seed to early stage, to developing a minimum viable product and scaling the business. During 2022 *TS Ventures* invested in nine domestic startup companies.

Additionally, there is plan to open two new venture capital funds in 2023 which will be supported by government subsidies and their investments will be primarily focused on the Serbian startup ecosystem and region of Western Balkans [1]. It can initiate additional growth of the startup ecosystem and the emergence of a greater number of new innovative startups, which additionally increases the attractiveness of the domestic innovative ecosystem. In addition to *TS Ventures* and two new venture capital funds, there is a number of foreign and regional private venture capital funds interesting in local ecosystem, which indicate that domestic startup innovation ecosystem is becoming more attractive and that can be expected more venture funds to enter domestic startup ecosystem in future.

The venture capital industry in Serbia is relatively young, with the first regional venture capital fund *South Central Ventures*, based in Belgrade, with offices in Belgrade, Ljubljana, Zagreb and Skopje. *South Central Ventures* seeks to invest in seed, early, and growth-stage companies operating in financial technology, agriculture technology, advertising technology, and SaaS sectors, with focus on tech startup companies in the Southeast Europe. The majority of the fund is allocated for early stage and growth investments of up to 5 million EUR per company [10]. Their last investment was in February 2023, startup tech company *Mily Technologies* has secured 1 million EUR in pre-seed funding, led by *South Central Ventures* and supported by a non-equity grant from *Katapult Accelerator*.

ICT Hub Ventures stand out as one of the two most important domestic venture capital funds in the region, along with *South Central Ventures*. *ICT Hub Ventures* was created in 2017 as an initiative of *ICT Hub* - one of the pioneering startup incubators in Serbia. Its mission is to strengthen the regional startup and venture capital ecosystem. Initial support for startups including an investment of up to 50,000 EUR in exchange for a 5-15% stake in the startup companies. The *ICT Hub Ventures* is ready to back pre-seed or seed startups, developing software solutions in the Southeast Europe region, with a team of no more than 5 members, a developed minimal viable product (or a prototype), a client base, and market knowledge [11]. In turn, *ICT Hub* provides capital, mentorship programs with industry experts, networking capabilities, guidance, and dedicated support through all development stages of backed startups.

In addition to the first venture capital funds, such as South Central Ventures, ICT Hub Ventures and TS Ventures, which have been financing local startup companies for several years, *Fifth Quarter Ventures* is currently in legal proceeding to become the fourth alternative investment fund ever established in the Republic of Serbia. Fifth Quarter Ventures is an early stage venture capital fund focused on investing in startup companies from the Western Balkan [12].

With the right support and investment, the venture capital industry in Republic of Serbia has the potential to drive significant economic growth and job creation in the coming years. Despite the current modest size of the venture capital industry in Republic of Serbia, there have been some notable successes in recent years. For example, during 2022 Serbia-based creative ads automation startup company *Hunch* raised 4 million EUR in a round, led by venture capital fund Catalyst Romania, backed by 3TS Capital Partners, alongside co-investors Euroventures, North Base Media, Seed Blink and South Central Ventures.

With the success of several domestic startups, the Serbian startup innovation system is gaining more interest even outside the country's borders, which has led to presence of few EU venture capital funds like *ZAKA Ventures* based in Czech Republic, with office in Belgrade or *Elevator Ventures* corporate venture capital entity of Raiffeisen Bank International based in Austria, both with primary focus in Central East Europe regions. The arrival of foreign investors is key to strengthening competitiveness and developing innovative technologies. Through cooperation with foreign partners, local venture funds can help improve technical knowledge and management in startup companies.

4. CONCLUSION

Serbian startup innovative ecosystem has been developing rapidly and there is a large potential for further growth and development. This exponential growth brings with it great challenges of access to funding, expanding business into a new markets and employment staff with adequate skills. Most Serbian startup companies see funding as the most significant problem for further scaling so venture capital can be key solution for it. Currently most startups are in early stages of development so it is not surprising that less than 10% of them had used venture capital as source of funding in recent years. The Republic of Serbia has also recognized the importance and possible impact of venture capital funds and supported their establishment and development trough programs like Serbian Ventures or first public corporate venture capital fund TS Ventures. Alongside with TS Ventures there are two more domestic venture capital funds – South East Ventures and ICT HUB Ventures which played important role in last several years. With the success of several domestic startups, the Serbian startup innovation system is gaining more interest globally, which has led to presence of few venture capital funds outside the country's borders. Taking into account that the majority of Serbian startups were founded in the last few years, it can be assumed that venture capital funds will play an even more important

role in the future with the transition of startups to scaling phases and the need for more significant investments in development.

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RURAL TOURISM AS A DRIVER OF RURAL DEVELOPMENT

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ABSTRACT:

The article presents the material on rural tourism as one of the directions of strategic development of rural areas. It gives an idea of ecological tourism. The known principles and directions of its realization are specified. The separate direction - rural tourism is allocated. Its definition and inherent features are given. The classification of the basic signs of rural tourism is given. The possibility of participation of business in rural tourism is defined. The features, opportunities and undeniable advantages of ecological (rural) tourism in the tourism industry. The tasks of all-regional and national importance in the implementation of rural tourism program are presented. Today rural (green, ecological, agrotourism) tourism has a great potential for development. Examples and experience in the implementation of rural (ecological) tourism in the regions of Russia are presented. Identified and highlighted the strengths and weaknesses of the regional development of rural tourism. Especially promising is the development of rural tourism between Moscow and St. Petersburg. For the implementation of possible models of this type of tourism should be developed classification, standardization and training. Higher education institutions must develop standards and programs for training and retraining of these specialists of small hospitality business. These programs should be tied to the specifics of business management in rural tourism.

Keywords: rural tourism, program, regions, experience, implementation, personnel. Russia has unique natural and climatic, cultural and historical features that allow to develop almost all popular types of tourism, one of which is rural tourism.

1. INTRODUCTION

Russia has unique natural and climatic, cultural and historical features that allow to develop almost all popular types of tourism, one of which is rural tourism. Rural areas have an extensive natural, demographic, economic, historical and cultural potential, the rational use of which can ensure sustainable development, decent standard of living and quality of life of the rural population. [1, c.6]

The modern interpretation of "sustainable development of rural areas" includes the following factors: stable socio-economic development of rural areas, increasing the production of agricultural products, increasing the efficiency of agriculture, achieving full

employment of the rural population and increasing their standard of living, rational use of land. [2]

Rural tourism is a relatively new and promising direction, allowing city dwellers to join the traditional way of life of rural residents. The essence of this type of tourism is recreation in the countryside, where all the organizational support of the tourists (including food, leisure, service, etc.) is undertaken by the host family. Rural tourism is a recreational opportunity for those who, for whatever reason, other types of tourism can not afford. Its attractive features are clean air, homely atmosphere, unspoiled nature, natural products, silence and unhurried life.

2. PRESENTATION OF THE BASIC MATERIAL

Rural tourism is developing rapidly, and in some countries takes a part of the tourist flow, so this direction is promising. In developed European countries agrarian (rural) tourism by popularity occupies the second place after sea vacations. Currently, agricultural (rural) tourism in Europe brings about 20% of the total income of the tourism industry. Rural tourism is thriving in Finland, Sweden, Poland, Czechoslovakia, Spain, Italy, Lithuania and Latvia. In Russia it is a new phenomenon. Also, according to the estimates of the World Tourist Organization, agrarian (rural) tourism is one of the five main strategic directions in the development of tourism in the world by 2020, combining a wide range of different types of recreation and developing rapidly in foreign countries.

Tourism is the best way to experience another culture. Combining recreation with learning about the life, history, and culture of another people is one of the tasks that tourism is fully capable of solving.

Ecotourism is traveling and visiting well-preserved natural areas represented by national and nature maps, reserves and other types of protected areas. Ecotourism implies the presence of certain, rather strict rules of conduct, which is a fundamental condition for the successful development of the industry itself. It is characterized by a relatively weak impact on the natural environment and is becoming almost the only type of use of natural resources in protected areas of the world.

Ecotourism combines recreation and environmental education [3, pp. 86-88]. And also ecotourism assumes that local residents not only work as service personnel, but continue to live in protected areas, to lead the former way of life, to engage in traditional types of economy, which provide a sparing mode of nature management. This brings a certain income to the population, contributes to its socio-economic development.

Based on known principles ecological tourism is represented by such directions as green, adventure, nature-oriented, non-technical, biological, rural, agro-ecological, soft, recreational, health-improving and others. [4, c. 24-26]

Rural tourism is a relatively new, promising direction that began to develop [5, p. 321-327] when agricultural land began to be developed. Tired inhabitants of megacities recently give preference to the countryside. The state, seeking to halt the exodus of rural residents, came up with a program through which everyone could experience all the pleasures of life outside the city.

Rural tourism (or agrotourism) is a form of tourism carried out in a rural environment, focused on the use of local tourist resources (natural, cultural, etc.) and aimed at familiarization with local customs and traditions, peasant, farming, etc. [6, p.3-4]. It is a type of tourism, which involves a temporary stay of tourists in rural areas for recreation and/or participation in agricultural work, a division of the tourism industry, aimed at the use of natural, cultural, historical and other resources of rural areas and its features to organize a comprehensive tourist product. [7, p. 149-153]

Rural tourism has the following characteristics: individuality, family, long duration of stay in the tour, quiet tone, motivation from within, lifestyle in accordance with the culture of the area visited, activity and diversity, the traveler learns a new culture, etc.

Rural or agrarian tourism includes various types of tourism, such as: health (Russian baths), children's (children's groups, couples), ethnographic (demonstration of rituals, traditions, performances of folklore groups), agricultural (harvesting, help on the farm, etc.), educational (painting lessons and courses in amber processing, cooking, vine weaving, wood painting, making Dymkovo toys, tapestry weaving, etc.), sports, culinary, crafts (harvesting, fishing, hunting), cognitive (studying local attractions), etc.

In rural tourism, in addition to tourism services, can develop and related businesses: timber and woodworking, production of building materials and construction; folk crafts and trades; household and socio-cultural services, harvesting and processing of wild fruits and berries, medicinal plants and other natural resources; trade.

The peculiarity of the countryside is determined by the fact that it is a source of many benefits: food and agricultural raw materials, a storehouse of natural resources, a place of residence, a recreational site, a place of assimilation of waste of urban life.

3. THE ADVANTAGES OF RURAL TOURISM DEVELOPMENT

The undeniable advantages of this type of tourism - clean air, homely atmosphere, unspoiled nature, natural products, quiet and unhurried life. Favorable environmental conditions contribute to the physical and psychological recovery. Rural tourism can boost the regional economy and become a good source of income. The essence of this type of tourism is to rest in the countryside, where all the organizational support of tourist accommodation (including food, leisure, service, etc.) is undertaken by the host family.

In addition to providing employment, the development of rural tourism solves a number of problems of regional and national importance, among them:

- preservation of small settlements and, therefore, of rural life;
- improving the living conditions of the rural population;
- creation of additional jobs;
- increasing the income of rural residents;
- retaining young people in the countryside;
- revitalizing the socio-economic infrastructure in rural areas;
- stimulating the study of folk customs and rituals;
- reviving and promoting traditional values and lifestyles;

- development of folk arts and crafts;
- regulating the use of natural sites, contributing to the preservation of the environment;
- preservation of cultural and historical heritage;
- attract foreign tourists.

Many regions have favorable prerequisites for the development of rural, forest and ecological tourism, a unique historical and cultural potential and a large number of diverse natural attractions. Over the past decades, the share of those employed in traditional sectors of the rural economy has decreased by a third in the employment structure of the rural population, respectively, employment has been redistributed to services, including financial, trade, construction, transport and communications, hotels, and catering (Rosstat).

The way out of this situation is seen in the organization of various types of non-agricultural activities, i.e. the development of rural tourism, the revival of folk crafts, the establishment in rural areas of enterprises for processing agricultural products and the production of consumer goods, cultivation of environmentally friendly products, etc.

OBJECTIVES OF THE STRATEGY

Currently, there is substantial support from the federal government and regional authorities for this direction - rural/agrotourism, farmers, pensioners, active people living on agricultural land.

Rural tourism, as a rule, is based on small-scale enterprises, and therefore does not require large investments, both public and private. At the same time, the industry has a serious multiplier effect and is of high social importance for the development of rural areas.

The potential for the development of rural tourism in Russia is also very high. "Strategy for tourism development in the Russian Federation until 2035", "Comprehensive program for development of rural areas" consider rural tourism as one of the promising areas of development. At the same time, the share of rural tourism in the total volume of tourist services in our country remains relatively low: it is estimated at 2% of the total turnover of domestic tourism. [8, p.3-4]

The main problems and barriers hindering the development of rural tourism in Russia include:

- the lack of a clearly formulated state policy and regulatory framework for the development of rural tourism at the federal level (including the lack of an official term "rural tourism" in the fed Lack of long-term and systematic practice of informing about success stories worthy of scaling examples of rural tourism organization in municipal and inter-municipal clusters of regions.
- subjects of rural tourism rarely participate in decision-making processes at the regional and municipal levels.

- the lack of a comprehensive, systematic and long-term program of financial support for rural tourism projects and initiatives at the federal and regional levels legislation).
- weak attention of controlling federal agencies (Ministry of Economic Development of the Russian Federation, Ministry of Agriculture of the Russian Federation, Posttourism, etc.) to small and very small objects (LPH, small means of accommodation, small farms, private mini-museums, etc.), as well as individuals, on which all over the world the rural tourism is based.
- the lack of a legal and transparent algorithm to support rural residents - individuals who want to start their own business in rural tourism (the creation of such opportunities in other countries has given a serious impetus to the development of the sector).
- lack of a comprehensive system of training (including advanced training) for the sphere of rural tourism, including in the curricula of Russian universities, thematic departments, etc.
- subjective barriers: distrust of rural residents, reluctance to change their familiar lifestyle, fear of a new type of activity, lack of local initiative.
- poorly developed understanding of the need to market the territory; insufficient understanding of the peculiarity, uniqueness and attractiveness of their "small motherland" and their object. Lack of "fashion" for rural tourism and rural life in general in Russian society, especially among young people.
- absence or insufficiently strong unification of economic entities of rural tourism at the federal, regional and local levels. Weak attention to the village and the preservation of traditional values and heritage of the countryside, including work with. Changes in the way of traditional village, leading to the degradation of rural culture and rural areas as a whole.
- weak popularization of rural tourism facilities. Russians do not know that it is possible to rest on the objects of rural tourism within the country, as well as fear of poor service, bad roads, poor quality of supply, etc. Lack of signs of tourist navigation by areas to rural tourism facilities.
- weak interaction between rural tourism facilities and travel companies.
- lack of support for thematic resource centers and other NGOs carrying out activities in the field of rural tourism at all levels. Lack of experts and mentors in the field of rural tourism in the regions of the Russian Federation.

Despite all the advantages, the development of rural tourism can have negative effects, such as the commercialization of the relationship with guests and the loss of value of real hospitality, garbage, uncontrolled development, spoiling the appearance of the area, excessive loads on natural areas, etc. Maximization of positive and minimization of

negative effects from the development of rural tourism is possible only as a result of a competent systematic approach to the planning and support of this sphere by the state. In some regions of Russia, local authorities are taking concrete steps to improve rural areas. Roads are being improved, urban-rural transport routes are being developed, new stores and cafes are being built in villages, monuments are being restored, and tourist routes are being developed. All this creates a positive image of rural areas. Ensuring the sustainability of their development is a complex task that creates the conditions for life in rural areas, combined with a socially-oriented responsible position of businesses working in rural areas, and the active participation of the population living in rural areas. [9, p.93-97]

4. ECONOMIC AND FINANCIAL MEASURES TO SUPPORT THE DEVELOPMENT OF RURAL TOURISM

Based on the above statistics, agrarian tourism is only about 6% of the total supply of rural tourism in the country. This should be taken into account when developing definitions of rural and, separately, agrarian tourism.

The indicators (number of tourists, number of visitors, number of overnight stays, average length of stay) According to the executive authorities of the subjects responsible for the development of domestic and inbound tourism, the number of tourists who visited rural tourism facilities in 2018 is about 8 million people. Average duration of visit: 1-3 overnight stays. According to the Federal Agency for Tourism, the total number of domestic tourists in Russia is 36 million people.

Thus, the number of consumers of tourism in rural areas is 22% of all tourists traveling in the country: every fifth tourist of domestic tourism travels through villages and country, visits major regional tourist brands (objects, events), located outside cities, including objects and routes of rural tourism.

Where do tourists go to the rural sites of the regions (in percentage ratio):

- from the regional center - 39%
- from the nearest cities of the region - 20%
- from other regions - 14%
- from Moscow and St. Petersburg - 20%
- foreign tourists - 7%.

Table 1. Economics of rural tourism

Where do tourists come from	In % of the total quantity	In number, people	Average bill per day, rubles.	Total income of rural
		5.	6.	Average value, mln. rub.
			7.	8.

From the regional center	9. 39	3 120 000	10. 1500	11. 4680
From nearby cities in the region	12. 20	1 600 000	13. 1500	14. 2400 15.
from other regions	16. 14	1 120 000	17. 2000	18. 2240
from Moscow and St. Petersburg	19. 20	1 600 000	20. 2500	21. 4000 22.
foreign tourists	23. 7	560 000	24. 3500	25. 1960
Total:	26. 100	8 000 000	27. _____	28. 15 280

The average duration of a visit is 2-3 days. Accordingly, according to preliminary estimates, the average income of local residents, employed in the sphere of rural tourism in Russia, is about 30 billion rubles a year. The average socio-economic portrait of the host/owner of the object rural tourism (according to experts in the field of rural tourism):

1. A married couple - 50%,
one woman - 40%,
one man - 10%.
2. Average age 45-60 years old.
3. In 40% of cases - native villagers, in 60% - newcomers (from the city or other regions).
4. In the vast majority of cases the case is a family affair, family members are involved in the work of the vast majority of cases are family-based, with family members including adult children taking part in the work of hosting guests.
5. In 70% of cases the case is an additional occupation, in 30% it is the main type of activity.

Assessment of the growth potential (based on the results of the study):

The vast majority of experts and representatives of the authorities of the subjects of the Russian Federation assess the potential for the development of the topic of rural tourism as very high.

In some regions of Russia, local authorities are taking concrete steps to improve rural areas. Roads are being improved, urban-rural transport routes are being developed, new stores and cafes are being built in villages, monuments are being restored, and tourist routes are being developed. All this creates a positive image of rural areas. Ensuring the sustainability of their development is a complex task that creates the conditions for life in rural areas, combined with a socially-oriented responsible position of businesses working in rural areas, and the active participation of the population living in rural areas. [10, p.93-97]

In the Novgorod region, the Valdai National Park on the territory of the farms organizes rural recreation, as well as services: hunting, fishing, visiting excursions, rustic bathhouses, but there are almost no entertainment programs. Attracts the nature of the place, log cabins, organic food, but aggravates the situation poor soils, harsh climate, too Spartan living conditions. But there is a huge advantage, there are no large enterprises within a radius of one hundred kilometers, and farmers do not use pesticides and mineral fertilizers.

Rural tourism infrastructure is developing and improving in the Leningrad region. Rural tourism is most actively developing in the Vyborg, Lodeynopolsky, Luga, Gatchinsky, Podporozhsky, Priozersky and Tikhvinsky districts of the region. Tourist routes in the Leningrad region run along the most beautiful places, through protected forests, along rivers, along the banks of lakes, in the area of wetlands.

Climate of Luga district of Leningrad region can be described as moderate-continental, the relief is hilly-level, belongs to the mixed forests of southern taiga, hydrological features are represented by 250 rivers, 8 specially protected natural areas with historical homesteads, there are museums in Luga. It is necessary to pay attention to the fact that the choice of recreation and development of rural tourism is influenced by the "natural landscape".

To develop this direction in Luzhskiy district, it is necessary to popularize and preserve the existing elements of culture, traditions, historical heritage of Luzhskiy district. To do this, it is necessary to propose activities: to restore the settlement network and organize technical equipment (club, theater venue, library, etc.); to create photo, video, library-catalogues of cultural heritage of Russian peoples, including intangible heritage (songs, tales, dances, customs, recipes of traditional cuisine, etc.) and develop catalogs reflecting traditional culture of settlements; to support youth initiatives to transfer experience and traditions; to expand funding of organizational activities for physical culture and sports work. For rural tourism to be more interesting, it is important that the location should be in an interesting area associated with an object, an event in history/

The following measures have been introduced to preserve the development of territories: support for peasant (private) farms and small businesses operating in rural areas; policies to attract migrants from other regions or from neighboring countries; expansion of seasonal dacha settlements in remote villages; creating conditions for the formation of eco-settlements on unused agricultural land; allocation of subsidies in each region for depressed areas; offering samples of rural local material culture, and And to make this idea interesting for the guest, you can offer to become not spectators, but full participants of

the village life. For example, to take part in milking cows, collecting eggs, heating the stove, to take part in a real subbotnik (tourists are lined up in a column, given a flag and led to work in the garden to the harmonica). For an hour, "subbotnik participants" enthusiastically help the villager with household chores, such as chopping wood, and then, in accordance with the tradition of the event, the hosts treat them, ending with a trip to the bath. The program is a great success - tourists, get real pleasure not so much from physical labor in the fresh air, but from participation, so if there are events in the village, such as a wedding, it is a great way to make the holiday memorable [11] One example of diversity in the provision of rural tourism in Luga district is a rural farmstead - the farm "Zarechye LLC" in the village of Zarechye. It is located on the bank of the small river Kuksa. Accommodations are equipped to all standards of hotel accommodation tourist. Services: meals, presented their own grown products, gastronomic tour "Russian cuisine: from the royal chambers to the peasant izba", horseback riding, fishing, walks in the woods, sauna. Family Kuzmins introduce the ancient household items and agricultural tools, various types of agricultural work, as well as farm animals and poultry (rabbits, goats with kids, ducks, raccoons, foxes, geese, chickens, turkeys), rope park. This homestead has been active since October 30, 2015.

For rural tourism Luzhsky district of the Leningrad region can identify strengths and weaknesses.

The strengths include:

- high agricultural potential of the district;
- rich natural and recreational potential;
- a wide range of cultural and historical monuments, both local and federal;
- the presence of public and commercial organizations that can contribute to the development of tourism in rural areas;
- multi-branch orientation of peasant and personal subsidiary farms.

Despite the positive examples of rural tourism development in the Luga district of the Leningrad Oblast, there are also problems facing this industry:

- lack of a generally accepted national concept for the development of rural tourism;
- the lack of a clear state policy in the field of rural tourism and, accordingly, the system of regulatory and legal support of this type of activity;
- the lack of special federal legislation regulating the activities in the field of rural tourism in the Russian Federation;
- the lack of standards and regulations applicable to rural tourism as a special sector of the tourism industry.

It should be noted that the standards and regulations of the Russian Federation, operating in the field of hotel and recreational business, cannot be mechanically transferred to the sphere of small family hotel business due to the specifics of the latter. This is conditioned by:

- lack of highly qualified specialists;
- lack of knowledge and experience in servicing domestic and foreign tourists;
- ignorance of own recreational resources.

It is noticeable that rural tourism is gradually beginning to lure tourists from resort tourism, attracting them with low prices and a wide range of recreational activities.

The development of rural tourism between Moscow and St. Petersburg is extremely promising. The presence of a large number of abandoned and destroyed villages indicates the great investment attractiveness of the region, as on these lands remain settlements and on them it is much easier to place ethnographic villages - guest complexes [7, p. 30-38]. It can be models of rural tourism of "Small family farm" type, a possible model of rural tourism functioning in the region can be "National village". To implement possible models it is necessary to work on classification, standardization and training.

The interest of city dwellers in the countryside as a pleasant exotic, or a return to the historical roots of many city dwellers, is growing. This means that there is a demand for hotels. If there is demand, there will be supply. Rural mini-hotel can become such an offer. The job of a hotel manager (or rural homeowner) requires extensive knowledge in many areas.

Higher education institutions should develop, together with hotel managers, standards and programs for training and retraining of these professionals (or hosts of rural houses) specifically for rural hotels and rural houses. These programs are tied to the specifics of business management in rural tourism. The peculiarity of small guest business is the focus on individual interests of tourists. The nature of modern labor activity, especially in rural tourism, requires the transition to modular principles of continuous education programs organization, the condition for consolidation of knowledge are internships and field trips to operating rural tourism facilities.

5. CONCLUSION

It should be stated that there is practically no legal framework regulating agro-tourism activities, there are no standards and regulations applicable to rural tourism as a specific sector of the tourism industry.

The advantage of the concept of sustainable development is to understand how economic activity fits into the system of socio-cultural values of local civilization and the natural processes of a particular region. In other words, sustainable development is a regional phenomenon, because in this case, economic development has to be put in dependence on the socio-cultural potential of the region and the assimilative capacity of the ecosystem.

The development of ecotourism should help to establish harmony between Man and Nature.

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SCOPE AND CHALLENGES OF ARTIFICIAL INTELLIGENCE APPLICATION IN ACCOUNTING

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ABSTRACT:

Having in mind that the accounting information system is one of the primary sources of information for making adequate business decisions, the tendency of the accounting practice to continuously monitor and apply modern trends in technology development is completely understandable. The introduction and implementation of artificial intelligence, as the latest technological solution today, attracts a lot of attention among theorists and practitioners. The aim of the authors of this paper is to review the possibilities of introducing artificial intelligence into accounting, the scope of its application, as well as the benefits that this technology can provide. In addition, special attention is focused on presenting the efforts and measures that need to be taken in order to fully utilize the potential of artificial intelligence and overcome its limitations.

Key words: *accounting transformation, artificial intelligence, digitization, skills of accountant*

1. INTRODUCTION

Accounting could be seen as a science that has always followed the development of new technologies. Thus, already in the late 60s of the last century, software that offered electronic calculations was introduced into accounting, and in the 80s stable accounting software was established, completely replacing manual execution of many accounting processes. Later, in the early 90s, desktop accounting software such as Pastel, Quickbooks and those based on cloud technology were launched, enabling mobility and the use of multiple devices for storing and processing information. At the same time, this kind of information exchange between different applications independently of people made it possible to manage accounting tasks without hiring accounting experts.

The development of technology has constantly caused changes in the accounting industry, however, artificial intelligence, which is the result of incredibly rapid technological development in recent years, attracts special attention from accounting practice. Actually, intelligent computer systems are imitating intellectual functions (Shaffer, 2020); simulating the process of thinking and gathering information (Afeng, 2017); able to learn from their own experience and simulate human intelligence in making decisions. Artificial

intelligence raises the possibilities of computing to a new level, it enables systems to predict and change accordingly just as humans would (Rana, 2018). The ultimate goal in the development of artificial intelligence is the creation of a smart system that will be able to think, learn from experience, solve problems and make decisions, adapt to a changing environment, behave independently and rationally.

The application of artificial intelligence in accounting represents an unprecedented trend that leads to a change in the paradigm of creating accounting records and financial reporting. As it has incredible potential for optimizing accounting practice, regardless of the fact that it also brings certain risks and poses great challenges for the accounting profession, artificial intelligence has become very acceptable technological solution that is considered to ensure the preservation of the purpose of accounting in the era of digitalization.

2. SCOPE AND BENEFITS OF APPLICATION OF ARTIFICIAL INTELLIGENCE IN ACCOUNTING

Having in mind that accounting records and classifies business transactions and events, processes and analyzes data, as well as interprets and transmits business results through reports to interested users, it represents the core of an enterprise's information system. Since it assumes the collection and processing of a large amount of data, which is a key area for the application of artificial intelligence, accounting practice recognized its potential properly and timely, therefore artificial intelligence, as the latest technological trend, is widely present in accounting. The inclusion of artificial intelligence in accounting practice has significantly influenced and changed the traditional directions and trends of accounting development and brought enormous innovations. Its role will certainly continue to grow as technology advances and reduces the reliance on manual data entry. Today, accountants are certainly aware of the fact that the application of artificial intelligence can provide solution of the problems at the critical points of inefficiency and not sufficient added value in the field of accounting, allowing accountants to turn to more creative work and creating greater benefits for the company. This is because using human language processing together with other artificial intelligence tools makes it possible to analyze information in minutes, which would take hours to humans. More advanced human language processing algorithms can also extract unstructured data that can help to identify and precise complex issues like fraud etc. By automating routine and repetitive activities that are performed on a daily, weekly and monthly level, artificial intelligence enables quick insight into a large amount of necessary data, empowers faster business decision-making and provides in-depth insights into the situation. Today, there are many artificial intelligence technologies that have become an indispensable part of accounting practice. Some of them are:

- Natural language processing (NLP), which enables computers to understand and classify elements of human language, which is the basis of speech assistants,

- Machine learning (ML) is a category of algorithms that are not programmed to perform a specific set of tasks, but are programmed in a way that they can analyze data and learn from it over time in order to achieve the appropriate goal. The philosophy behind machine learning algorithms is similar to that of humans – learning through experience and observation,
- Cognitive computing (CC) represents platforms that include numerous technologies such as machine learning, human language processing, reasoning, speech recognition and vision (object recognition), human-computer interaction, dialogue, etc.
- Robotics (Robotic process) which implies the use of software for automating computer processes.

Accounting tasks that machines can perform include (Rana, 2018):

- Monthly or quarterly situation - artificial intelligence is able to provide data from different sources and consolidate them. By performing this process significantly faster and more reliably, due to the involvement of machines in the work, accountants have more time to create strategies for what can be done with the obtained data;
- Simplifying procurement - tracking purchases for many companies involves a lot of administration meaning a lot of paperwork and different file formats that are not compatible. However, technology can be integrated in such a way that even unstructured data can be processed. This allows the procurement process to be simpler with less paperwork. At the same time, there are technologies that can easily track changes in the prices of different suppliers;
- Management of receivables and payables - existing systems use management processes that follows receivables and payables using a digital workflow.
- Costs management – reviewing and approving costs that are in line with company policy can be a very time-consuming process. Artificial intelligence can make this process much simpler, given that it can check accounts, review expenses and warn of their overruns and possible deviations from the adopted business policy.
- Chatbots based on artificial intelligence through which machines can effectively answer common user queries, such as questions related to due bills, account balance, account status, etc.

By performing these routine tasks, artificial intelligence significantly helps accountants in (Gusai, 2019, 60): obtaining, unifying and combining data from different sources, thereby saving their time and helping them plan their goals more easily and efficiently; helps and facilitates the search and access of digital data; enables monitoring of assets, expenses, income and identifying violations of adopted accounting policies and more.

Also, Keir (2019) recognizes the enormous benefits that accountants gain from artificial intelligence because it is a technological solution that:

- They provide easier prediction of possible solutions. With artificial intelligence integrated into the software, accountants are able to provide comprehensive insight

and forecasting without the usual manual and hard "mining" of the data from the created reports. More specifically, daily ability to have quick and easy access to updated and accurate reports and forecasts can help accountants provide more useful advices to company management..

- They can function as a personal smart assistant, or to be the first line of communication with management providing necessary information. At the same time, smart assistants appear in the form of: (1) scripted bots that are based on key expressions with the aim of giving a ready answer to a question, they existed for a long time and are simpler to create and (2) natural bots that are more sophisticated because they include speech recognition and accurate synthesis of the human voice, so that they can respond to natural language queries, and the more they are used, the more they learn.
- They enable easier detection of errors. Constantly processing large amounts of data allows machine learning to detect errors that may arise faster and with less effort. Targeted check and verification or control is focused on all data and not only on the appropriate sample, without the huge resources that would normally be engaged when traditional control is carried out.
- They automatically tag and allocate transactions because the software learns from the previous decisions of the accountant when assigning the appropriate transactions to positions. Although some of these assignment rules are intuitive, many are complex, at least from a computer's usage point of view. However, over the years, technology's ability to detect rules and predict them will greatly assist accountants in eliminating a significant component of their day-to-day work.
- They recognize data optically. The application of artificial intelligence in optical data recognition allows the software to recognize the type of document and elements such as inflows, invoice number, date, etc. This means that visible data can be extracted without human action, which significantly reduces the time required to distribute and sort data without human effort.

Li and Zheng (2018) especially point out that, although the accounting system is not a guarantee, the application of artificial intelligence in accounting contributes to minimizing the possibility of fraud. This in a way that a large volume of accounting work relies on software, and the accountant's job is reduced to monitoring them. The same authors further emphasize that artificial intelligence undoubtedly *contributes to improving the quality of accounting information*.

In traditional accounting, creating accounting documents, recording business changes, preparing financial reports, etc. implies that accountants check all these procedures. Such a way of working implies great human efforts, material and financial resources and very often overtime work of accountants in order to complete the tasks on time. In this sense, the usage of accounting software implies that all procedures are completed on time, which increases the efficiency of work, because accountants only need to monitor the operation

of the software. On the other hand, by using software, accountants only need to provide inputs and allow the software do the procedure. Even if it happens that accountants enter wrong data, the accounting software will automatically register the error and thus significantly increase the quality and reliability of accounting information.

Finally, *the reform of traditional accounting* towards changing the work methodology is the main implication of artificial intelligence on accounting. The reform stimulated by artificial intelligence provides an increase in the efficiency of work and the quality of work of accountants through (Washy, Law, 2019): a significant increase in the quality and quantity of data analysis (artificial intelligence can process a huge number of structured and unstructured data and perform rigorous analyses); increasing the power of observation and detection (artificial intelligence can provide insight, recognize weak signals and detect significantly more complex examinations than humans can); increasing cognitive capacity (by using feedback, artificial intelligence can automatically and instantly learn from mistakes or new cases and become smarter over time, never forgets and constantly upgrades and deepens memory); maintaining consistency in work and decision-making (robots never get bored with work, never get tired, are not lazy, moody, emotional, hungry, thirsty, sick, machines are not affected by fluctuations in biological or physiological conditions like humans); reducing errors (automatic data processing ensures immediate detection of errors and ensuring the accuracy of accounting records) and through reducing repetitive tasks (instead of spending time performing daily tasks, accountants can focus their efforts on work that requires human effort).

3. THE CHALLENGES OF ARTIFICIAL INTELLIGENCE APPLICATION IN ACCOUNTING

Today, without any doubt, it can be said that the introduction and application of artificial intelligence in various business segments creates many opportunities for improving the efficiency and effectiveness of companies' business, while achieving significant competitive advantage. However, despite the numerous advantages it provides, the application of artificial intelligence, not only in accounting, but also in all economic activities, brings with it numerous challenges. This refers primarily to the high costs of establishing, or incorporating artificial intelligence into the business system, with the expectation that capital investments provide appropriate guarantees for success. The fact is that the contemporary technological solutions require high investments, which have a slow return (Luo, Meng, Cao, 2018). Companies aiming to incorporate artificial intelligence into their business need to design a unique system that matches the characteristics of the specific company. After the implementation of the technology, it is necessary to adjust the human resource management and the daily work routine, and finally, when the intelligent transformation of the information system is completed, a series of appropriate trainings should be conducted, including training for the use of new system functions and information security (Chen, 2017). All mentioned points to the fact that due to the personalized characteristics of intelligent systems, companies need a large amount of resources during the initial application and later use, which represents a great

challenge for business costs controlling, which, in turn, slows down the further implementation of advanced technologies.

In addition to large investments, the challenges of introducing artificial intelligence are also reflected in the presence of appropriate regulatory restrictions, doubts about the privacy and security protection, etc. However, the most debated challenge regarding the introduction and implementation of artificial intelligence has primarily social character - the constant fear and constraints among employees that the existence and application of artificial intelligence will result in the loss of millions of jobs. Controversies related to these fears resulted with two aspects of observing the phenomenon of artificial intelligence.

The first aspect represents optimistic opinion that the emergence of artificial intelligence can create more jobs than it would close. According to some estimates, it would be up to 500,000 more jobs created than extinguished. This would practically mean that new educational centres will be needed to train and teach people to work with and alongside these highly intelligent machines. People would be educated to operate with them and vice versa, and in that sense, there is no reason to worry. On the other hand, as expected, pessimists fear that machines will take over jobs and thereby wipe out certain human occupations. They are aware of the fact that these machines would consume less, be able to process huge amounts of data in real time, function more reliably than humans, and be able to repeat the same work over and over again without fatigue. Because of this, they take the position that many routine jobs could disappear completely, harming millions of employees.

Similar to other business sectors, artificial intelligence in accounting could be seen as a technology that will significantly replace accountants, so the profession may become redundant in the future. Accountants can reasonably perceive it as a threat to the "survival" of the profession because they are aware of the fact that artificial intelligence can automate and simplify complex calculations that until now could only be done by accountants. However, the discussion of the executive director of the American Institute of Certified Public Accountants (AICPA) Barry Melancon, on the application of artificial intelligence and related future role of accountants was directed toward opinion that negative attitudes regarding the application of artificial intelligence in accounting, actually, represent views of people who do not fully understand the accounting profession. The fact is that artificial intelligence will take over many accounting tasks, but accounting does not rely only on a series of tasks that are performed in exactly the same way every time with exactly the same type of data.

The reality is significantly different - the data used is often unstructured and the situations accountants facing are always new and require human insight. True, Melancon expressed some concern for the accounting profession, based on a study by Accenture and Deloitte predicting that by 2020, robotics will eliminate or automate 40% of basic accounting jobs. However, he also believes that accountants will adapt and smartly use the most of advances in technology. Therefore, accountants are expected to be agile and make the best use of the potential of new technologies, because in this way they gain expertise that makes them more valuable for the transformation of business processes.

Daugherty & Wilson (2018) also point out that it is completely wrong opinion that technology will gradually replace human work and that trends should go the other way - achieving cooperation between humans and machines. Although certain tasks and functions will be taken by machines, the main strength of technology is reflected in the complementation of human work. More specifically, both humans and machines have their own strengths that cannot be replaced. The areas in which each side is irreplaceable, as well as those in which they can be complementary, are shown in table No.1.

Table 1. Team work of the humans and machines

Lead	Understand behaviour and culturism	Judge	Train	Explain	Sustain	Amplify	Interact	Embody	Transact	Iterate	Predict	Adapt
Human-only activity			Humans complete machines			Machines complete humans			Machine-only activity			
			Human-machine hybrid activities									

Source: Kruskopf et al., 2019, 4

Optimistic attitudes are also confirmed by statistical data on the significant increase in the number of jobs in the accounting sector. The Bureau of Labor Statistics of the United States Department of Labor included the profession of accountant and auditor in the list of "newest jobs" with an expected growth rate of 10% in the period from 2016 to 2026 (Kadian, 2018). However, the facts supporting this projected growth, do not indicate that the job profile in this field will remain the same. The work that accountants, auditors, bookkeepers and other professionals do today is certainly different from what they did ten years ago, but also from work they will be doing a decade later. Namely, despite the fact that artificial intelligence can perform close to 86% of the work of bookkeepers, accountants and auditors, at the same time, there are many things that it cannot do without relying on the skepticism and judgment of people. More specifically, although machines can perform all the calculations, human effort is required to analyze the process and draw meaningful conclusions. Shaffer et al. (2020) represent this opinion, pointing to the different impact of artificial intelligence on certain areas of accounting. According to their opinion, the area of accounting in which the influence of artificial intelligence is expected to a high extent are: accounting of business changes, risk management and inventory management. Artificial intelligence will have more moderate impact on: financial reporting and tax accounting. Otherwise, the areas on which artificial intelligence will have weak impact are: financial planning and management accounting. These are areas in which artificial intelligence is unable to replace the human efforts necessary for data interpretation, making investment strategies, planning, optimizing capital usage,

improvement processes, etc. In the areas of interpretation and management, accountants have primacy over artificial intelligence, and this transition for them means moving to the role of business advisors and providing services that will add value to companies. They are expected to provide optimal use of technology-generated data to help company management make the best business decisions. Therefore, in the conditions of new technologies, accounting jobs continue to grow due to the fact that technology offers solutions to solve already existing issues and problems, but the fact is that, for now, only human intelligence can recognize future issues and problems and develop solutions to solve them (Kadian, 2018). Having this in mind, the accounting profession has shifted its current focus on whether accountants will be replaced by technology, to a discussion of how to adapt to the requirements of the new digital era. So the question in the focus is what skills accountants need to be equipped with in order to thrive in a changing world. In this sense, it was concluded that in addition to traditional "numerical" skills, accountants are required to acquire new skills. Those new skills that will provide accountants with a key position in the company are presented in Table 2.

Table 2. New skills of accountants

Required skills	Explanation
Technical Skill	The ability to perform a task consistently to a defined standard while maintaining the highest level of integrity, independence and scepticism
Emotional Intelligence	The ability to identify your own emotions and those of others, regulate, manage and apply them to tasks reasonably
Digital Skill	The awareness and application of existing and emerging digital technologies, capabilities, strategies and practices
Creative Skill	The ability to use existing knowledge in a new situation, explore potential outcomes and generate new ideas
Vision	The ability to anticipate future trends accurately and fill the gaps in an innovative way
Experience	The ability to understand customer expectation and meet the desired outcome

Source: Ezeribe, C., 2019

Only by acquiring and strengthening these skills accountants tend to:

- Improve their potential (by adopting automation to perform everyday tasks such as data entry, accountants significantly save time, reduce costs and increase work productivity),
- Become innovators (new technologies give a new perception of problems and finding ways to solve them, and with relevant education and good professional experience, accountants can innovate numerous solutions) and

- Initiate decision-making (accounting has always been focused on decision-making, but by possessing so-called soft skills, the advisory role of accountants is especially strengthened and emphasized).

The above mentioned points to the fact that, today, the greatest expectations are aimed at improving the qualitative characteristics of accountants and, accordingly, achieving a combination of professional knowledge in the field of accounting, skills in using accounting software and data management, and possessing of the high level of complete information literacy, in general.

3. CONCLUSION

Artificial intelligence, which can be seen as the capacity of an artificial creation to realize functions that are characteristic of human thinking, represents the central preoccupation of computer scientists throughout the second half of the twentieth century. Researches focused on machine learning, thinking, problem solving, perception, and natural language understanding are components of artificial intelligence that are receiving particular attention. Despite the presence of skepticism among people, regarding the possibility of developing true artificial intelligence, the achievements in this field may be considered as really incredible. Today, the explosive growth in innovation in the field, has opened the door to artificial intelligence in all segments of business and people's lives.

Accounting as a source of a "critical mass" of information for the needs of business management and achieving and preserving a competitive advantage in the increasingly intense market competition, is an area where artificial intelligence inevitably had to enter. The key contribution of artificial intelligence in the field of accounting could be seen in removing the need for slow, manual processes in performing accounting tasks and leaving more room for accountants to create additional value for the company's operations.

Accountants are moving away from routine work and are giving more emphasis on the activities of analysis and interpretation of data generated by technology, all with the aim of becoming strategic partners to company management. Certainly, it is still a long way to think about the possibility of artificial intelligence that, based on experience, it could be able to learn and perceive problems, to make an impact that can encourage a change in accounting standards. However, the potential it has today certainly contributes to the improvement of the accounting sector.

However, although artificial intelligence has entered in accounting practice long time ago, it can be said that its application is still at a low level. More specifically, although a large number of companies have introduced accounting robots, these robots are aimed exclusively at performing some automated processes with a clear logarithm suitable for certain repetitive operations without the possibility of deep learning, which is actually the essence of artificial intelligence. In this sense, the scope of application of artificial intelligence is reduced mainly to the level of bookkeeping, recording of business changes, while it has not yet sufficiently entered the crucial areas of accounting such as is, for example, financial analysis. In this sense, the further development of artificial intelligence

is aimed at the aspiration of its full integration into accounting in order to replace human work related to the entry of original documents, the process of accounting information forming, the generation of financial reports and appropriate proposals for decision-making. Therefore, whether we are talking about the depth or width of the application of artificial intelligence in accounting, it can be said that it is in its infancy, because the complexity of the technology and the lack of experience with its application lead to certain difficulties in its further development. Therefore, there is still a long way to go for the development and application of artificial intelligence in the accounting sector.

Improving the appropriate conditions for the further development and implementation of artificial intelligence in accounting at a higher level implies the appropriate support of the state administration. More precisely, there are views that this topic should become a matter of national strategy, so that companies would be encouraged to initiate its implementation. Governments of countries should adopt relevant plans and take measures to actively create favorable conditions for more intensive application of artificial intelligence in accounting. In addition to appropriate policies and regulations, it would be invaluable to provide incentives and guidance to companies in adopting artificial intelligence in accounting. Also, it is necessary to increase the awareness of companies that in modern conditions of business, artificial intelligence should be in focus when thinking about improving the effectiveness of work and companies' competitiveness. Although the introduction and implementation of artificial intelligence will increase the overall business costs in the short term, however, looking into the future, it will enable more stable and sustainable development of companies.

Beside the measures that should be taken by the state, great expectations towards supporting the implementation of artificial intelligence in accounting are directed at the profession and accountants themselves - at the need to improve their knowledge and skills, in order to adapt to the digital transformation. This is due to the fact that in the initial phase of the implementation of artificial intelligence in accounting, the presence of top talents in this field is insufficient. Therefore, accountants themselves are expected to focus their attention on continuous improvement of personal professional skills, nurturing professional ethics and establishing awareness of the importance of lifelong learning in order to adapt to rapid changes and development requirements of accounting theory and practice. Therefore, the fact is that in the conditions of automation of routine tasks, only those accountants who improve their business offer will "survive", putting less emphasis on calculating and simple checking accounting results (technical skills), and focusing on interpretation, analysis of data and providing advices for business improvement (soft skills). Significant support in this, certainly, should be provided by professional organizations, but certain expectations are also directed towards faculties and universities. These educational institutions are expected to design adequate professional training programs, to emphasize the great importance of the combination of theoretical knowledge and accounting practice, to strengthen cooperation with the business sector and thus create opportunities for improving the practical knowledge and skills of future professional accountants. On the other hand, these institutions should take care of the continuous improvement of the teaching staff knowledge and providing of keeping up with modern

trends in the field of information technologies, as well as with development and changes of international accounting standards and international financial reporting standards. Only in this way, the theoretical study of accounting and teaching in practice would follow contemporary requirements and produce accountants who can meet the demands of the modern market.

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BRANDING OF BELGRADE NIGHTLIFE'S ORGANIC CAPACITY

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ABSTRACT:

City branding has become a popular area of research in spatial sociology, as a result of global urbanization of society, as well as a new phase of capitalism. Belgrade has enjoyed the title of the capital of nightlife of Eastern Europe for over a decade, and that "new Berlin" image was created completely organically - with no strategy, promotion, urban management, or even a clear plan on the part of tourist organizations. This paper aims at examining the potential and possibilities, as well as problems and potential hurdles on the path of building on, and highlighting the aforementioned potential, provided that a longterm plan and a strategy to promote and brand the city was put into effect. It will explore how taking these steps would affect the overall improvement of the city, its tourism and economy, as well as the impact they would have on the fulfillment of the socio-cultural needs of its inhabitants. The goal is to examine the general traits of city branding as well as the popularity and relevance of Belgrade nightlife, for tourists and migrants, as well as the local population, and eventually provide a concrete branding process plan. This entire process would consist of detailed analysis, research, interviews, as well as the mapping of current hotspots credited with creating this image of Balkan nightlife epicenter. Finally, it aims to develop a branding and development vision, utilizing all the modern instruments for urban management, and therefore secure Belgrade's competitive advantage on the market.

Keywords: *Belgrade, branding, city, nightlife, urban management*

1. INTRODUCTION

In a capitalist society where people even brand themselves, it is obvious how much branding of cities is necessary - even inevitable - for competition in the tourist market and staying in trend. New York is "the city that never sleeps," Paris is a "city of love," and Berlin paid 14 million dollars in 2008 for its new slogan "Be Berlin," which tourists were told: You do not come here for something new you can already see that you are becoming something new. However, Central and Eastern Europe has been in a transition period for too long, and it was challenging to brand any city whose politics also constantly changed. The capitals of Central and Eastern Europe have passed or are still passing through

complex transitions resulting from three crucial processes: post-socialist transformation, Europeanization, and globalization (Stenning, 2004; Hamilton et al.2005)

According to United Nations research, 55% of the world's population currently lives in cities. By comparison, in 1900, 13% of the world's population lived in cities; predictions say that by 2050 that percentage will rise to 68%. However, the importance of cities is growing in terms of the number of inhabitants and the concentration of power but also those needed resources for their functioning: "Cities cover only 2% of the territory planets, but require 75% of the resources. This data opens up a series of economic, social, and ecological sustainability of urban development and the peculiarities of urban policy by which this process shapes to a greater or lesser extent" (Petrović, 2009, p. 7).

Today, globalization seriously affects the economy, architecture, urbanism, and residents' cultural and social needs. Therefore, the management of cities began to become increasingly commonly viewed through the capital - where promotion provides cities with positioning opportunities in the world, creating a good reputation based on their uniqueness, authenticity, tolerance, transformability, communication, tradition, talent, as well as testimonies tourists, students, residents, and business people who add or subtract value their reputation (Morgan, Pritchard and Pride, 2015). However, to reach the goal and successfully rank on the market, it is necessary that state and local government, as well as business and economy community, recognize the concept of city branding and assume the expectations of tourists, foreign and domestic investors, buyers, as well as potential future residents.

The concept of city branding represents the profiling of a recognizable and unique image of the city, which will, with a long-term strategy and with constant cooperation with local government, residents, businesses, and economic community, attract foreign parties, investors, tourists, and residents; at the same time, this process makes cities better position in international market frameworks. The very process of breeding cities, though, looks like a marketing campaign; it is actually a long-term strategy which, in truth, involves many marketing activities and visibility planning, but also a lot of research and listening to the pulse of the market, the needs and expectations of the people who live in those cities, potential, target audience, communication with the media (local, regional and global level), social networks and events, creating a visual identity of the city, analyzing and choosing adequate and available tools for place branding.

This paper will explore Belgrade's nightlife as a breeding potential, try to explain how Belgrade has been so popular for decades, and that an image created organically, without a preconceived strategy, promotion, urban management, or a clear and organized plan of tourist organizations. Also, it will apply some of the urban management models and offer potential strategies for the promotion and branding of Belgrade's nightlife, and therefore Belgrade as one of the capitals of Europe. The research will be carried out through several methods: analysis of the content of selected literature, as well as tourist websites that, in one way or another, they promote Belgrade's nightlife, and through the comments and experiences of visitors to those sites. We will objectively and systematically examine the existing data using the content analysis method to obtain a realistic overall picture. In

addition to these, descriptive methods, mapping, and comparative analysis will also be used.

Work on practical examples of popular cultural locations will show and discuss possible directions toward a more distinct city identity.

2. BELGRADE, THE EPICENTER OF NIGHTLIFE IN THE BALKANS

In the early 2000s, Belgrade received a new epithet: the new Berlin. This seemingly flattering slogan - Belgrade is the new Berlin - actually positions Belgrade in the number 2 place it is from impossible to leave because there is always Berlin, to which Belgrade simply refers. Some of the descriptions of Berlin can be applied to Belgrade, such as "city of history" and "poor but sexy." Nevertheless, Belgrade is not just a shadow of Berlin, especially not after Berlin lost its mysteriousness - which is the reason for searching for a new Berlin. A famous quote from George Balašević's "We used to come to Belgrade as a pilgrimage" also underlines the potential of Belgrade as a city that knows how to change people. Capitalist vocabulary: Belgrade can monetize the experience. People come to Belgrade for that experience.

According to data from the Secretariat for Administration / Statistics Sector of the City of Belgrade, a record number of registered overnight stays in Belgrade accommodation facilities was achieved in 2022, a total of 3,180,977 was 18% more than the record in 2019. Furthermore, the total number of tourists who visited Belgrade in 2022 reached the number of 1.179.889 so far, of which almost a million are foreign guests, more precisely 982,495, which is an increase of 86% compared to last year.

In 2020, the constant growth of tourists in Belgrade was interrupted by COVID-19, which recorded a decrease in tourists by about 70% compared to the previous year. However, after a more profound analysis of the tourist reviews on platforms such as TripAdvisor, Booking.com, and Google Reviews, as well as social networks such as Twitter, Facebook, and Instagram (where trending hashtags #belgradenightlife, #beogradnocu, #nightinbelgrade, #belgradeatnight), we can conclude that Belgrade's rich nightlife has been around for a long time, especially among young people, recognized as the capital of good time in Eastern Europe.

Belgrade has had a good reputation as a nightlife city for many years backward. Maja Vukadinovic and Aleksandra Mikata, in the book Chronicle of a good marriage, which was created based on the concept of "Belgrade at night - Symbol of one time," which is published in several installments in the daily newspaper Politika, very vividly respond to the question of why exactly Belgrade has the image of a city that lives at night. Vukadinović and Mikata chronologically take us - everywhere from the shy sixties, when Belgrade had already positioned itself as the center of culture, entertainment, and social life. It is the age of romantic dances, landings, May Day parades, relay races, twists, and the beginning of Yugoslav rock and roll, the hippies' revolution, and the gradual interest of the socialist society in Western model entertainment.

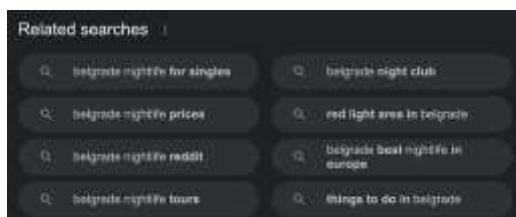


Fig.1. *A Google search for "Belgrade nightlife" offers thousands of articles and references without a clear plan and program.*

On April 25, 1967, the capital of the former Yugoslavia got its first disco in the Balkans - "At Laza Šećer" (on the site of today's "Šećer"/Sugar club). After the sixties the merry seventies came when the night offer became significantly more diverse - how musically and in terms of possible expression. Young people from different backgrounds and subcultures - finally got their places to hang out. Belgrade Night, which was already in the seventies, felt the potential of its nightlife; it brought new genre diversity and the right to choose: from hippies, discophiles, rockers, and ravers, all the way to punks, no while neglecting their folklore. The people of Belgrade got their first real one in the seventies disco club "Zeppelin," modeled on European clubs, which occupied 400 m², had three podiums, and seventeen seating options. With its floor covered with black artificial leather and with 20 mirrors under a flock of light bulbs, Zeppelin quickly became a "club that destroyed the youth."

After the fusion of disco lights and socialist concrete, Travoltiada (a competition in dance based on the popular movie "Saturday Night Fever") came to the eighties. With them, the cult club Akademia (primarily a club of art academy students), of which Vodič is through Europe ranked among the ten best underground places to go out in Europe. Through we can recognize this club as the beginning of the promotion of Belgrade's nightlife: the Academy did not go only for music; the Academy was the center of artistic, alternative, performative, and intellectual scenes. During the eighties, Belgrade improved the management of its nightlife - that is, starts to address its potential. Let us say the city starts then for the first time to offer night activities during the summer: pool parties, basketball courts, and the Panorama public swimming pool on Banovo brdo is also open disco on rošua.

At the peak of the branding of Belgrade as the capital of nightlife - the problematic, bloody, warlike but unique nineties began, which - paradoxically - as Mikata writes, ensured that Belgrade profiled itself as the center of the nightlife parties in the Balkans: "During the nineties, the most important tourism brands were created - debauchery, going out on weekdays, coffee shops in "Silicon Valley," Belgrade women like beauties, a city that resists globalization, in a word - a capital that everyone wants to visit."

The 1990s impoverished charming, artistic, and intellectual Belgrade with different laws (or the lack of them) and such a climate was followed by the arrival of turbo-folk and rafts. Lots of fun for little money, fights, murders, and sensationalism at any cost - again paradoxically - even such nightlife in Belgrade also had its audience in Europe. Everyone secretly wanted to hear, see and feel the crazy night events in the wartime, sanctioned and isolated Belgrade, where crime, inflation, and anarchist free nights. Although there were turbo folk, kitsch discos, and more modern bars as its most visible

parts, the Belgrade nightlife of the nineties also had positive moments. Jazz bars and clubs began to spring up in Belgrade, which were (un)expectedly crowded. That is when electro and techno sounds are heard for the first time in Belgrade, but also acid jazz, funk, and soul. In response to isolation, war, diesel, turbo-folk, and criminal confrontations, Belgrade hosts massive rave parties similar to the world rave parties organized in industrial cities like Detroit and Manchester. Symbolically, the techno club Industrija is born. Today, rave is one of the symbols of Belgrade's mainstream nightlife, and back then, it was organized in marginal and alternative spaces: fair halls, abandoned industrial buildings and hangars, Tašmajdan catacombs, in the old power plant in Dorćol... Although musical influences managed to penetrate what was then Belgrade, although Belgrade musicians and artists managed to find their expression in funk or techno, they existed on the margins for a long time, waiting for their time to become visible and take over the throne. They finally got it: after October 5, 2000, Belgrade once again opened the door to Europe and the world, and thus to the general improvement in culture and art.

Today, Belgrade is considered a city that never sleeps, where every night can be treated as a weekend and where, unlike in the seventies, going out starts after 11 pm because parties and gigs don't start until after midnight. Millennials have made Belgrade's nightlife eclectic: Belgrade has begun to offer spaces and entertainment for all tastes openly. The old phrase "from Silvana to Nirvana" is now visible in one of Belgrade's nights. Following the example of world trends and countries in transition, by reviving industrial zones and abandoned buildings and revitalizing urban pockets of the city, Belgrade contributed a better reputation on the international market. It stood side by side with many European and world metropolises. Such revitalized night oases are Betonhala, Hangar, Dragstor, Savamala with KC city (created as the first alternative cultural center), Cetinjska, the BIGZa building, and many others. One of the most important phenomena in Belgrade night assigned another taste is the pubs. Today, they are a transformed version of the cafe that existed in Yugoslavia or during the nineties, but despite that, they kept their interior, menu, and atmosphere the spirit of old times - with local cuisine and brandy that they are still served on checkered tablecloths.

Many foreign and world media have recognized Belgrade as the epicenter of good entertainment and nightlife. Some of them are:

- "The Guardian," wrote about Belgrade's nightlife, where the accent is put clubs like Drugstore and KC Grad on the alternative scene.
- Lonely Planet" also wrote about Belgrade's nightlife, where he presented guides to the best clubs, bars, and rafts in town.
- "VICE UK" had a few articles about nightlife in Belgrade, including raft parties and a guide to the best clubs in town.
- "The New York Times" wrote that Belgrade is slowly turning into a new Berlin regarding the club scene and alternative culture.

- BBC also had an article about Belgrade's nightlife, pointing out the club "20/44" as one of the best in town.
- CNN, In a 2017 article entitled "Belgrade Nightlife: New Wave creativity," CNN describes how Belgrade is becoming the new nightlife mecca in Europe.
- "The New York Times," in some of its articles, described Belgrade's nightlife's diversity and liveliness. One was called "Belgrade: The City that never sleeps," and the second was "Belgrade Bohemian Scene," published in 2009.
- "The British Telegraph" published an article in 2018 called "Belgrade nightlife: clubs, bars, and rafts. Other articles mentioning nightlife in Belgrade "How Belgrade Became the Serbian Berlin" and "How is the Serbian capital became the Host of the World's best festivals."

If a place has a positive reputation, that brand is an influential intermediary culture, community, and people, and the more potent its reputation, the easier it is to attract attention; therefore, it is better to compete for funds, jobs, and new investments. A positive reputation of a place increases its competitiveness; the value of that place and its brand accumulates and thus establishes its position as a place worth visiting (Morgan, Pritchard, and Pride, 2015).

Unfortunately, after all the war events on the soil of the former Yugoslavia, the foreign media was much more interested in the negative aspects and consequences of the war in the Balkans - and Belgrade was viewed through the prism of a post-socialist, post-war city, and after NATO bombings in 1999 - it received the status of a bombed city. City brand Belgrade is associated with numerous conflicts, nationalism, and crime economic and social problems, such as a high unemployment rate, poverty, and corruption. Apart from that, Belgrade did not have a good reputation regarding respect for human rights - i.e., treatment of certain minorities and vulnerable groups. Discrimination based on race, gender, sexual orientation, and other characteristics still exists in Belgrade and Serbia. However, many organizations and state institutions are trying to reduce it - and thus promise foreigners and future tourists that their rights in this city will be respected, regardless of the differences they bring.

To the same extent, how positively the city's reputation can affect the improvement of the city's brand, just as much as a negative reputation can threaten those activities that the city is acquired in other fields and can turn away potential tourists, investors and visitors, and residents. That is why before, in parallel with planning, and after planning, an urban strategy should work intensively to suppress and prevent the creation of a negative reputation and mistrust. Instead, build trust and provide a safe ground for all people.

3. REPUTATION MANAGEMENT OF BELGRADE'S NIGHTLIFE

As already said, the foundation of a winning and successful reputation of a creative destination is to provide a safe and tolerant space where all people feel welcomed despite their differences.

The term creative destination Morgan, Pritchard, and Pride, in the publication "Destination as a Brand," describe and define it as an urban and/or rural place that improves tourism well-being of its inhabitants and accepts new trends of thinking and sustainable way of thinking of life. In addition, these are attractive places to live and visit, smart places that attract attention regardless of their size and political influence. The virtuous circle of destination reputation has six elements that should mark future strong brands: *tone of communication, tradition, tolerance, talent, transformability, and testimonies* (Morgan, Pritchard, Pride, 2015, p. 28). In the implementation of the strategy should implement these elements of the virtuous circle of the reputation of a creative destination.

In the previous section, a lot has already been said about the *tradition* and rich history of the nightlife of Belgrade; various testimonies of visitors about uniqueness and specificity were also mentioned Belgrade nights, but also that Belgrade is a treasure trove of *talents*, young artists (both music, film, stage and literary industries) that have the power to create a unique and innovative scene. When we talk about transformability - Belgrade indeed is experiencing a slow but steady transformation regarding openness and inclusion diversity: be it gender, race, class, sexual orientation, or ethnicity belonging. *Transformability* is achieved by that keyword of a democratic society, i.e., tolerance, which is Belgrade's development point, especially the nightlife Belgrade brand.

All these things - tolerance, transformability, testimonies, tradition, talent - in one place can happen organically and exist at the level of the phenomenon or the unconscious potential. However, what must happen is conscious, planned, and intended establishing a clear and recognizable tone of communication that will attract the target group visitors. It can be, for example, a focus on the diversity of musical genres, a recognizable Belgrade sound, a friendly and open attitude towards foreign visitors, or accentuating the city's alternative scene.

After collecting data from various sources of literature, media, websites, social networks, and informal interviews - we can conclude that Belgrade enjoys a reputation as the nightlife capital of Eastern Europe. That image has been made prominent partly organically, almost by accident. According to Anholt, the author who developed his reflections on branding as a marketing expert: the process of branding cities should be understood as a long-term process, which is a product of intellectual (innovation) rather than financial capital (money spent in the media campaign) (Anholt, 2010, p. 74).

Implementing an urban strategy for rebranding Belgrade's nightlife can be complex and long-term. In the following text, we will try to implement the combination of the model used for the development of Kikinda's cultural and tourist content, which was managed by professor Uroš Radosavljević and his collaborators Aleksandra Đorđević and Jelena Radosavljević with a group of students, as well as other models described and explained in the publication "Destination as a Brand" (Morgan, Pritchard and Pride, 2015).

3. 1. Steps to implement the strategy

1. Perform analysis, research, and mapping of the current situation: The first step in implementing the urban strategy for rebranding Belgrade's nightlife is already an analysis of existing capacities and potentials. This analysis should focus on researching existing night destinations, identifying trends and shortcomings, and studying the needs of tourists and the local community.

- Research and analyze the authenticity, uniqueness, originality, and specificity of Belgrade;
- Map and display relationships between existing content, networks, and programs, as well as physical ones, urban structures, and spaces;
- Determine the values, potentials, and problems for branding the place. For example, in Table 1, a brief SWOT analysis (Tabele 1.) of Belgrade's nightlife is presented.
- Along with all the previous research, it is essential to research the competing cities and identify their strengths and weaknesses concerning Belgrade.

2. After appropriate research and mapping, follow the definition of the brand and its goals, i.e., visions of development. This step involves defining the desired identity of nightlife in Belgrade and setting clear goals to be achieved:

- Place branding using modern instruments of urban management;
- Integral spatial and programmatic concept of place branding based on the recognized values, potentials, and problems;
- Defining the vision of development, spatial networks, content, and activities.

3. If we treat the brand as a product, we go to the market with it, which is sold capitalized through a specific audience. **Identifying the target audience** is a crucial step in this stage of re-branding. This step will help understand the target audience's needs and preferences, which will be helpful when making decisions about the offer and promotion of overnight destinations.

4. Developing an action plan: After defining the brand, goals, and target audience, the next step is to develop an action plan to implement the strategy. The action plan should include concrete solutions to improve nightlife in Belgrade, including developing new night destinations, improving existing ones, promoting and marketing, improving infrastructure, and more.

The action plan begins with an analysis of examples and model options for projects and programs branding following the interests and needs of relevant actors. Then it continues analyzing and selecting urban management instruments that would be foreseen project. Before the actual implementation, it is necessary to work out spatial interventions, branding projects, and programs following the specifics of the cultural context. The last step is the implementation of the action plan. Implementation implies implementing planned activities, monitoring results, and adjusting the plan if necessary.

3. 2. External and internal actors for implementing the strategy

Implementing the urban strategy of Belgrade's nightlife is interdisciplinary and should involve different actors. Cooperation with the authorities is an important factor for the implementation of the strategy for the rebranding of Belgrade's nightlife because the Government has a key role in decision-making and providing support for the improvement (or deterioration) of nightlife in the city. In addition to the government, cooperation and the involvement of others is very important actors, such as city officials, local organizations and associations, entrepreneurs in the night sector, experts in urban planning, architecture, sociology, tourist organizations and agencies, media, police, representatives of cultural organizations, and art groups who would could contribute to the creation of a more diverse offer of cultural events and activities in nightlife, the public transport sector, and the non-governmental sector that would ensure that nightlife be inclusive and diverse, etc. Apart from external actors, they are significant for the success of branding essential and internal actors. Involvement of the local population in the process of creation i strategy implementation can help ensure their support and understanding. This may include convening public hearings, polls, and other activities that will enable the local population to actively participate in creating a new night identity life for yourself and your future guests.

If branding is seen as an organic and phenomenological process, local actors/citizens continuously shape the identity and image of the city and precisely the way they live, work, and have fun; their skills and entrepreneurship provide a specific added value to the branding of the city (Insch, 2011: 8).

Table 1. SWOT analysis of nightlife in Belgrade

S	W
<ul style="list-style-type: none"> - Belgrade's long and rich history of nightlife can be attractive to tourists and visitors. - Variety of offers: Nightlife in Belgrade offers various entertainment options, including clubs, bars, restaurants, rafts, concerts, and festivals. - Strong spirit of the place. - Belgrade has a rich cultural scene, including theaters, cinemas, museums, and galleries, which can add interest to tourists for nightlife. - Belgrade is located at the crossroads between West Europe and Southeast Europe, which makes it an attractive destination for transit passengers. - The prices of drinks and food and entrances to clubs in Belgrade are relatively affordable compared to other cities in Europe. 	<ul style="list-style-type: none"> -Lack of a clear identity of nightlife in Belgrade - Absence of innovative concepts and new ideas -Lack of promotion and marketing of nightlife - Security problems, such as violence, theft, and drugs, are a major concern for tourists and local audiences - Low quality of service in some clubs and bars, such as untidy toilets and poor service, may turn off potential visitors. - Lack of a marketing campaign that promotes nightlife in Belgrade. - Outdated infrastructure, including an inadequate public transport system and parking problems. -Lack of investment in nightlife development, including lack of funds for renovation and modernization of space, may limit the development of this area.

<p>O</p> <ul style="list-style-type: none"> -Potential for attracting new tourists. -Organizing events and festivals in nightlife. - Introducing new trends in nightlife, such as new musical genres and board games. - Business guided by the principles of social responsibility, including respect for human rights, environmental protection, and support for the local community. - Possibility of cooperation with local artists and musicians. - Belgrade has many different spaces that can be used for nightlife, including clubs, bars, restaurants, and venues outdoors, and abandoned industrial spaces that provide various possibilities for new concepts and formats. - Belgrade's rich history and cultural heritage can be used to promote nightlife, including cultural tours, thematic evenings, and events. 	<p>T</p> <ul style="list-style-type: none"> -Regulations related to nightlife can limit business opportunities and reduce profitability. - Competition in the nightlife field is great in the region and other cities in Europe, which can reduce tourist interest. - The capacity of some clubs and bars may be limited, leading to crowding and crowd dissatisfaction. - The COVID-19 pandemic has significantly affected nightlife in Belgrade and around the world, making the recovery of this area difficult.

In addition to the proposed basic steps for the implementation of the urban strategy of rebranding Belgrade's nightlife, based on the SWOT analysis (Tabele 1.) is very important to include the following steps that are vital to the success of the strategy:

-Monitoring and evaluation: In order to ensure the successful implementation of the strategy, it is important to monitor and evaluate progress at regular intervals. This will enable the identification successes and shortcomings of the strategy and adaptation of the action plan according to needs and new trends.

-Linking with other city strategies: Belgrade's rebranding of nightlife should not be isolated from other urban strategies in the country and region. Therefore, it is crucial

to connect strategies at the local, state, and even regional levels and work on synergy to ensure a long-term sustainable improvement in the quality of life in the city.

-Creating a new offer: It is essential to create a new offer to attract a new target audience and improve the overall quality of nightlife in Belgrade. It may include the development of new music festivals, cultural events, and other manifestations that will attract tourists and local audiences. At the same time, it means investing in artists, musicians, and performers all over Serbia - so that they would be the ones who offer an authentic and unique style.

- Improvement of infrastructure: Improvement of public transport, lighting, and security, as well as arranging public spaces and solving the problem of noise and crowding, can be vital to the strategy's success and the comfort of both residents and visitors.

4. CONCLUSION

Nightlife is inseparable from culture and art. And in today's hyper-production market, when we talk about creating a new offer - any offer is not enough. You need a specific Belgrade voice, a recognizable Belgrade sound, you need to be constantly "edgy." Therefore, the answer to the question "where to start?" is "from art." Investing in local creators is what Belgrade lacks today in order to rise to the level of world capitals of nightlife. Socialism invested in its people; however, after the collapse of Yugoslavia, there was a huge "brain drain" - about 300,000 university-educated people left the country. The years that followed did not invest in the creative industry, and Belgrade is still recovering from the consequences of that period of "intellectual hunger."

Nevertheless, Belgrade persistently shows its adaptability when it comes to entertainment. The concept of a "fun zone" represents an organized night out within a specific zone (which in Belgrade is mostly industrial and underutilized). The ephemeral and unstable quality of entertainment zones in Belgrade and the occupation of seemingly marginal spaces contribute to the revival of the city's capacity for entertainment, especially when it comes to countries in transition, which abound in abandoned and empty buildings. Such spaces continue to "sprout" in Belgrade, such as in the last couple of years, a space like DIM also appeared. As the poet Maša Seničić writes: DIM is not just a bar in Cetinjska Street; it is a platform for theater, gallery, concert, and club events; it is a space for playing between day and night (according to beforeafter.rs).

Certainly, this paper suggests that, in addition to clubs and rafts (which are the most well-known to tourists), serious work should be done on presenting the other contents of Belgrade (such as museums, galleries, theaters, exhibitions, sports events...) that would adapt their program to night outs (from 21:00 to 00:00, for example). The capacity for such activities is, for example, a night tour of the Kalemegdan Fortress, Skadarlija, Gardoš Tower in Zemun or some other tours in different parts of the city, as well as "Museum Night," "Book Night," etc. In order to achieve this, it is necessary for the city authorities, in cooperation with the tourist organization of Belgrade, to look at all the potentials, capacities, and resources of the city and to create a long-term branding plan for the Serbian

capital, the implementation of which would change and improve the image of the city, maintain existing qualities and indicate new directions. and the city's contents, both in terms of nightlife and the overall branding of Belgrade.

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EVALUATING INTANGIBLE PROJECT MANAGEMENT ASSETS: EMPIRICAL EVIDENCE IN SERBIAN CONTEXT

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ABSTRACT:

Project-based firms have a wide range of tangible and intangible resources, while a significant share in the total value of the company has intangible assets. Traditional accounting standards are not sufficiently effective in determining created value in the era of knowledge and digitalization. Digitalization has contributed to numerous challenges, among which is the repositioning of the role of human intellectual potential in the value creation process. The automation and artificial intelligence are recognized as a widespread and central component of modern factories as well as the most important driver of technological change in society. Despite the benefits of using robots and machines, humans are still considered an irreplaceable component, and the success in the digital economy is largely determined by intangible assets. Considering limited empirical studies in project management, the purpose of this paper is to assess intangible project management assets, using project managers' perspective. The intangible project management assets is explored in terms of human, structural and relational capital. The findings reveal that the relational capital has reached the highest level of development in analyzed project-based firms. The conducted research is a good starting point for the development of value creation model in project-based firms. The findings imply the potential space for the improvement of intangible project management assets, as an important element in value creation process. The future research may be focused on exploring intangible project management assets from the point of view of other project stakeholders, which can be used in comparison analysis.

Keywords: *project management, intangible assets, project-based firms*

1. INTRODUCTION

Project-based firms have a whole spectrum of diverse tangible and intangible resources, while their potential is perceived differently in the value creation process. Numerous national economies their competitiveness based on intangible assets (Švarc et al., 2021). Physical or tangible resources are no more unique and they may be the subject of imitation by competitors, therefore, they are not a source for generating sustainable competitive advantage. Contemporary companies are focused on intangible resources that are a basis of intangible assets. Intangible resources have no physical or financial appearance and

they are related to knowledge and information, abilities of employees, relationships with customers and different stakeholders, including resources, which are related to the management process, information systems, organizational routines and culture, intellectual property and reputation.

The main difference between tangible and intangible assets is reflected in the fact that tangible assets are decreased by use, while intangible assets are increased (Simić & Ognjanović, 2019). Considering that a significant share in the total value of the company is the value of intangible assets, the issue is to investigate its evaluation and measurement system. Traditional accounting measures are not sufficiently effective in determining the value of the company in the era based on knowledge and digitization, considering that the most of the company's assets are invisible, non-material and not presented in financial reports (Roos & Roos, 1997). Respecting the multidimensional nature of intangible assets, in literature, there are different approaches of the evaluation of intangible assets, which can differ in practice depending on the scope and difficulties in carrying out the necessary calculations.

Despite different approaches in the evaluation of intangible assets and the exception of consensus on the choice of the most effective method, the value of project-based firms is determined to a significant extent by the efficiency of the use of intangible assets (Handzic & Durmic, 2015). Project is an endeavor with limited duration, and determined resources, which can be used in different ways to achieve the project goals (Handzic et al., 2016). Thus, one of the important tasks on the way to achieve the project success is the identification of the resources, as well as the way in which it can be effectively managed. Respecting the requirements of the era of knowledge, it has been proven that there is an impact of intangible assets on firm performance (Firer, & Stainbank, 2003; Peng et al., 2007; Cheng et al., 2010). Previous studies examined the relationship between intangible assets and competitive advantage. Intangible project management assets are found to be a source of competitive advantage, directly and through a mediating role in the relationship between tangible project management assets and the competitive characteristics of the project management process (Mathur et al., 2007), while there is an empirical study that explained the link between the characteristics of the project management assets and project and firm performance (Mathur et al., 2013).

There are numerous previous studies that has the purpose to determine the components of intangible assets, such as human capital (Edvinsson & Malone, 1997; Bontis, 1998, Sullivan & Sullivan, 2000, Roos et al., 2005; Khalique et al., 2011; Tefera & Hunsaker, 2020), structural capital and organisational capital (Edvinsson и Malone, 1997; Kaplan & Norton, 2004), social capital (De Castro & Sáez, 2008; Khalique, Isa, Nassir Shaari & Ageel, 2011), customer capital (Bontis, 1998; Khalique, Isa, Nassir Shaari & Ageel, 2011), psychological capital (Tefera & Hunsaker, 2020), technological and spiritual capital (Khalique et al., 2011). In the literature on project management, there are several important elements of intangible assets: human, structural and relational capital (Handzic & Durmic, 2015; Handzic и cap., 2016; Milošević et al., 2018; Negash & Hassan, 2020). However, there is limited evidence on the evaluation of intangible assets in project-based firms. Current evidence shows that there are different approaches: direct intellectual capital

methods, market capitalization methods, ROA methods, scorecard models, while there is no evidence about their implementation in project management context.

This study makes a contribution to the growing body of empirical works on intangible project management assets. According to abstract and dynamic nature of intangible assets, the difficulties in assessing different components are evident. One of the approaches is Skandia Navigator model, which is based on different perspectives of Balanced Scorecard (BSC). The concept of BSC is the starting point for the development of other models for the evaluation of intangible assets. The approaches based on BSC are based on exploring attitude of using a wider range of indicators, qualitative or quantitative. Instead of the presented perspectives of BSC, Skandia navigator recognizes several focuses or components of intangible assets, such as human, structural, relational capital (Edvisson & Malone, 1997; Kamaluddin & Rahman, 2009; Wang et al., 2021).

The sections that follow include the literature review, the used methodology, a discussion of obtained results, and made conclusions.

2. LITERATURE REVIEW

Respecting VRIO framework and the resource-based view (RBV) of the firm, resources are considered strategic if they have the competitive characteristics. In other words, if they contribute to economic value (valuable), they are rare, difficult to copy, and they have organizational support (Barney, 1991), they can be classified as strategic assets that contribute to a competitive advantage (Mathur et al., 2007). According to previous studies the resources that have strategic relevance for the company contain codified and tacit knowledge (Kaplan et al., 2001; Nonaka, 1994) embedded in unique skills, knowledge of the firm's employees (Jugdev & Mathur, 2006). Explicit, tangible knowledge may be imitable, because it documented and easily shared, while tacit knowledge is shared informally through social exchanges, and can be viewed as difficult to imitate and a source of competitive advantage (Mathur et al., 2007).

Project management is "a set of practices applied to a project to deliver a result, product, or service based on tangible and intangible assets" (Mathur et al., 2007). After the review of the project management literature, there are few empirical studies on project management as a strategic asset (DeFillippi and Arthur, 1998; Jugdev & Mathur, 2006), and intangible project management assets (Mathur, et al., 2007). According to DeFillipi and Arthur (1998) an important part of project management assets is personnel embedded in human capital, that can be used in generating a competitive advantage. Members of project teams often share knowledge and relevant information through communities of practice (Jugdev & Mathur, 2006), such as brainstorming, mentoring, and storytelling (Mathur, et al., 2007), creating unique combination of intangible resources. The RBV and the VRIO framework were used to explore how project management contributes to a competitive advantage of the company (Mathur, et al., 2007), to investigate the relationship between tangible and intangible project management assets (Jugdev et al., 2007). In their study, Mathur et al. (2013) revealed that tangible project management assets are valuable, but intangible project management assets are rare, and difficult to copy, therefore they contribute to competitive advantage. Mathur et al. (2007) argue that

intangible project management assets are a source of competitive advantage, directly and through a mediating role in the relationship between tangible project management assets and the competitive characteristics of the project management process.

Consequently, recent researches increasingly indicate the importance of intangible assets and their components as factors that significantly determine the success and performance of the project. Considering project management perspective, the components of intangible assets are important factors for project success (Handzic & Durmic, 2015). In addition, the importance of intangible assets may be analyzed through its contribution to the value creation of the company (Gamayuni, 2015). Including tacit and explicit knowledge, intangible assets may be interpreted differently in the context of generating competitive advantage. Explicit knowledge is more formal, codified, and easily shared, while tacit knowledge is shared informally through practices and social exchanges among employees. Thus, tacit knowledge can be viewed as valuable, rare and difficult to imitate (Mathur et al., 2007). Bearers of tacit knowledge are employees within firm, due to an important component of intangible project management assets is human capital. Apart from employees that are engaged in the project, a relevant part of the intangible project management assets are all individuals, groups, institutions that are influenced by project and may have interest in realizing project results (i.e., relational capital), as well as the way in which the project is planned, executed and delivered (i.e., structural capital) (Handzic & Durmic, 2015, Milošević et al., 2018).

The importance of the evaluation of intangible assets is evidenced by previous studies. A study conducted by the Danish Agency for Trade and Industry (2000) implies that companies that assess and evaluate their intangible assets are more likely to achieve long-term success. Bontis (1998) argues that there is a strong relationship between the investments in intangibles and corporate performance. Therefore, it is important to assess and monitor the investments in intangible assets, in order to improve corporate performance. Engström, Westnes and Westnes (2003) in their research highlight the informative significance of the evaluation of intangible assets. In other words, thanks to different evaluation approaches, the information is provided to shareholders and, it is essential when making important decisions, providing guidelines for managing "hidden assets" in order to achieve strategic goals.

The evaluation of intangible project management assets is realized using the RBV and VRIO framework (Mathur et al., 2007; Mathur, et al., 2013). Numerous studies considered the assessment and the development of the indicators that were used for the evaluation of intangible assets at the company level, such as ROA methods, direct and market approach (Chareonsuk & Chansa-ngavej, 2010; Visconti, 2020). Previous approaches are usually based on the usage of the information available in official financial reports (Janošević et al., 2013; Ognjanovic et al., 2023), due to it is difficult to use them in the evaluation of project management assets. The most frequently used quantitative approach, which enables the assessment of the efficiency of individual components of intangible assets, is the VAIC method (Pulic, 2004; Janošević et al., 2013). There are numerous studies that used this approach (Ullum et al., 2014; Peković et al., 2020), which application is also limited due to used data including official documents, and difficulties

regarding the part of assets used in the realization of the given project. As a possible solution for the value assessment of intangible project management assets may be used Skandia Navigator model. Based on the Balances Scorecard antecedents, this is qualitative approach that includes several perspectives for the assessment of intangible assets and, considers numerous indicators, such as competence and attitudes of employees, creative potential, organizational culture and structure, organizational learning, operating processes, information systems, innovation capabilities, marketing skills and, indicators of client loyalty (Chen et al., 2004). In this paper Skandia Navigator approach is used in order to evaluate the intangible project management assets as strategic assets of the firm, as well as its important components. According to this purpose, the study makes a contribution to the growing body of empirical works on intangible project management assets.

3. METHODOLOGY

In order to collect primary data, the survey method was applied. The designed questionnaire contains 20 questions, 10 demographic questions, and an open-ended question for additional input. It is used a 5-point Likert scale with the anchors being “Strongly Agree” and “Strongly Disagree”. To improve validity, the survey was pretested with 10 academic colleagues and feedback was incorporated in item wording and list of questions. Our random sample was generated from the Business Registry Agencies database. The questionnaire was distributed via email to the project managers, who have been responsible for delivering at least 15 projects in last 7 years. The selected project managers have been asked to answer the questions regarding various projects they have run in the last period and that have been finished in last 5 years. The total of 134 questionnaires was collected, while 17 were non-valid questionnaires, thus the total sample counts 117 observations.

Analyzing the sample structure, according to the years of working experience, 46.1% of total respondents have less than 10 years of experience, 29,1% of total respondents have between 11 and 15 years of experience and, more than 15 years of the experience have 24.8% of the respondents who took part in this research. In the sample 70.9% respondents are male that are engaged as project managers, while others are female (29.1%). Out of the total number of respondents, 20.5% have finished secondary school, 27.4% have finished high school or equivalent, while 52.1% hold Bachelor's degree or higher.

It is used SPSS v. 13 to conduct exploratory factor analysis and extract factors representing intangible project management assets. In this research Principal Component Analysis (PCA) is used, which represents the process of simplifying data by reducing the number of variables (Karamizadeh et al., 2013). As a rotation method it is chosen Varimax rotation, which implies minimizing the number of variables with high absolute values of factor weights (Abdi, 2003). It is used 0.40 as a cutoff to identify items with the highest loadings for inclusion with a factor (Sass, 2010). Eigenvalues over one were used to extract reliable factors. Cronbach's alpha measures how well a set of items measures a single unidimensional latent construct. A reliability coefficient of 0.70 or higher is acceptable in the social sciences (Nunnally, 1978). As it was expected three factors are

extracted, named human, structural and relational capital, while 11 items were selected as relevant to explain the following factors.

4. FINDINGS

In Table 1 the results of conducted analysis are presented, considering items used for the evaluation of intangible project management assets. In this case, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) is higher than 0.50, while the Bartlett's Test of Sphericity is statistically significant ($p < 0.001$) (Williams, Onsman & Brown, 2010). Three factors were extracted that comprised intangible project management assets that represent 76.429 per cent of the total variance of the original variables, which is quite acceptable for a factor analysis. Each factor presents one component of intangible project management assets:

- [1] relational capital, implies the nature and quality of the relationships that project team members have developed with the most important stakeholders, such as clients/investors, suppliers and subcontractors (Negash & Hassan, 2020). The latent construct of relational capital consisted of five items and had a Cronbach's Alpha of 0.762;
- [2] human capital, refers to managing the employees engaged in a project (Milošević, Dobrota & Rakočević, 2018) and considers the key activities of managing human capital, such as recruiting, developing, retaining human capital (Dess & Lumpkin, 2003). The latent construct of human capital consisted of four items and had a Cronbach's Alpha of 0.868;
- [3] structural capital, includes applied systems and procedures (Engström, Westnes & Westnes, 2003), aspects of the work environment and atmosphere in which projects are implemented (Bontis, 1998; Handzic et al., 2016). The latent construct of structural capital consisted of two items and had a Cronbach's Alpha of 0.711.

Table 1. Exploratory factor analysis

Items	Relational capital	Human capital	Structural capital
IT1	0.924		
IT2	0.860		
IT3	0.820		
IT4	0.738		
IT5	0.663		
IT6		0.904	
IT7		0.845	
IT8		0.779	
IT9		0.652	

IT10			0.907
IT11			0.552

Note: In table are presented factors loadings. KMO = 0.594; Bartlett's test of sphericity =1004.059; df = 55; p < 0.001.

Source: Authors' research

Table 2. Descriptive Statistics

	Mean	Std. Deviation
Relational capital	4.3675	0.60112
Human capital	3.8889	0.78059
Structural capital	3.9145	0.95432

Source: Author's research

Additionally, the calculation of arithmetic means and standard deviation is performed, that represents the degree of respondents' agreement with the given statements, as well as the homogeneity of the respondents' attitudes (Table 2). The presented values of mean show that project managers argue that relational capital is at the highest level of development in comparison to other components of intangible project management assets, while the lowest level is examined in case of human capital. Despite the high homogeneity of the respondents' attitudes, the value regarding relational capital is the lowest, while the highest level is in case of structural capital.

5. DISCUSSION AND CONCLUSION

The purpose of this research is the evaluation of intangible project management assets, as well as its key elements. The presented relevance and the role of intangible assets in the value creation process implies the expected huge potential of these resources in the project value creation process. The intangible assets of the projects can be perceived through: (1) characteristics and competences of employees engaged in a project, (2) implemented systems and procedures and working atmosphere, (3) the nature and quality of the developed relationships between employees and project stakeholders. The previous studies have the purpose to investigate the potential of intangible project management assets in achieving competitive advantage (Mathur et al., 2007; Mathur et al., 2013), which findings were the starting point for the conducting this research. In addition, it is concluded that intangible assets and its elements represent the important determinant in achieving project success (Handzic et al., 2016; Negash & Hassan, 2020) and superior project performance (Milošević et al., 2018).

The empirical research was conducted in project-based firms in Serbia. The first step in analysing collected data was exploratory factor analysis that was used to identify the components of intangible project management assets. According to given results there were three factors, which were expected and in relation to previous studies in project management context (Handzic et al., 2016; Milošević et al., 2018; Negash & Hassan, 2020). The first important component of intangible assets refers to the nature and quality of the relationships that project team members have developed with the most important

stakeholders, such as clients/investors, suppliers and subcontractors. Named as relational capital, this components of intangible assets highlights the development of relationship among internal and external stakeholders of the project, as determinants relevant for project success. Considering the fact that project stakeholder is a person or a group of people that supports project implementation, or which has an impact on project outcomes, or there is an interest for project outcomes, as the most important component of relational capital is considered customer capital (Bontis, 1998; Khalique, Isa, Nassir Shaari & Ageel, 2011). The bearers of customer capital are the users of the project, who have the benefits from the project implementation. The quality of the customer capital of the project depends on the degree of user participation in the implementation of project activities, respecting users' requirements, users' resistance to changes and understanding users' problems. However, in addition to users, relations with other stakeholders, such as subcontractors, suppliers and IT service providers, strategic partners and regulatory bodies should not be neglected. The purpose of the project is to create and deliver value for the stakeholders, due to the conclusion about the project success is made in accordance to the degree to which the project results meet the stakeholders' requirements.

In addition, a descriptive statistical analysis was conducted, whereby the highest degree of agreement was recorded in the case of items related to the relational capital of the project. The project managers, who took part in the research, rated their relations with stakeholders (e.g. clients/investors, suppliers and subcontractors) as extremely good, which means that any problems in communication and coordination during the project implementation are effectively solved, and there are no delays or they are very rare in work caused by these or similar reasons. In order to successfully manage relational capital, it is necessary to have supporting competencies such as the ability to solve problems, interpersonal communication and leadership, teamwork, analytical thinking, as well as appropriate communication channels and support systems that enable timely responses to stakeholder requests. In this way, the dynamic nature of the components of intangible project management assets is indicated, as well as their mutual connection. Therefore, it is necessary to develop appropriate frameworks for the evaluation of intangible assets, in order to identify the space for improvement and achieving superior performance, which can contribute not only to maximizing the project value, but also to organizational success.

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STVARANJE VREDNOSTI KROZ SPAJANJA I PRIPAJANJA TOKOM GLOBALNE EKONOMSKE NEIZVESNOSTI

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SAŽETAK:

Značajne i nepredvidive promene vrednosti preduzeća i mogućnosti spajanja i pripajanja predstavljaju aktuelni globalni istraživački problem. Ovaj rad analizira proces spajanja i akvizicija kao priliku za stvaranje vrednosti u vremenima globalne ekonomske neizvesnosti. Rad ima za cilj da predstavi relevantne teorije i koncepte kroz teorijski okvir analizom prethodnih istraživanja o M&A. Takođe, biće reči o najznačajnijim slučajevima uspešnih i neuspešnih globalnih M&A i značaju diversifikacije. Nadalje, analiziraće se strateški, finansijski i menadžerski motivi za M&A, njihova evolucija, stvaranje vrednosti i merenje. Pored toga, razgovaraće se o mogućnosti budućih M&A.

Ključne riječi: M&A, mergers and acquisitions, value creation, diversification.

1. UVOD

Globalna pandemija je izazvala poremećaje u većini industrija u poslednjih nekoliko godina. Međutim, tehnološka i druge industrije su iskoristile krizu i doživele procvat. Kao rezultat toga, većina akcija je imala značajan rast tokom pandemijskih pritisaka 2020-21. Ipak, sa porastom kamatnih stopa, usporavanjem ekonomske aktivnosti, normalizacijom potrošačkih navika i načina života pre COVID-19 i globalnom ekonomskom nestabilnošću, svaki sektor se suočio sa intenzivnim pritiskom u 2022 i 2023. Pored toga, u Ukrajini je početkom 2022. godine izbio oružani sukob, što je dovelo do značajnog povećanja cena energenata i oštrog pada akcija kompanija sa ruskih i ukrajinskih tržišnih. Pad vrednosti akcija predstavlja priliku za druge kompanije da uspostave čvrstu konkurentsku poziciju za budućnost kroz procese spajanja i pripajanja.

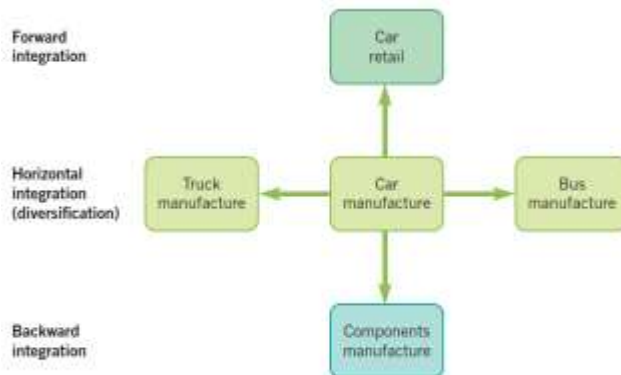
2. PREGLED LITERATURE

Eksterne strategije rasta su često neophodne tokom razvoja biznisa. Često je isplativiji od organskog rasta i može biti održivo rešenje ako treba iskoristiti priliku za rast u kratkom roku. Jedan od načina da se postigne eksterni rast je kroz spajanja i pripajanja sa drugim kompanijama [1], [2].

Spajanja i pripajanja podrazumevaju kombinovanje dve kompanije kroz različite strukture transakcija [3]. Kada jedna kompanija kupi akcije druge, to se zove akvizicija (pripajanje), a kompanija koja se kupuje je poznata kao „meta“. [4]. Do spajanja (merđžera) dolazi kada se dva ili više preduzeća udruže da bi stvorili novi entitet, kao što su Kompanija A i Kompanija B, postajući jedan entitet (Kompanija A). Za razliku od akvizicija, gde kompanija sticalac obično dobija kontrolu, spajanja uključuju partnere jednake veličine koji očekuju jednak status [5]. Termini „merđžer“ i „akvizicija“ se obično koriste zajedno kao „M&A“ [4].

2.1. M&A tipovi i motivi

Kada se kompanije spajaju ili preuzimaju druge kompanije, one to obično rade kroz horizontalne ili vertikalne M&A. Horizontalni M&A uključuje dve konkurentske firme u istoj industriji koje udružuju snage, dok vertikalni M&A uključuje jednu kompaniju koja kupuje dobavljača ili distributera kako bi poboljšala upravljanje lancem snabdevanja [3]. Horizontalni M&A može biti od koristi za kompaniju jer može povećati njen tržišni udeo i dovesti do uštede troškova i rasta prihoda [6]. S druge strane, vertikalne M&A imaju za cilj da steknu bolju kontrolu nad resursima, poboljšaju kontrolu kvaliteta i pristupe novim bazama kupaca ili proizvodima [7],[3]. Na Slici 1. prikazane su mogućnosti diversifikacije i integracije kroz M&A na primeru proizvođača automobila [8].



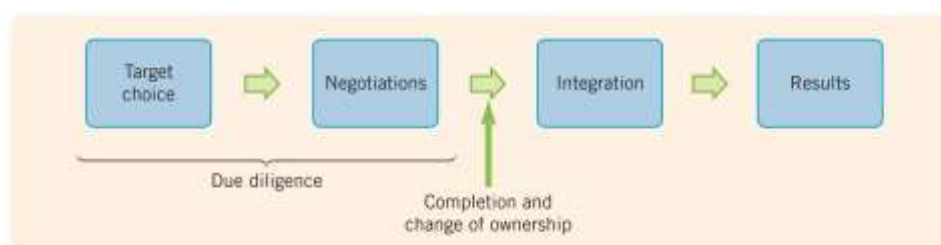
Slika 1. Opcije diversifikacije i integracije kroz M&A: primer proizvođača automobila

Postoji nekoliko motiva zbog kojih se kompanije upuštaju u spajanja i akvizicije (M&A), uključujući strateške, finansijske, menadžerske i motive vezane za resurse [2], [4]. Kombinovanjem snaga, kompanije mogu da otključaju sinergiju koja rezultira povećanjem tržišnog udela, rastom prihoda i uštedom troškova. Pored toga, M&A

omogućava kompanijama da diversifikuju svoju ponudu, ojačaju svoju konkurentsku poziciju i prošire bazu kupaca [9]. Konačno, cilj M&A je stvaranje vrednosti za akcionare.

2.2. Proces M&A

Spajanja i akvizicije podrazumevaju niz koraka koji zahtevaju mnogo posla pre i posle preuzimanja. Prvi korak je pronalaženje mete koja odgovara potrebama kompanije, što može značajno potrajati. Zatim se vode pregovori o uslovima i ceni. Na kraju, menadžeri moraju odlučiti kako da integrišu stare i nove poslove, što će uticati na brzinu stvaranja vrednosti [4]. Na Slici 2. prikazan je proces akvizicije [4].



Slika 2. Proces akvizicije [4].

Izbor mete počinje definisanjem svih potencijalnih meta, a zatim se koriste različiti kriterijumi ili testovi kako bi se suzio izbor. Dva glavna kriterijuma za izbor cilja su strateška i organizaciona usklađenost [4].

Izraz „strateška usklađenost“ odnosi se na to koliko je strategija kompanije preuzimaoca ojačana ili dopunjena metom. Za menadžere je od ključnog značaja da pažljivo procene stratešku usklađenost kako bi izbegli rizik da potencijalne sinergije budu precenjene kako bi se podržali visoki troškovi akvizicije [4].

Sa druge strane, „organizaciona usklađenost“ se odnosi na to koliko se dobro poklapaju principi upravljanja, kulturne prakse i karakteri zaposlenih u metama i firmama koje preuzimaju. Ako postoje značajne razlike, verovatno će se pojaviti problemi integracije. Međunarodne akvizicije su posebno podložne organizacionim neskladima zbog jezičkih i kulturoloških barijera [4].

Pre zaključivanja posla, važno je sprovesti detaljnu analizu mete kompanije. Ovaj proces, poznat kao *due diligence*, uključuje procenu organizacione strukture kompanije, stila upravljačkih i operativnih aspekata kao što su proizvodna tehnologija, procesi i sistemi, ljudski resursi, pravni aspekti i informacioni sistemi. *Due diligence* ima za cilj da proceni benefite i rizike potencijalne akvizicije. Zanimarivanje ovog koraka može dovesti do značajnih poteškoća nakon što se nabavka završi [10].

Kada kompanija odluči da kupi drugu kompaniju, ona ima dve opcije: pregovarati o uslovima spajanja ili dati ponudu za preuzimanje. Krajnji cilj je da se završi posao koji je u skladu sa strateškim ciljevima kompanije. Međutim, proces strukturiranja ugovora i

pregovora može biti veoma složen, sa mnogo međusobno povezanih koraka [6]. Preduzeće koje vrši preuzimanje obično određuje cenu kroz različite metode procene, kao što su period otplate, diskontovani novčani tok, procena vrednosti imovine i analiza vrednosti akcionara. Međutim, obično se plaća premija za kontrolu, što je dodatni iznos koji treba platiti da bi se stekla kontrola u poređenju sa uobičajenom procenom cilja kao odvojene kompanije. Iako spajanja zahtevaju obostranu saglasnost, ako pregovori ne uspeju, može biti neophodna neprijateljska ponuda za preuzimanje. U takvim slučajevima, fokus je na ubeđivanju akcionara, a ne na razgovoru sa rukovodiocima ciljne kompanije.

U M&A, plaćanje se može izvršiti u gotovini, putem razmene akcija, ili kombinacijom gotovine i duga ili akcija od kupca [10]. Nakon spajanja, organizacioni sistemi obe kompanije moraju biti integrisani, uključujući njihove procese, procedure, strategije i sisteme izveštavanja [10]. Ovo je izazovan zadatak, sa kulturološkim razlikama i nekompatibilnim finansijskim i IT sistemima koji su glavne prepreke uspešnoj integraciji [4]. Štaviše, ljudi će možda morati da promene svoje razmišljanje, kulturu i ponašanje kako bi integrisali različite organizacije [6]. Otpor promenama i kulturna nekompatibilnost su značajni izazovi integracije [10].

2.2. M&A talasi

Metode eksternog rasta popularizovane su u talasima kroz istoriju. Bilo je šest prepoznatljivih talasa spajanja i preuzimanja. Prvi talas (1890-1905), poznat kao talas horizontalnih spajanja, fokusirao se na postizanje ekonomije obima i kapitalizaciju monopolskih pozicija na tržištu, što je rezultiralo stvaranjem globalnih kompanija kao što su General Electric, American Tobacco i DuPont. Oko 1.800 kompanija je konsolidovano i nestalo tokom ovog talasa integracije. Drugi talas, tokom 1920-ih, predstavlja period kada su kompanije uspele da steknu oligopolsku poziciju na tržištu i iskoriste prednosti masovne proizvodnje omogućene napretkom u transportu i komunikacijama - talas vertikalnih spajanja. Tokom 1960-ih, došlo je do porasta nepovezane diversifikacije, gde su se mnoga mala i srednja preduzeća spojila u konglomerate. Ovo je imalo značajan uticaj na industrije kao što su proizvodnja automobila i aviona, železnički saobraćaj, duvan i tekstil. Osamdesete su bile poznate kao *Deal Decade* zbog velikog broja M&A transakcija, sa deset najvećih pojedinačnih transakcija koje su premašile 6 milijardi dolara. Ovo doba je takođe obeleženo značajnom pojavom neprijateljskih preuzimanja.

Tokom 1990-ih, peti talas spajanja se fokusirao na stratešku integraciju kako bi se stekla konkurentna prednost kroz ključne kompetencije, poznate kao srodna diverzifikacija. Ovaj talas je bio pod uticajem globalizacije, deregulacije i napretka u komunikacijskoj tehnologiji i proizvodnji. Šesti talas se desio od 2003. do 2008. godine i karakterisao ga je preveliki iznos M&A transakcija finansiranih iz pozajmljenih izvora zbog niskih kamatnih stopa i povećanog apetita za rizikom, što ga je označilo kao talas visokog finansijskog leveridža pre finansijske krize.

Slika 3. naglašava značaj M&A u današnjem svetu. Predstavlja godišnji broj i ukupnu vrednost izvršenih M&A transakcija. Preko 790.000 M&A transakcija je obavljeno širom sveta od 2000. godine. Broj transakcija M&A dostigao je najviši nivo u istoriji u 2021. sa

57.947 transakcija. Što se tiče ukupne vrednosti M&A poslova, najveća vrednost je zabeležena 2007. godine pre krize, sa vrednošću od 4.920 milijardi dolara. U poslednjoj deceniji, najveća vrednost je postignuta 2021. godine, sa vrednošću od 5.218 milijardi dolara.



Slika 3. Broj i vrednost M&A širom sveta [11].

3. NAJZNAČAJNIJI SLUČAJEVI SPAJANJA I PRIPAJANJA

U ovom poglavlju analiziraćemo dva najznačajnija i najveća slučaja spajanja i pripajanja.

3.1. Slučaj 1: *Vodafone*-ova akvizicija *Mannesmann*-a (1999)

Tokom proteklih decenija, industrija telekomunikacija je pretrpela značajne promene usled tehnološkog napretka, regulatornih promena i globalne konkurencije. Da bi proširile svoj tržišni udeo, diverzifikovale svoje usluge i povećale profitabilnost, kompanije su obično koristile spajanja i akvizicije kao strategiju. Godine 1999. *Vodafone*, glavni igrač u industriji, ušao je u istoriju kupovinom *Mannesmann*-a, konkurentskog telekomunikacionog konglomerata, za 183 milijarde dolara.

Vodafone je imao nekoliko razloga za kupovinu *Mannesmann*-a. Želeli su da prošire svoj globalni domet, posebno u Evropi gde je *Mannesmann* već bio dobro uspostavljen. Koristeći *Mannesmann*-ovu ekspertizu u fiksnim i mobilnim komunikacijama, kao i internet i usluge prenosa podataka, *Vodafone* se nadao da će diversifikovati svoju ponudu. Pored toga, *Vodafone* je želeo pristup *Manesmann*-ovoj imovini kao što su infrastruktura i baza korisnika, što bi im dalo prednost u odnosu na konkurente kao što su *Deutsche Telekom* i *France Telecom* koji su takođe pokušavali da povećaju svoj tržišni udeo.

Kupovina *Mannesmann*-a od strane *Vodafone*-a bila je privlačna zbog različitih strateških oblasti. Obe kompanije su imale fokus na inovacije i tehnologiju, što im omogućava da razviju nove proizvode i usluge i ostanu ispred konkurencije. Takođe su imali jake

brendove koji su privlačili i zadržavali kupce. Štaviše, njihov komplementarni asortiman telekomunikacionih usluga čini sveobuhvatan portfolio.

Vodafone je stekao nekoliko koristi od akvizicije *Mannesmann*-a, uključujući povećanje tržišnog udela, raznovrsne usluge, vrednu imovinu i konkurentsku prednost. Međutim, postojali su i neki nedostaci, kao što su visoki nivoi duga, izazovi integracije, kulturne razlike i regulatorna kontrola. Integracija dve kompanije bila je složen i izazovan zadatak, jer je *Vodafone* morao da uskladi različite sisteme, kulture i stilove upravljanja. Pored toga, visoki nivoi duga vršili su pritisak na finansijski učinak *Vodafone*-a, utičući na njegovu sposobnost da investira u nove tehnologije i usluge.

Akvizicija kompanije *Mannesmann* imala je značajan dugoročni uticaj na telekomunikacionu industriju, postavljajući presedan za velika spajanja i akvizicije u sektoru.

3.2. Slučaj 2: Spajanje AOL-a i Time Varner-a

Još u januaru 2000. AOL i Time Varner objavili su svoj plan za spajanje i stvaranje ogromne medijske i internet kompanije. Ovo spajanje je vredelo 165 milijardi dolara, što ga čini najvećim u istoriji američkih kompanija. Spajanje AOL-ove internet tehnologije i sadržaja *Time Varner*-a smatralo se hrabrim potezom, sa ciljem uspostavljanja moćne medijske firme koja bi mogla da vodi tržište.

Spajanje između AOL-a i *Time Varner*-a bilo je podstaknuto nekoliko faktora. Prvo, AOL je želeo da proširi svoj domet i da postane glavni igrač u medijskoj industriji. Drugo, *Time Varner* je imao za cilj da koristi internet za distribuciju svog sadržaja i privlačenje nove publike. Treće, kompanije su verovala da će spajanje rezultirati značajnim sinergijama i uštedama troškova jer će AOL-ova tehnologija smanjiti troškove distribucije *Time Varner*-a, a sadržaj *Time Varner*-a obezbediti AOL-u vrednu imovinu.

Međutim, spajanje se od početka suočilo sa značajnim izazovima. Jedna od glavnih prepreka bio je sukob kultura dve kompanije. AOL je imao brzu, preduzetničku kulturu, dok je *Time Varner* bio tradicionalnija medijska kompanija koja se sporo razvijala. Kao rezultat toga, došlo je do sukoba oko donošenja odluka i stilova upravljanja.

Jedna od prepreka sa kojima su se AOL i *Time Varner* suočili bio je pejzaž medijske industrije koji se stalno razvija. *Dot-com* balon je pukao i tržište oglašavanja je opalo, što je uticalo na prihod i profitabilnost AOL-a. Ovo je, zauzvrat, izvršilo pritisak na finansije spojene kompanije. Štaviše, pojava društvenih medija i servisa za strimovanje poremetila je industriju tradicionalnih medija, čineći *Time Varner*-u izazov da se takmiči sa igračima u nastajanju.

Spajanje AOL-a i *Time Varner*-a služi kao opomena o poteškoćama spajanja kompanija sa različitim kulturama i poslovnim modelima. Spajanje nije dalo očekivane rezultate, što je dovelo do toga da kompanije krenu svojim putem u 2009. Lekcija naučena iz ovog spajanja je da uspešna spajanja zahtevaju temeljno ispitivanje kulturnih razlika, poslovnih modela i tržišnih trendova.

Pridruživanje AOL-a i *Time Varner*-a bio je značajan događaj u svetu medija, ali nije postigao očekivane rezultate. Spajanje je naišlo na velike poteškoće zbog razlika u kulturi

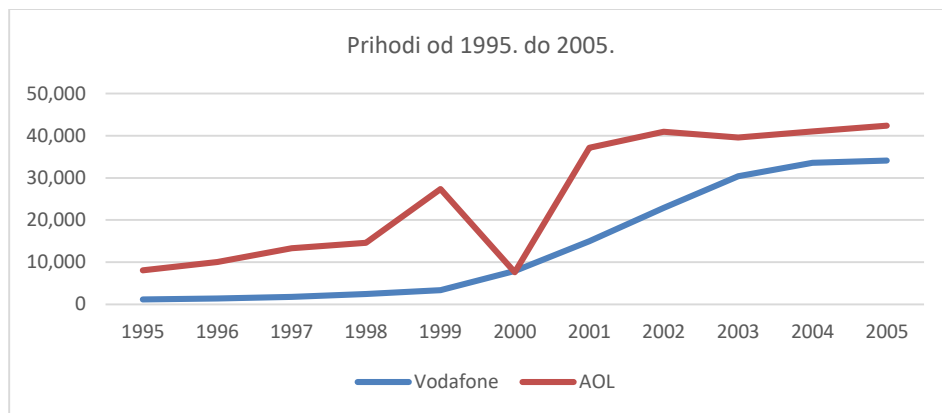
i promenljivog medijskog okruženja. Spajanje nas uči da prosperitetna spajanja zahtevaju promišljenu procenu kulturnih varijacija, poslovnih strategija i tržišnih obrazaca.

4. POREĐENJE SLUČAJEVA SPAJANJA I PRIPAJANJA

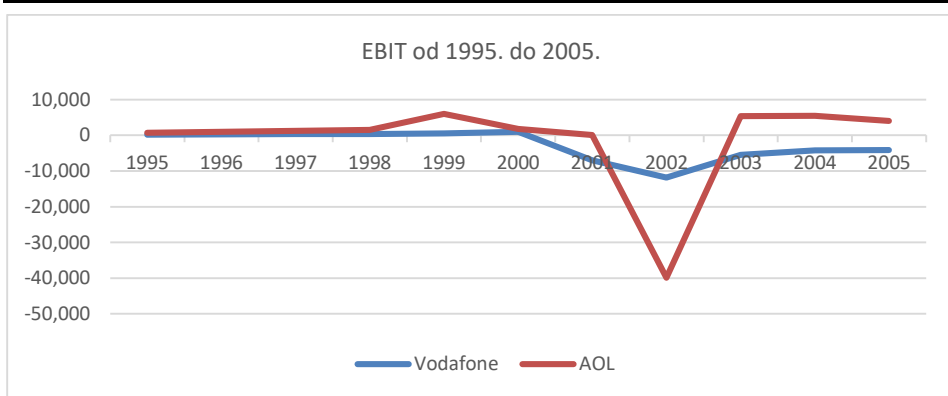
Kraj petog M&A talasa obeležile su dve najznačajnije M&A transakcije ikada realizovane – *Vodafone*-a akvizicija *Mannesmann*-a. Prva akvizicija donela je prednosti *Vodafone*-u, poput jačanja njegove tržišne pozicije i pokretanja rasta. Drugi slučaj, spajanje *AOL*-a i *Time Varner*-a stvorio je moćnu medijsku i komunikacionu kompaniju koja je potrošačima mogla ponuditi širok spektar usluga.

Iz finansijske perspektive, *Vodafone* je imao značajno povećanje prihoda u godinama nakon akvizicije (slika 3), dok je sam operativni profit (EBIT) bio negativan (slika 4). Slična je situacija i sa kompanijom *AOL*, gde su, doduše, zabeležene značajne fluktuacije u promenama prihoda i dobiti. U narednim godinama dug se povećavao, a vrednost preduzeća padala.

Najznačajniji razlog za to je pucanje *Dot-com* balona - gde su kompanije bile precenjene, što je dovelo do oštrog pada cena akcija. Drugi razlog je bila strateška i organizaciona usklađenost. Kulturološke razlike i različiti poslovni modeli doveli su do loše sprovedenih integracija preduzeća. *Vodafone* se finansijski stabilizovao u narednim godinama, dok *AOL* i *Time Varner* nisu.



Slika 3. Poređenje prihoda pre i posle transakcije



Slika 4. Poređenje EBIT pre i posle transakcije

5. ZAKLJUČAK

Nakon analize dva slučaja spajanja i pripajanja, otkriveno je da takve transakcije mogu imati značajan uticaj na finansijske rezultate kompanije. Ovaj uticaj možda neće biti odmah očigledan i mogao bi se manifestovati godinama nakon sklapanja ugovora. Dugovi se mogu povećati, profiti i prihodi se mogu smanjiti, a struktura troškova kompanije može biti promenjena. Negativne promene u kritičnim finansijskim pokazateljima takođe mogu da se jave, ali one ne moraju nužno da ukazuju na uspeh ili neuspeh spajanja ili akvizicije. Međutim, postoje i potencijalne koristi od spajanja i preuzimanja, kao što su povećanje tržišnog udela, raznovrsne usluge, vredna imovina i konkurentske prednosti. Vredi napomenuti da se ove prednosti često ostvaruju na duži rok. Ako je M&A hitan, važno je pažljivo razmotriti kulturne razlike, poslovne modele i tržišne trendove.

Očekivano je da će u narednom periodu preduzeća slediti oprezniji način delovanja i više se fokusirati na unutrašnju transformaciju nego na eksterno sklapanje poslova. Osim toga, smatra se da je vreme za kupovinu po niskoj ceni. Sa povećanjem troškova finansiranja i porastom drugih rizika, mnoge kompanije i fondovi se ponašaju konzervativnije. Očekuju se manji poslovi M&A i stavlja se veći naglasak na restrukturiranje i reviziju prethodnih akvizicija.

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MERGERS AND ACQUISITIONS AS A VALUE CREATION OPPORTUNITY IN ECONOMIC UNCERTAINTY

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ABSTRACT:

Significant and unpredictable instabilities in the value of companies and the possibility of mergers and acquisitions represent a current global research problem. This paper analyzes the process of mergers and acquisitions as an opportunity to create value in times of global economic uncertainty. The paper aims to present relevant theories and concepts through a theoretical framework by analyzing previous research on M&A. Also, the most notable cases of successful and unsuccessful global M&A and the importance of diversification will be discussed. Furthermore, strategic, financial, and managerial motives for M&A, their evolution, value creation and measurement will be analyzed. In addition, the possibility of future M&A will be discussed.

Keywords: M&A, mergers and acquisitions, value creation, diversification.

ACQUA ALTA AS TOURISTIC AND MEDIA SPECTACLE OF VENICE

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ABSTRACT:

Venice is a city in northeastern Italy located on a group of 118 small islands separated by canals and connected by bridges. The economic system and the mere existence of Venice have always been based on water. Water meant shelter, safety, nourishment, wealth, military strength and breath-taking views of spectacular sceneries from the bridges of Venice. The canals and lagoon are its main features and they give the city a relaxed and unique atmosphere. On the other hand, the destructive power of water also present the biggest enemy of the city's infrastructure. This paper discusses a problematic phenomenon named Acqua Alta that has been affecting Venice for centuries and its influence on the creation of scenic space and its perception. The aim of this paper is to analyze Venice as a scene of tourism and media spectacle during the disasters unique to this fascinating world surrounded by water. The problem of the research is the change in the perception of the city at the moment when an event occurs, more precisely the change in the very meaning of the city space when the event is experienced. This creates a hypothesis, that the change of the city space that we witness through our eyes (live or in the media) affects the formation of the scenic character of the city.

Keywords: city, spectacle, tourism, Venice, acqua alta

1. INTRODUCTION

"A city is always and despite everything a place from which culture and civilization radiate, a place of "production of knowledge," a place of historical initiative, freedom, diversity, multi-ethnic and multicultural coexistence, a place of urbanity in the sense of the noble urban behavior of educated people whose basic virtues are dialogue, tolerance, and empathy." [1]

According to Jean Baudrillard [2], the modern city is defined as "the spectacle of consumption and the consumption of spectacle." This idea of his shows in an excellent way the close connection between the city and the spectacle as two significant and complex socio-spatial creations. The relationship between the city and the spectacle is complex and established on many different levels. [3]

"If we look at the city as an attempt to create a living space, similar to a highly artificial and functional organism or body, then we can define the spectacle as the soul of the city; more precisely, an attempt to translate the mental space of the city into an infinite space of art, as well as an attempt to stop time and thereby convey the city into a new space-time dimension." [4]

The adjective qualifier spectacularly expands the field of meaning and use of this word. Spectacular expresses the dramatic effect of something that is exciting and unusual. Therefore, every appearance becomes a subject and an object in the conceptual order of the spectacle, that is, a macro sign of public representation. On the other hand, in Baudrillard's terms, the frequent use of the word spectacle nullifies its essence because everything is screened and spectacularized, and the question arises whether the spectacle exists in its basic conceptual form anymore. The notion of spectacle is difficult to define taxonomically because, in the bureaucratic meta language, it is not recognized as a separate determinant (regulations, branches, reports), and its role as *genus proxima* is taken over by the determinant's event or manifestation. [5]

2. ACQUA ALTA

Even those who have never been to Venice are extremely familiar with the acqua alta [6] (high water) phenomenon. A larger inflow of water into the Venetian lagoon is caused by a combination of astronomical tides, strong southerly winds, and sea waves in the winter, which is when acqua alta primarily occurs. The results include the installation of reinforced walkways, the need to erect partitions in front of the entry, and the flooding of a portion of the city. The flooding often only affects a small area near Piazza San Marco and lasts for a short period of time before the tide changes again. The city's average relative elevation loss during the past century can be calculated at 23 cm, with land infill and sea level rise accounting for 11 and 12 cm, respectively. Millions of piles of wood, each roughly 14 cm thick and up to 3 meters long, support the entire city. More specifically, 12,000 trees, 100,000 for the Campanile in Piazza San Marco, and more than a million for the Church of Santa Maria della Salute were utilized to sustain the weight of the Rialto Bridge, the Campanile, and the Church. Venice still has the same appearance as it did when it was first built, thanks to a number of different circumstances. The sort of wood (oak or larch) is particularly waterproof, to start. Second, only in the presence of both air and water provides wood rot. As a result, the absence of oxygen in the water below created protection for the wooden piles.

Building. In order to prevent silt from accumulating, stone and rock were scattered between the piles after they had been set as close together as the earth would allow. Furthermore, it was and still is necessary for houses to be constructed in a particular manner because they must stand upright on unstable ground and withstand the forces of water. For instance, you might have noticed that the majority of the structures in Venice have marble floors. This is mostly because marble is water-impervious, rather than just for reasons of aesthetics. In order to prevent water from entering the house during acqua alta, other examples of particular Venetian construction standards include outside walls

that are wider than internal walls and larger, deeper foundations, or "paraties," that are placed in front of entrances.[7]



Fig. 1. Square of St. Marco at the time of Aqua alta, source: Husein Đulović

2.1. Media spectacle

When a city is as widely recognized as Venice, the issue of what exactly must happen for someone or something to become so significant emerges. In addition, we can draw the conclusion that these other factors likely had an impact on the fact that Venice becomes a spectacle in the first second when her name is mentioned, aside from course from its uniqueness in its location and the fact that this city was built in an unusual manner that always set it apart from the rest of the world, which were written about in one part of the paper.

Although the uniqueness of Venice has never been in doubt since its founding, it seems as though it is stressed and felt much more strongly in the modern era.

Technology development has led to an increase in tourism because it has reduced the cost of seeing and experiencing every region of the earth. It is interesting to notice that there are a few locations that we can argue have earned the title of "most popular" precisely because of this option and the enormous choice.

Today, a city's popularity is primarily determined by how many tourists visit it, how much is written about it, and how much of it is displayed on social media and other platforms.

The media, it should be mentioned, are the most important force that will shape a city's character, highlight its significance in terms of history and culture, or just provide information. Given that the media is founded on the ideas of novelty, the impact of knowledge, surprise, or astonishment, it only makes sense that they serve as a venue for spectacle in addition to being a source of information. The most popular title in modern media is a perpetual target of competition. Populism is a phenomena that has swept the political and media landscapes around the globe, creating entirely new benchmarks and approaches to breaking through and making money in the media. As a result, competition is stronger than ever in the context of populist content and a populist audience, as well as in the post-truth period and the "infotainment" trend, which refers to the inclination to deliver instructive content in an amusing and sensational way. Sensationalism, tabloidization, and false news have significantly pushed the limits of aesthetics, drama, and apparent originality while distorting the media's core function in a democratic society. The term "media spectacle" refers to both the audience's participation in the spectacle's creation as well as its sensation, attractiveness, and ability to break up the audience's daily routine.[8] The commercialization of the spectacle has been influenced by new media, particularly social networks, using both indirect and direct advertising content created by the users themselves. Social networks are the primary source of information for millennials, and it is user activity on sites like YouTube, Facebook, and others that helps shape new media and social habits as well as metrics for gauging popularity. The audience must now actively participate in the development of trends, images, and material in order to be effective.[9] Nearly all social media users under 30 share their travel experiences through visual content on social media platforms, according to recent research. Additionally, about 30% of travelers base their decisions on the "instagrammability" of potential vacation spots, or how well-liked a particular location is in terms of aesthetic standards established by powerful social media users.[10]

As was evident from the previous sentence, social networks now play a significant part in establishing and preserving a city's identity. It's necessary to point out the permeation of educational and entertaining information while discussing the impact of new media and the spectacle phenomena on tourism, using the example of the disastrous floods that ravaged Venice in 2019. The second-largest flood in the city's recorded history was broadcast by users of social media and government services themselves using the popular "infotainment" techniques, which turned the natural disaster into a sensation and, even more, a landmark or characteristic of the city rather than a potential barrier for tourism.

2.2. Touristic spectacle

Open city spaces host a variety of activities, many of which contain aspects of spectacularity. It is challenging to categorize urban spectacles precisely because they can be political, socioeconomic, or cultural, according to Jean Davallon.[11] Commercial and advertising spectacles aid cities in one way or another to sell things and maintain themselves. Even though spectacle is very obvious and tangible, the experience of it can be very personal. According to research, the city on the water is losing a significant

number of its residents since living there has become nearly unpleasant for them, despite the fact that many people consider it to be one of the most beautiful cities in the world. Today, Venice only has 50,000 residents due to the city's inability to function normally due to the millions of tourists who visit each year, as well as the city's poor business climate and high cost of living. Even when the city is operating normally, every feature can be seen as a spectacle by the entire globe, but the phenomena of high water levels, or aqua alta, considerably intensifies that experience and the very identity of the "city on the water."

The high water season is not as appealing to Venetians, who live and work in the city all year long, as it is to tourists. Despite the fact that this phenomena does not endanger humans, it has a number of negative effects, including traffic obstructions, flooded basements, flooded warehouses, and other destroyed products.

The functioning and adjustments to daily life during floods will be briefly discussed in the text that follows, and we will understand why floods are a remarkable experience from the outset. The primary mode of transportation for both people and visitors in Italy is the "vaporetto." These boats make it possible to travel to all of the city's islands and enjoy the stunning sight of their silhouettes against the water. Every time there is flooding, leaving the house is an adventure and a new story. based on the amount of concern in the situation, traffic flows as usual, however there is a shift in lines based on which pier is submerged.

When we arrive at Saint Marco's Square, we discover that water has permeated every inch of the magnificent historical structures. With metal waterproof partitions on the doors that are half a meter high and are intended to protect the interiors, locals try to protect their small tobacco kiosks and souvenir shops. Due to their location at the lowest point in the city, the stores in the center are actually most at risk of flooding, even when the tide is not exceptionally high.



Fig. 2. Public transport in Venice, Vaporetto



Fig. 3. A seller in front of a tobacco and souvenir shop, source: Husein Đulović
When sirens sound to warn of potential flooding, a person immediately experiences a sense of unpredictability and excitement. At that point, everyone dons large rubber boots, and on the water is transformed into a wonderful theater with players playing every man, every animal, every tree, and every item. Every step outside of these paths constitutes a danger for someone inexperienced with the city who does not know what might be waiting for them at the next step. Assembly paths become new streets.



Fig. 4. St. Marco's Square at the time of Acqua alta and assembly path,source:H.Đulović

This phenomena is typically adored by visitors because it produces a magnificent, slightly weird, distinctive, and incredibly attractive scene. St. Marco's Square is crowded with joyful people who are overjoyed to be able to see this amazing sight. The setting is certainly both utopian and dystopian in nature.

In Aqua Alta, abandoned bar stools and tables float completely free between storefront windows and columns. A million tiny steps were taken to capture each instant, and the result is a mixture of orange and yellow colors that double the reflections of the spectacular facade.



Fig. 5. St.Marco's Square at the time of Acqua alta -tourists taking selfies

3. CONCLUSION

The spectacle is actually present in the city's open areas. But before something can be considered a fact, it must first be noticed and acknowledged for what it is, making the event a spectacle that belongs in the city's scenic area.

A picturesque area is generated by involving the city in some way, whether it be by planning a large event, traveling through it, sailing the canals of Venice, or just by being there. Even if the city has been scenographically developed, the place is still not entirely dynamic. In order to be fully submitted, it must be observed, perceived, and felt.

It may be claimed that extraordinary phenomena like Aqua Alta undoubtedly have an impact on the production of spectacular sceneries, and that a scene can be both destructive and beautiful at once, painful and pleasant, and so can arouse various experiences in a person.

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MENADŽMENT LJUDSKIH RESURSA U FUNKCIJI EFIKASNIJEG POSLOVANJA BANAKA

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SAŽETAK:

U današnjem poslovnom okruženju zaposleni predstavljaju značajan resurs na kome se zasniva dalji razvoj svakog poslovnog sistema, pa i banke. Moderni poslovni sistemi čije je poslovanje zasnovano na tržišnim principima, i u okviru različitih pravnih oblika organizacije, razumeju značaj kadrova tj. ljudskih resursa, kao bitnog faktora u postizanju i održavanju konkurentne prednosti. Iz tog razloga se prilikom izbora kadrova fokusiraju na kandidate koji svojim kvalitetima mogu da zadovolje zahteve i standarde kompanije, pre svega u delu ostvarivanja kvalitativnih i kvantitativnih ciljeva, sposobnosti rada u timu, prilagođavanja promenama i slično. Upravo zato izbor kadrova, odnosno politika ljudskih resursa u savremenim uslovima poslovanja, predstavlja jedan od ključnih faktora uspešnosti poslovanja i jako poželjan atribut. Izbor (selekcija) kadrova postaje značajna tema istraživanja u organizacionoj teoriji jer predstavlja neophodan faktor za uspeh svake organizacije. Imajući u vidu da su ljudski resursi neophodan činilac za funkcionisanje svake kompanije, uključujući i banke, da u savremenom svetu predstavljaju ograničen resurs, s obzirom na sve kompleksnije zahteve poslodavaca, cilj ovog rada je da utvrdi ulogu koju imaju ljudski resursi tj. adekvatno upravljanje njima u razvoju poslovnih banaka.

Ključne reči: menadžment, ljudski resursi, banka, poslovanje

1. UVOD

Ljudski resursi imaju veliki značaj za svako privredno društvo pa samim tim i za banku. Efikasni poslovni sistemi, različitih pravnih formi, da bi opstali u sve konkurentnijim i težim uslovima poslovanja, zahtevaju strategijsko razmišljanje, ali i kreiranje poslovne kulture. Vizija i misija firme se može realizovati jedino ukoliko je ljudski faktor, kao resurs, tj. svaki pojedinac u okviru kolektiva, posvećen ostvarivanju te vizije. Samim tim, upravljanje ljudskim resursima pruža najveći doprinos u stvaranju efikasne organizacione strukture i poslovne kulture, kako bi korišćenjem ostalih raspoloživih resursa ostvarili zadate ciljeve, kako pojedinačne, tako i u okviru tima u kome rade, i time

svojim aktivnostima dali lični doprinos ostvarivanju ukupnog rezultata kompanije (u ovom slučaju banke).

Cilj menadžmenta ljudskih resursa treba da bude usmeren na osnaživanje i davanje podrške zaposlenima jer svaki pojedinac u kompaniji predstavlja značajnu kariku za uspešan i održivi razvoj kompanije (u ovom slučaju banke), jer je on taj koji maksimiziranjem svojih ličnih rezultata i efekata svoga rada, putem ukupnog efekta, utiče na rezultat i konkurentsku prednost banke u celini.

U radu se sveobuhvatno obrađuje materija koja se odnosi na upravljanje ljudskim resursima. Pri tome, napravljen je poseban osvrt na ulogu i značaj adekvatnog upravljanja ljudskim resursima u poslovnim bankama, kako bi se ostvarili ciljevi banke, kao profitno motivisane institucije sa jedne strane, i motivisanosti i ličnog zadovoljstva, sa druge strane [2].

2. UPRAVLJANJE LJUDSKIM RESURSIMA U POSLOVNIM BANKAMA

Upravljanje ljudskim resursima je deo celokupnog upravljanja jednom kompanijom (u ovom slučaju bankom). U tom smislu, kao deo tj. podsistem upravljanja bankom, upravljanje ljudskim resursima se u svojim aktivnostima oslanja na menadžerski tim koji vodi banku. Upravljanje ljudskim resursima u banci, kao i upravljanje bankom, u današnjim uslovima podrazumeva veći broj aktivnosti, kako u oblasti istraživanja tržišta i razvoja novih proizvoda, primene zakonske regulative, marketinga, praćenja konkurencije, finansija, organizacije, tako i u oblasti menadžmenta ljudskih potencijala i informatike. Zato možemo da konstatujemo da je upravljanje ljudskim resursima jedan multidimenzionalan i složen proces.

Sam proces upravljanja zasnovan je na određenim pravilima i principima, ali se njima ne sme robovati, jer je ljudsko ponašanje podložno promenama, često nepredvidivo, a svaka banka ima svoje specifičnosti tj. priča je za sebe. Ono što daje pozitivan efekat na jednom mestu, ne daje na drugom, što je dobrodošlo u jednom trenutku, u drugom nije. Za razliku od proizvodnih preduzeća, celokupni resursi banke moraju biti usmereni na pružanje najbolje usluge klijentima, ispunjenje njihovih najrazličitijih potreba i zahteva, kroz kontakt na dnevnom nivou.

Pored postojećih pravila, moraju se stvarati i nova pravila, koja su prilagođena konkretnim ljudima, organizacijama i konkretnom okruženju. U skladu sa ovim činjenicama, pored dobrog poznavanja konkretnog okruženja, neophodno je i poznavati ljudski karakter i sklopove ličnosti, kako bi se precizno utvrdili interesi, očekivanja, navike i potrebe, kao i vrednosni stavovi pojedinaca i grupa. Zato možemo da konstatujemo da je upravljanje ljudskim resursima jedan dinamičan proces podložan konstantnim promenama, stalnim prilagođavanjem i promenama u banci i okruženju. To je proces koji je pun izazova i radikalnih promena, posmatrano u srednjeročnom periodu.

Prema definiciji, motivacija može biti sposobnost rukovodioca da iz prosečnog saradnika izvuče maksimu [4]. Postoje argumenti protiv novca kao primarnog motivatora, a neki do njih važe prvenstveno za uslove u razvijenim zemljama tržišne privrede. Ti argumenti su sledeći: zaposleni mogu imati strah od visokih plata, znajući da su one vezane za visoke

norme i standarde ponašanja koje se teško mogu ispuniti, pa tako biraju manje intenzivan rad sa nižim dohotkom; definicija „dobre plate“ je sama po sebi subjektivna; novac nema istu važnost za svakog radnika, niti za istog radnika u svakoj situaciji i zaposlenima često može biti važnija nezavisnost od menadžmenta, sloboda da mogu da kreiraju svoje timove i odnose u njima, po svojoj meri, nego visoke zarade [1].

Najbitnija promena koja se desila i koja je osnov savremenog upravljanja ljudima jeste to da, citiram ”tradicionalni odnosi nadređenosti i podređenosti polako ustupaju mesto odnosima saradnje i kreativnog rešavanja postavljenih ciljeva, stavljajući u prvi plan zaposlenog i timski rad, a sve u cilju da se ličnost, integritet i inicijativa zaposlenog podignu na viši nivo” [3].

3. REZULTATI

Za potrebe ovog rada sproveden je anonimni upitnik u okviru jedne banke u Srbiji, u periodu od 30 dana, tačnije od 01.06.2022. do 30.06.2022. u svim organizacionim jedinicama na teritoriji centralne i jugoistočne Srbije. Od 151 zaposlenog, njih 120 je prihvatilo anketiranje.

Tokom intervjuja, korišćene su prednosti ove metode, kao što su radoznalost, uvažavanje, pristojnost i komunikativnost učesnika. Istovremeno, nedostaci ove metode kao što su: rezervisanost, strah od posledica i zloupotrebe, gubitak vremena su svedeni na minimum. U tom kontekstu su pitanja jasna i ne zbunjuju ispitanike, a anketa je rađena van radnog vremena i van službenih prostorija.

Generalna hipoteza glasi:

H0: Što je upravljanje ljudskim resursima u poslovnim bankama bolje - poslovanje banaka je uspešnije, jer je veća ekonomičnost, produktivnost i rentabilnost bankarskih operacija. Bolje upravljanje ljudskim resursima u poslovnim bankama rezultira uspešnijim poslovanjem banaka, kako u poslovanju sa privredom, tako i u poslovanju sa fizičkim licima.

Pomoćne hipoteze:

H1: Što je osposobljenost kadrova veća, konkurentna prednost banaka je veća.

H2: Što je veće obrazovanje i veća edukovanost ljudskih resursa, komunikacija sa klijentima i njihovo zadovoljstvo je veće.

H3: Što je veće zadovoljstvo i motivisanost zaposlenih, veće je i njihovo angažovanje ka maksimizaciji poslovnih rezultata.

Sastav upitnika:

- Pol ispitanika
- Godine starosti
- Radni staž
- Bračno stanje
- Stručna sprema
- Odgovarajuće (neodgovarajuće) radno mesto prema stručnoj spremi
- Mogućnost napredovanja

- Učenje iz rada i uz rad
- Prekvalifikacija (dokvalifikacija)
- Zadovoljstvo (nezadovoljstvo) poslom
- Motivisanost na poslu
- Kako se upravlja ljudskim resursima u poslovnoj banci
- Kako osposobljenost kadrova utiče na uspšnost banke (pitanje iz prve pomoćne hipoteze)
- Kako se obrazovanje zaposlenih odražava na komunikaciju između zaposlenih (pitanje iz druge pomoćne hipoteze)
- Kako motivisanost zaposlenih utiče na rezultat poslovanja banke (pitanje iz treće pomoćne hipoteze)

Upitnik:

1. Pol ispitanika

Tabela 1. pol ispitanika

Пол	Мушкарци	Жене	Укупно	χ^2	sig	
	35	85	120	20.83	<0,001	



Grafikon 1. Distribucija ispitanika u odnosu na pol

Hi-kvadrat testom je ispitano da li je zastupljenost muškaraca i žena ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da je broj žena značajno veći i zastupljen je na svim radnim mestima.

2. Godine starosti ispitanika-Hi kvadrat testom je testirano da li je zastupljenost starosnih kategorija u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} = 0,001$) se može reći da su mlađi ispitanici zastupljeniji, njih trideset petoro je starosti između 20 i 30 godina, tridesetoro je starosti između 30 i 40 godina i između 40 i 50, deset između 50 i 60 godina i 15 njih je preko 60 godina.
3. Radni staž-Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitim radnim stažom u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da su najzastupljeniji ispitanici sa srednjom dužinom radnog staže, 15-20 i 20-25 (po 35 ispitanika).
4. Bračni status-Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitim bračnim statusom u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} = 0,153$) se može reći da su sve tri kategorije bračnog statusa ujednačeno prisutne. Visok procenat razvedenih dobijen prilikom istraživanja ukazuje na postojanje socioloskog problema.
5. Stručna sprema-Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitim stručnom spremom u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje bitne razlike i da je SSS najzastupljenija, 65 ispitanika, nema doktora nauka, samo 5 sa diplomom mastera, 15 sa višom i 35 sa visokom stručnom spremom.
6. Odgovarajuće / neodgovarajuće radno mesto prema stručnoj spremi-Hi kvadrat testom je testirano da li je zastupljenost ispitanika odgovarajućim, neodgovarajućim i delimično odgovarajućim radnim mestom u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje značajne razlike i da je ispitanika sa odgovarajućim radnim mestom značajno više tj. 65 ispitanika, a samo 15 sa neodgovarajućim radnim mestom.
7. Mogućnost napredovanja-Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitim mogućnostima za napredovanje u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje značajne razlike i da je ispitanika sa mogućnošću napredovanja značajno više. Ovde se očigledno ponavlja situacija iz prethodnog pitanja, i to da je njih 60 odgovorilo da postoji mogućnost napredovanja, dok je njih 25 odgovorilo da delimično postoji mogućnost napredovanja.
8. Učenje uz rad- Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitim mogućnostima za učenje uz rad u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje značajne razlike i da je ispitanika sa mogućnošću učenja značajno više. Iz odgovora se vidi da je učenje uz rad moguće kod 62 ispitanika a delimično moguće kod 40 ispitanika.
9. Prekvalifikacija i dokvalifikacija-Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitim mogućnostima za prekvalifikaciju u uzorku ujednačena. Na

osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje značajne razlike i da je ispitanika sa mogućnošću prekvalifikacije značajno više. Odgovori ispitanika su ubedljivi kada je u pitanju prekvalifikovanje, čak 71 ispitanik je odgovorio da je prekvalifikacija moguća, njih 19 je odgovorilo da je prekvalifikacija delimično moguća, što je bolji rezultat od odgovora na prethodno pitanje, da li je moguće učenje u i iz radnog odnosa.

10. Kako se obrazovanje odražava na komunikaciju- Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitim mišljenjem o uticaju obrazovanja na komunikaciju u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje značajne razlike i da je ispitanika koji su stava da obrazovanje uspešno utiče na komunikaciju značajno više. Ovim je potvrđena druga pomoćna hipoteza da viši stepen obrazovanja zaposlenih utiče na uspešnije poslovanje banke.
11. Motivisanost poslom-Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitom motivacijom u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje značajne razlike i da je ispitanika, koji su motivisani materijalnom dobiti značajno više. Podaci pokazuju da su zaposleni dobro plaćeni, a da samo njih 15 živi za slavu i uspeh.
12. Kako motivisanost zaposlenih utiče na rezultat poslovanja banke-Hi kvadrat testom je testirano da li je zastupljenost ispitanika sa različitim mišljenjem o uticaju motivisanosti na uspešnost poslovanja u uzorku ujednačena. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje značajne razlike i da je ispitanika koji su stava da motivisanost uspešno utiče na poslovanje značajno više. Visok procenat odgovora na pitanje pokazuje da je motivisanost glavni pokretač za dobre rezultate banke.

4. ZAKLJUČAK

Na osnovu upitnika koji je postavljen i sproveden u banci, u periodu od trideset dana, u svim organizacionim jedinicama dat je odgovor na glavnu hipotezu “Što je upravljanje ljudskim resursima u poslovnim bankama bolje, poslovanje banaka je uspešnije, jer je veća ekonomičnost, produktivnost i rentabilnost bankarskih operacija”. Pokazatelji su dali osnovu za te X2 test, gde je odnos zavisne i nezavisne promenljive dobar, a dobijeni stepen značajnosti dovoljan, čime je dokazana glavna hipoteza da je menadžment ljudskih resursa adekvatan što rezultira većom ekonomičnošću i rentabilnošću poslovnih banaka.

Prva pomoćna hipoteza koja glasi „Što je osposobljenost kadrova veća, konkurentska prednost banaka je veća”.

Na osnovu dobijenih rezultata da je ispitanika sa mogućnošću napredovanja značajno više i dobijene značajnosti ($\text{sig} < 0,001$), dokazana je prva pomoćna hipoteza.

Druga pomoćna hipoteza glasi “Što je obrazovanje veće i veća edukovanost ljudskih resursa, komunikacija sa klijentima i njihovo zadovoljstvo je veće”. Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da je broj ispitanika sa mogućnošću

učenja značajno veći. Iz odgovora se vidi da je učenje uz rad moguće kod 62 ispitanika, a delimično moguće kod 40 ispitanika, čime je dokazana druga pomoćna hipoteza.

Najzad, treća pomoćna hipoteza koja glasi „Što je veće zadovoljstvo i veća motivisanost zaposlenih, veće je i njihovo angažovanje ka maksimizaciji poslovnih rezultata.”

Na osnovu dobijene značajnosti ($\text{sig} < 0,001$) se može reći da postoje vidne razlike kod ispitanika u zavisnosti od stepena stručne spreme tj. da ispitanici sa nižom stručnom spremom su motivisaniji i zainteresovaniji za bolje rezultate.

Usavršavanje, edukacija i konstantno obrazovanje i specijalizacija kadrova su garancija za uspešno i profitabilno poslovanje banaka u svetu i kod nas.

Suština je u tome da poslovanje bude postavljeno tako da stvaranje profita bude vezano za motivaciju zaposlenih, a da njihovo angažovanje bude mereno normom, učinkom, rezultatom, ostvarenošću planova i drugim kategorijama, koje će kod zaposlenih podstaći inicijativu i odgovornost. Na ovaj način se može očekivati da će potencijali banaka biti optimalno iskorišćeni.

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HUMAN RESOURCES MANAGEMENT IN THE FUNCTION OF MORE EFFICIENT OPERATIONS OF BANKS

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ABSTRACT:

In today's business world, employees are an important resource, on which development of every business system is based, including commercial banks as well. Modern business systems, of different legal forms, which functioning happens according to the market principles, understand the importance of the employees i.e. human resources, as the decisive factor of creating and managing competitive advantages. Due to that fact, in the process of hiring their employees, those systems are focusing on candidates which have the qualities to meet the requirements and standards of the company; above all in meeting the qualitative and quantitative objectives of the company, in terms of the team work skills and ability to adjust themselves to changes.

This is the reason, why the staff hiring i.e. human resource policy in the modern business era is one of the key factors of a company's success and a desired characteristic of the company. Hence, hiring (selection) of employees becomes an important topic in the organizational theory.

Taking into account that the human resources are an inevitable factor of every company's success, including banks, and that in the modern business world exist, both scarce resource and more complex requirements of the employers, the objective of this paper is to check and define the role of human resources in the company and how the adequate management of the human resources in the company influences the development of the commercial banks.

Keywords: management, human resources, bank, operations

KONKURENTNOST REPUBLIKE HRVATSKE KAO TURISTIČKE DESTINACIJE I USPOREDBA S CRNOM GOROM

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SAŽETAK:

Konkurentnost turističkih destinacija može se pratiti kroz stalan rast statističkih podataka o broju dolazaka i noćenja, te rastu nacionalnog bruto domaćeg proizvoda uzrokovanog rastom prometa u sustavu turizma. Iz tog razloga konkurentnost postaje ključan koncept pristupa i istraživanja u ovome radu.

Tijekom godina razvili su se pokazatelji od strane raznih organizacija koje se bave određenim aspektima konkurentnosti, ali i dalje nedostaje sveukupni okvir mjerenja konkurentnosti u turizmu. Utvrdilo se kako je zapravo teško normirati idealan skup pokazatelja, stoga se mjerenju konkurentnosti turističkih destinacija treba pristupati kao sustavnom procesu.

U ovom radu prezentirati će se i analizirati sekundarni podaci iz izvještaja Svjetskog gospodarskog foruma (eng. World Economic Forum - WEF), turističkog prometa objavljenih od strane Ministarstva turizma i sporta Republike Hrvatske te usporediti s sekundarnim podacima turističkog prometa Crne Gore.

Cilj rada je utvrditi konkurentnost dviju turističkih destinacija usporedbom statističkih podataka koji mjere nacionalnu turističku konkurentnost iz različitih izvještaja te procijeniti vrijednost izabranih pokazatelja kao važnih elemenata kod kreiranja budućih modela za sustavno pačenje konkurentnosti.

Ključne riječi: *pokazatelji konkurentnosti turističke destinacije, mjerenje konkurentnosti*

1. UVOD

Razumijevanje konkurentnosti zemlje kao turističke destinacije u turizmu važno je pitanje i veliki izazov za sve profesionalce. Tijekom godina razvili su se pokazatelji od strane raznih organizacija koje se bave određenim aspektima konkurentnosti, ali i dalje nedostaje sveukupni okvir mjerenja konkurentnosti u turizmu. Utvrdilo se kako je zapravo teško normirati idealan skup pokazatelja, stoga se mjerenju konkurentnosti turističkih destinacija treba pristupati kao sustavnom procesu.

Naime, pri istraživanju konkurentnosti turističkih destinacija u literaturi se najčešće izdvajaju radovi Portera (1990), Ritchiea i Croucha (2003), Dwyer i Kima (2003), Enrighta i Newtona (2004) te Gooroochurna i Sugiyarta (2005). Upravo su Gooroochurn i Sugiyarto (2005) kreirali tzv. model **Motrenja konkurentnosti** koji propisuje 23 kriterija za utvrđivanje konkurentnosti destinacije. Njihov model temeljio se sustavu dostupnosti sekundarnih podataka proizašlih iz baze podataka Svjetskog vijeća za putovanja i turizam (eng. *World Travel and Tourism Council – WTTC*) koji propisuje praćenje 54 pokazatelja koji sadrže načelne, jednostavne i složene pokazatelje, koji objedinjeni utvrđuju indeks konkurentnosti za 200 zemalja. Baza modela je proučavanje osam čimbenika, poput cijena, otvorenosti tržišta, tehnologije, infrastrukture, ljudskih resursa, društvenog razvoja i okoliša. Upravo zahvaljujući tom modelu Svjetski gospodarski forum (eng. *World Economic Forum*) započeo je predstavljati svoja izvješća o konkurentnosti turističkih destinacija.

Model Svjetskog gospodarskog foruma značajan je zbog toga jer je utabao put prema izgradnji složenijih pokazatelja za praćenje konkurentnosti, a koji je trenutno poznat kao **Indeks konkurentnosti putovanja i turizma** (eng. *Travel & Tourism Competitiveness Index - TTCI*). TTCI pokazatelj rangira zemlje prema skupu kriterija koji se temelje na četrnaest stupova (ili pokretača) a koji se dalje pretvaraju u četiri podindeksa i 90 pojedinačnih pokazatelja (World Economic Forum, 2019). Takvi podaci prikupljeni od strane raznih međunarodnih institucija objedinjeni su u jednom izvještaju te predstavljaju sredstvo usporedbe i djeluju zapravo pozitivno kao smjernice za praćenje razvoja sektora putovanja i turizma na globalnoj razini.

Osim toga najpoznatiji modeli konkurentnosti turističke destinacije identificirali su konkurentnost zemalja koja se može pratiti i kroz proučavanje statističkih izvještaja turističkog prometa kojega objavljuju tijela javne uprave poput ministarstva ili drugih javnih institucija. Primjerice, takvi podaci dostupni su putem izvještaja objavljenih od strane Državnog zavoda za statistiku, Ministarstva turizma, Instituta za turizam i dr. u Republici Hrvatskoj. S druge strane u Crnoj Gori podaci su dostupni putem Uprave za statistiku – MONSTAT, Ministarstva ekonomskog razvoja i turizma ili Nacionalne turističke organizacije Crne Gore. Takvi izvještaji objavljuju se redovito te predstavljaju vrijedan izvor u sveobuhvatnom proučavanju konkurentnosti.

Zbog općeprihvaćenog fenomena konkurentnosti može se slobodno zaključiti kako ne postoji model konkurentnosti koji je univerzalno prihvaćen. Međutim, može se naglasiti kako se konkurentnost može analizirati i istraživati sustavno (putem usporedbe turističkih zemalja i prometa), strukturno (ekonomsko područje) ili povezano s poslovanjem (poput pojedinačnih poduzeća).

Doprinos ovoga rada predstavlja prikaz prikupljenih podataka koji su se analizirali temeljem različitih skupina izvora podatka po godinama i koji su rangirali TTCI

pokazatelje i glavne sektorske pokazatelje turizma usporedbom dviju susjednih Mediteranskih turističkih destinacija.

2. MJERENJE KONKURENTNOSTI TURISTIČKE DESTINACIJE

2.1. Indeks konkurentnosti putovanja i turizma (TTCI)

Indeks konkurentnosti putovanja i turizma rezultat je projekta koji su zajedno pokrenuli WEF i Svjetska turistička organizacija. Njihovi izvještaji predstavljaju sredstvo usporedbe poslovanja i djeluju kao smjernice za daljnji razvoj sektora putovanja i turizma na međunarodnom području. Svakako je prednost izvještaja što omogućuje usporedbu i praćenje napretka nacionalnih ekonomija kroz konkurentnost turizma, te informiranje o politikama i investicijskim odlukama. Ujedno predstavlja platformu za dijalog s više zainteresiranih strana kako bi se pokazatelji mogli upotrijebiti u daljnjem razvoju strateških planova (World Economic Forum, 2019).

Usprkos pokušajima kvantificiranja konkurentnosti destinacija, TTCI nerealno pretpostavlja kako je 58 varijabli koje se koriste u izračunima jednako važno. Ovaj model je iz godine u godinu značajno izmijenio rangiranje država izračunavanjem osnovnih čimbenika kao jednostavnih prosjeka (Hanafiah & Zulkifly, 2019). Zato su se pokazatelj konkurentnosti putovanja i turizma u izvještajima Svjetskog gospodarskog foruma postupno mijenjali od 2013. godine.

Prije toga još su Assaker, Vinzi i O'Connor (2011) pokušali unaprijediti model motrenja turističke konkurentnosti na način da su sedamnaest od originalnih dvadeset i tri pokazatelja suzili na samo četiri. Naime, otkrili su kako pokazatelji turističke konkurentnosti funkcioniraju kao jedna dimenzija i previše ovise o samoj kompozitnoj konstrukciji modela. Drugi su pak istraživači otkrili kako je model motrenja zanemario važnost veličine tržišta, ekonomske snage i stupanj ovisnosti o turizmu, te kako se inicijalni model Svjetskog gospodarskog foruma nije mogao ponoviti u skupinama zemalja. Takva istraživanja opet su potvrdila uzročno-posljedičnu vezu među konstruktima na osnovnoj razini, dodatno filtrirajući i na kraju poboljšavajući dotadašnje modele turističke konkurentnosti (Hanafiah & Zulkifly, 2019).

Danas TTCI predstavlja referentnu točku u proučavanju konkurentnosti. Prema modelu iz 2019. indeks se mjeri kroz četiri agregatna područja, i to: Poticajno okruženje, Pravnu regulativu vezana uz putovanja i turizam, Infrastrukturu, te Prirodna i kulturna bogatstva.

Indeks se dodatno dijeli na ukupno 14 stupova koje uključuju: Poslovno okruženje, Zaštitu i sigurnost, Zdravlje i higijenu, Ljudske resurse i tržište rada, Razvijenost informacijsko-komunikacijske tehnologije (ICT-a), Važnost sektora turizma i putovanja, Međunarodnu otvorenost, Cjenovnu konkurentnost, Zaštitu okoliša, Infrastrukturu zračnog prometa,



Prometne infrastrukture (kopnene i morske), Turističke infrastrukture, Prirodnih resursa, te Kulturnih resursa i poslovnih putovanja (Nacionalno vijeće za konkurentnost, 2017).

U ovom radu fokus će se usmjeriti na TICI pokazatelj u izvješćima WEF-a za 2013., 2015., 2017., 2019. i 2021. godinu te će se kasnije usporediti s glavnim pokazateljima turizma za isto promatrano razdoblje.

2.1.1. TICI pokazatelji Hrvatske i Crne Gore

TICI je rezultat mjerenja konkurentnost sa aspekta četiri glavna pod-indeksa čiji su objedinjeni podaci prikazani u tablici 1.

Tablica 1. TICI pokazatelji konkurentnosti Hrvatske i Crne Gore po godinama

WEF po god.	2013.		2015.		2017.		2019.		2021.	
	TICI	Rang	TICI	Rang	TICI	Rang	TICI	Rang	TICI	Rang
	4,59	35	4,30	33	4,42	32	4,5	27	4,2	46
	4,50	40	3,75	67	3,68	72	3,9	67	3,9	67

Izvor: Usporedna analiza oblikovana temeljem podataka iz izvještaja WEF-a TICI: 2013., 2015., 2017., 2019. i 2021.

Usporedbom po godinama primjećuje se kako je Hrvatska zauzimala poziciju oko 30 mjesta, s tom razlikom što je napredovala od 2013. do 27 mjesta u 2019. godini. Posljednji objavljeni podaci iz 2021. godine ukazuju na pad konkurentnosti i značajnom padu na 46 mjesto što može ukazivati na opći pad konkurentnosti kao turističke destinacije. S druge strane Crna Gora je od 2013. gubila na konkurentnosti jer je sa 40 mjesta pala na 72 mjesto u 2017. godini što je bio najlošiji rezultat. Nakon toga, za razliku od Hrvatske, pozicija se od 2019. do 2021. nije mijenjala.

Ako se promatra pojedinačno prema stupovima konkurentnosti onda se može zaključiti kako je Crna Gora konkurentnija u području poslovnog okruženja, cjenovne politike, te važnosti sustava turizma na ukupnu gospodarsku djelatnost. S druge strane Hrvatska je konkurentnija u području zdravlja i higijene, razvijenosti ICT-a, kopnene, pomorske i turističke infrastrukture, te prirodnih i kulturnih resursa.

Sljedeći korak u prikupljanju sekundarnih podataka predstavljaju pokazatelji turizma objavljeni od strane javnih institucija bilo nacionalnih ili internacionalnih poput izvještaja Svjetskog vijeća za putovanja i turizam, a koji će biti prezentirani u sljedećem potpoglavlju.

2.2. Glavni pokazatelji turizma Hrvatske i Crne Gore

Turizam je iznimno važan u gospodarstvu Hrvatske jer podupire gospodarski rast i zapošljavanje. Prema istraživanju Horwath Consultinga (Topalović, 2017) turizam zauzima petinu hrvatskog gospodarstva. Sličnog su stajališta Veličković i Tomka (2017) koji potvrđuju kako turizam predstavlja najdinamičniju i najznačajniju gospodarsku granu u Crnoj Gori. Stoga je jedan od najvećih izazova s kojim se suočava svaka turistička zemlja odgovoriti na pitanje kako osigurati konkurentnost? Za svakog istraživača u turizmu izazov predstavlja pronalazak najboljeg modela kojim bi se ta konkurentnost na sustavan način mogla pratiti. Europska komisija je izradila Europski sustav pokazatelja za turizam (2013) koji se koristio u usporedbi konkurentnosti Hrvatske i Crne Gore kao turističke destinacije. Rezultati se prezentiraju u tablici 2. i 3. te uključuju broj noćenja i dolazaka turista, prihode od turizma, te udio turizma u BDP-u.

Tablica 2. Glavni pokazatelji turizma Hrvatske 2013., 2015., 2017. 2019. i 2021. godine

HRVATSKA	2013.	2015.	2017.	2019.	2021.
Broj noćenja (u milijunima)	64,6	71,6	86,2	91,2	70,2
Broj dolazaka (u milijunima)	12,2	14,3	17,4	19,6	12,7
Prihodi od turizma (u milijardi €)	7,2	7,9	11,4	13,9	9,1
Ukupni udio turizma u BDP (%)	16,6	18,2	25,0	24,8	16,1

Izvori: Izrada autora prema podacima Državnog zavoda za statistiku, Ministarstva turizma Republike Hrvatske, Hrvatske narodne banke i Izvještaja Svjetskog savjeta za putovanja i turizam (eng. *World Travel and Tourism Council – WTTC*)

U tablici 2. mogu se vidjeti kretanja glavnih pokazatelja turizma Republike Hrvatske od 2013. do 2021. godine. Broj dolazaka i noćenja turista bilježe stalan rast od 2013. do 2019. godine. Međutim, mjesečni podaci o broju ostvarenih noćenja turista potvrđuju izuzetnu sezonalnost i ovisnost turizma o glavnim ljetnim mjesecima. Otprilike više od dvije trećine ukupnog godišnjeg broja noćenja turista se ostvaruje tijekom lipnja, srpnja i kolovoza, pri čemu samo na kolovoz otpada trećina ukupnog broja ostvarenih noćenja. Dakle, može se utvrditi kako je povećanje broja noćenja u 2019. iznosilo nevjerojatnih 40 postotnih poena u odnosu na 2013. godinu. Naravno opet sa najvećim rastom u ljetnim mjesecima čijim brojkama su pridonijeli i rast broja kreveta za 30 postotnih poena. Istraživanja Horwath

Consultinga (Topalović, 2017) dodatno potvrđuje kako je sezonalnost hrvatskog turizma daleko najlošija na Mediteranu. Jedan od razloga takve visoke sezonalnosti je svakako struktura smještajnih kapaciteta koju obilježava dominacija privatnog smještaja i kampova koji uglavnom posluju za vrijeme glavne (ljetne) turističke sezone.

Dodatnu problematiku kod proučavanja sekundarnih podataka predstavljaju razlike u podacima koje su objavljene od strane Ministarstva turizma Republike Hrvatske i izvješća *Turizam u brojkama* gdje su primjerice prihodi od turizma u 2019. godini iznosili 10,5 milijardi eura, dok se u izvješćima WTTC za Hrvatsku navodi prihod od 13,9 milijardi eura što je značajna razlika koja sigurno može utjecati na kvalitetu izrade analize. Osim toga razlike postoje kada se promatra i njihov ukupni udio u BDP 2019. gdje se u domaćim izvještajima prezentira udio od 19,5 posto, dok kod WTTC-a iznosi 24,8 posto. Dodatno objašnjenje ovakvim razlikama može se pronaći u izvještaju BLUTOURSYSTEM Interreg Italy-Croatia (2018) gdje se argumentira kako WTTC procjenjuje izravni i ukupni Doprinos putovanja i turizma u BDP-u. Tako je primjerice u 2017. godini za Republiku Hrvatsku izravni doprinos iznosio 10,9 posto, dok je njegov ukupni (izravni i neizravni) doprinos iznosio 25,0 posto BDP-a. To je svakako više od 19,6 posto koliko je procjenjivalo Ministarstvo turizma Republike Hrvatske u svojim izvješćima. Možda je upravo takva razlika uvjetovana kriterijima koji određivanja izravnih i neizravnih doprinosa zbog kojih se na kraju dolazi do znatnih oscilacija u podacima. Zato se naglašava kako se zbog dostupnosti podataka u ovom radu koristili podaci *Turizam u brojkama* za prihode od turizma i njihovog udjela u BDP-u za razdoblje od 2013. do 2015. godine. Dok su se za 2017, 2019. i 2021. godinu koristili podaci iz izvješća WTTC-a.

Prema tome podaci WTTC-a ukazuju kako je u 2019. godini ostvaren prihod u visini od 13,9 milijardi eura što čini četvrtinu ukupnog BDP-a Republike Hrvatske. Pozitivan rast deviznog priliva prisutan je još od 2010. godine te se u razdoblju od 2013. do 2019. godine primjećuje njegov stalni rast koji istovjetno prati povećanje broja dolazaka i noćenja po godinama što može ukazivati na rast konkurentnosti Hrvatske kao turističke destinacije u promatranom razdoblju.

Podaci za Crnu Goru prezentiraju se u tablici 3.

Tablica 3. Glavni pokazatelji turizma Crne Gore 2013., 2015., 2017. 2019. i 2021. godine

CRNA GORA	2013.	2015.	2017.	2019.	2021.
Broj noćenja (u milijunima)	9,4	11,0	11,9	14,4	9,8
Broj dolazaka (u milijunima)	1,4	1,7	2,0	2,6	1,6

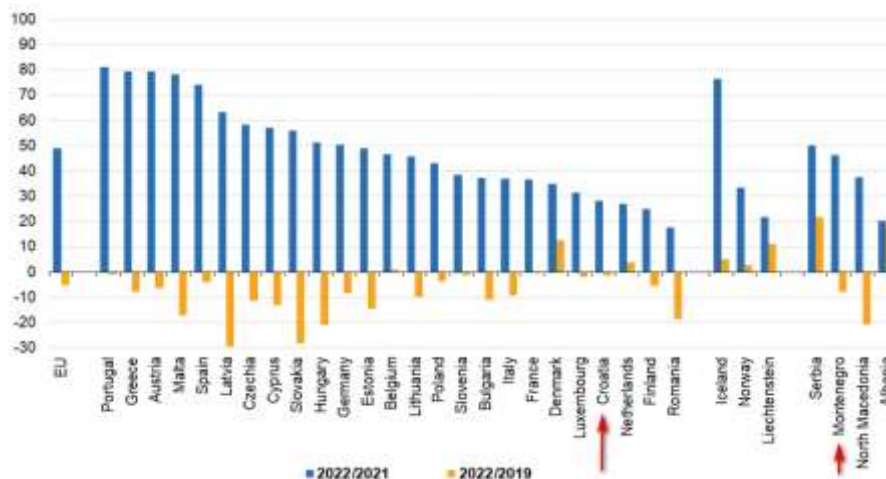
Prihodi od turizma (u milijardi €)	0,75	0,87	0,98	1,55	1,18
Ukupni udio turizma u BDP (%)	22,3	23,8	22,8	30,8	25,5

Izvori: Izrada autora prema podacima Uprave za statistiku – MONSTAT, Komparativne analize turizma Skupštine Crne Gore i i Izvještaja Svjetskog savjeta za putovanja i turizam (eng. *World Travel and Tourism Council – WTTC*)

Prema podacima WTTC-a ukupan doprinos turizma i putovanja u BDP-u 2019. godine pokazuje kako Hrvatska i Crna Gora bilježe najznačajniji rast u usporedbi s ostalim europskim zemljama. Za Crnu Goru takva ovisnost prihoda od turizma još je izraženija te iznosi 30,8 posto. Ostali podaci o broju dolazaka i noćenja u tablici 3. ukazuju na stalan rast i povećanje broja noćenja više od 50 postotnih poena u 2019. u odnosu na 2013. godinu što također može upućivati na rast konkurentnosti Crne Gore kao turističke destinacije.

Usporedbom podataka prezentiranim u tablicama 2. i 3. može se potvrditi kako su i noćenja i dolasci za Hrvatsku i Crnu Goru u 2019. godini dosegнули vrhunac. To znači kako su obje turističke destinacije te godine ostvarile najveće brojke što u kontekstu proučavanja statističkih podataka predstavljaju referentu točku za sve buduće analize. Na takav način kada se uspoređuju primjerice noćenja ostvarena u 2021. i 2022. godini zapravo se uspoređuju sa 2019. godinom. Eurostat je tako objavio podatke o turističkom prometu 2022. te utvrdilo kako je to godina povratka opsega putovanja u usporedbi s onim prije pandemije, te ostvarenih 2,73 milijarde noćenja u turističkom smještaju na području EU (EUROSTAT, 2023). Taj podatak predstavlja 95 posto broja noćenja ostvarenih u 2019. godini i porast od 49 posto u usporedbi s 2021. godinom. Detaljni prikaz noćenja po zemljama i usporedba sa podacima iz 2019. može se vidjeti na slici 2. Za Hrvatsku podaci ukazuju na manji pad u broju noćenja 2022. u usporedbi s 2019. i u odnosu na prosjek EU, dok je porast broja noćenja 2022. u odnosu na 2021. bio izraženiji te iznosio blizu 30 posto. Za Crnu Goru pod broja noćenja 2022. godine u usporedbi s 2019. je iznosio manje od 10 posto ali ipak nešto više od prosjeka EU. S druge strane porast broja noćenja u usporedbi s 2021. je iznosio blizu 50 posto.

Slika 1. Noćenja inozemnih gostiju u turističkom smještaju 2022. u usporedbi s 2021. i 2019. (u %)



Izvor: Tourism statistics, EUROSTAT (2023)

Temeljem navedenog može se zaključiti kako obje promatrane turističke destinacije posjeduju konkurentske prednosti i nedostatke koji se mogu pratiti kroz usporedbu statističkih podataka. Međutim, međusobna povezanost relativnih podataka i njihov utjecaj na konkurentnost turističke destinacije do sada nije bila u dovoljnoj mjeri istražena i prezentirana. Ono što je jasno jest da na uspjeh turističkih destinacija na svjetskim tržištima utječe njihova relativna konkurentnost (Dwyer & Kim, 2003).

Zbog toga se identificirala moguća praznina u razumijevanju konkurentnosti turističke destinacije a zapravo se misli na odabir onih pokazatelja koji su neophodni za procjenjivanje konkurentnosti. U nastavku rada prezentiraju se rezultati analize pokazatelja konkurentnosti kroz izračunavanje osnovnih statističkih pokazatelja.

2.3. Rezultati analize pokazatelja konkurentnosti

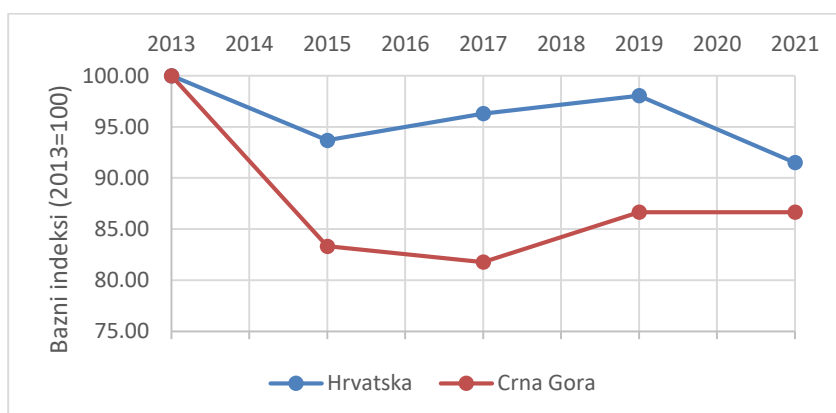
Na grafikonu 3. može se pratiti kretanje TTCI-a za razdoblje od 2013. do 2021. godine i zaključiti kako je nakon 2013. godine uslijedio pad konkurentnosti za obje promatrane turističke destinacije. Primjerice za Hrvatsku je TTCI pokazatelj u 2013. godini iznosio 4,59 (pozicija 35.), a za Crnu Goru 4,5 (pozicija 40.) a nakon toga obje turističke destinacije su u 2015. godini zabilježile pad konkurentnosti.

Naime, promatrano pojedinačno u Hrvatskoj konkurentnost ponovo raste od 2015. do 2019. da bi se situacija ponovo pogoršala u 2021. godini. kada je zauzela 46. mjesto na ljestvici konkurentnosti što je daleko najlošije mjesto u promatranom razdoblju. Razlozi pada mogu se potvrditi kroz istraživanje Portolan (2019) koja zaključuje kako Republika Hrvatska treba poboljšati svoju konkurentsku poziciju kroz unapređenje ljudskih

potencijala i tržišta rada te razvijenosti ICT-a. Dalje se navodi kako je napredak potreban u poslovnom okruženju jer Republika Hrvatska ima jako loše uvjete poslovanja za strane ulagače, neučinkovit pravni okvir u rješavanju sporova, visoku razinu oporezivanja poticaja za rad i ulaganje, visoke troškove rješavanja građevinskih dozvola itd. koji su se dodatno pogoršali u godinama pandemije te negativno utjecali na pad konkurentnosti u 2021. godini.

S druge strane kod Crne Gore primjećuje se veliki pad konkurentnosti u razdoblju od 2013. do 2015. i to sa 40. na 67. mjesto. Međutim, za razliku od Hrvatske koja je od 2015. do 2019. zabilježila rast konkurentnosti, Crna Gora je kroz cijelo vrijeme promatranja zadržala otprilike sličnu poziciju te je u 2021. godini zauzimala 67. mjesto.

Grafikon 1. Kretanje TTCI-a u razdoblju 2013.-2021.



Izvor: Oblikovao autor prema Tablici 1.

Razlozi koji utječu na pad konkurentnosti za Crnu Goru u 2015. godini odnose se na područje pravne regulative posebno međunarodne otvorenosti za poslovanje gdje se misli na vizni režim koji onemogućava lakšu dostupnost destinacije kod međunarodnih putovanja te nedostatan broj regionalnih trgovačkih sporazuma koji bi potaknuli gospodarsku aktivnost. Osim toga najslabija konkurentnost Crne Gore prezentira se kroz Kulturne resurse i poslovna putovanja gdje se ističe nedovoljan broj sportskih stadiona (120. mjesto) i Digitalna potražnja kulturnog i zabavnog turizma (112. mjesto). S obzirom na razloge pada konkurentnosti 2015. godine zanimljivo je za primjeriti kako se u promatranom razdoblju do 2021. godine pozicija Crne Gore nije značajnije mijenjala.

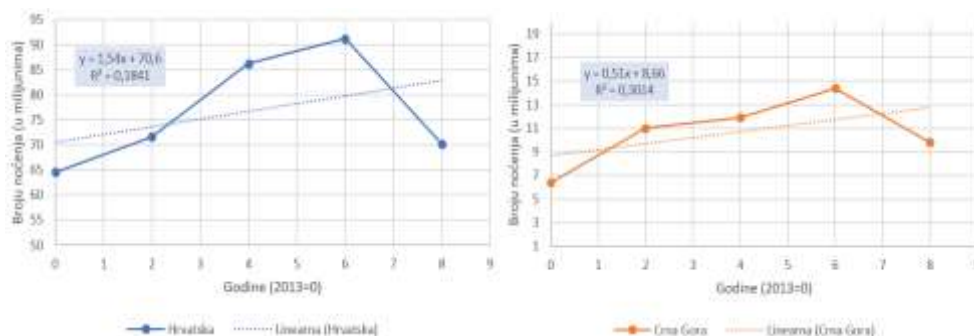
Do sličnog zaključka došli su Bulatović i sur. (2018) koji su vlastitim istraživanjem utvrdili kako se u Crnoj Gori općenito loše upravlja turističkom destinacijom, te kako se treba bolje promicati zaštita prirodnih i kulturnih resursa koji su neophodni za unapređenje crnogorske konkurentnosti. Autori navode kako tranzicija sektora turizma i drugih

dijelova gospodarstva u Crnoj Gori nije završena. Od decentralizacije gospodarstva prirodni resursi se ekstremno i nekontrolirano koriste, a mala i mikro poduzeća, koja su dominantna u turističkoj industriji Crne Gore, još uvijek su slaba i nemaju sposobnosti da se odupru visoko konkurentnom i dinamičnom tržištu. Zaključuju kako niža razina konkurentnosti Crne Gore je uvjetovana njezinom skromnijem ekonomskom razvoju.

Temeljem navedenog može se zaključiti kako su rezultati analize TTCI-a pokazali kako je pozicija Republike Hrvatske (RH) i Crne Gore (CG) i dalje manje turistički konkurentna na međunarodnom tržištu u odnosu na baznu 2013. godinu.

Zatim se analiziraju glavni sektorski pokazatelji turizma kao što su broj noćenja i dolazaka turista, prihoda od turizma i udjela u BDP-u. Podaci su analizirani jednadžbom linearnog trend modela, te su obuhvatili razdoblje od 2013. do 2021. godine.

Grafikon 2. Kretanje broja noćenja RH i CG za 2013. - 2021.



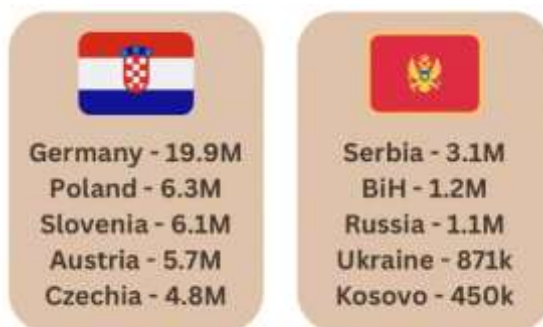
Izvor: Oblikovao autor prema tablici 2. i 3.

Grafikon 4. tako prezentira kretanje broja noćenja u promatranom razdoblju. U jednadžbi linearnog trenda vrijednost broja noćenja u turističkoj destinaciji u ishodišnoj 2013. godini za RH je iznosila 70,6 milijuna, dok se broj noćenja svake godine u prosjeku povećavao za 1,54 milijuna. Nastavno, vrijednost koeficijenta determinacije iznosi: $R^2=0,1841$, što znači kako je 18,41 posto periodičnih promjena broja noćenja u promatranom razdoblju objašnjeno linearnim trend-modelom. S druge strane vrijednost broja noćenje u ishodišnoj 2013. godini za CG iznosi 8,6 milijuna, te se broj noćenja svake godine povećavao za 0,51 milijuna. Vrijednost koeficijenta determinacije iznosi: $R^2=0,3014$, što znači kako je 30,14 posto periodičnih promjena broja noćenja u promatranom razdoblju objašnjeno linearnim trend-modelom.

Svakako bi bilo poželjno i dalje sustavno prikupljati empirijske podatke za obje destinacije jer je uslijed pandemije došlo do poremećaja trenda i evidentnog niskog koeficijenta determinacije koji se posebno ističe za RH. Dobivene vrijednosti linearnog trenda ukazuju na sporiju mogućnost porasta broja noćenja do primjerice 2026. godine. Za RH prognoza

je 89,08 milijuna dok za CG iznosi 14,78 milijuna noćenja. Kada se ti podaci usporede o ostvarenim noćenjima u 2022. godini tada se zaključuje kako je u RH ostvareno 104,8 milijuna noćenja (Hrvatska turistička zajednica, 2023) što je za 19,54 milijuna noćenja više od procjene trenda. Dakle, sustavnim unosom podataka porasti će vrijednost koeficijenta determinacije koji će opet u velikoj mjeri ovisiti o stabilnosti turističkih putovanja u budućnosti. Kod CG u 2022. godini ostvareno je 12,42 milijuna noćenja (Uprava za statistiku Crne Gore, 2023) što je manje od procjene trenda koji iznosi 13,25 milijuna noćenja. U jednadžbi linearnog trenda vrijednost koeficijenta determinacije CG je veća što znači kako se očekivao i veći stupanj točnosti. No CG u 2022. godini nije ostvarila procijenjenu vrijednost niti ju je uspjela prebaciti ako se uspoređuje s RH. Salvia (2022) navodi kako je glavni razlog u nedostatku gostiju iz Rusije i Ukrajine, ali i gostiju iz regije. Dalje se navodi kako Hrvatska ima zdraviju strukturu turističke potražnje u kojoj dominiraju Nijemci, Slovenci, Austrijanci i dr. dok Crna Gora puno više ovisi o Srbiji, Rusiji i Ukrajini te nije na vrijeme napravila diverzifikaciju emitivnih tržišta. Zbog rata u Ukrajini taj nedostatak je posebno došao do izražaja u 2022. godini što potvrđuje slika 3.

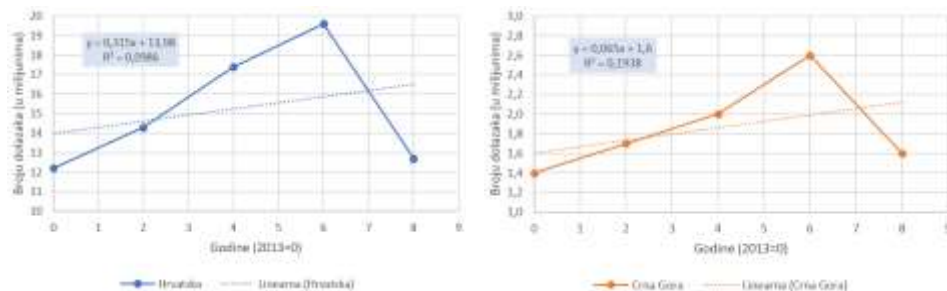
Slika 2. Najvažnija inozemna turistička tržišta u noćenjima za RH i CG u 2021. godini



Izvor: LinkedIn profil Darko Đikanović (2023)

Usporedbe pokazatelja broja dolazaka (turista) mogu se vidjeti na grafikonu 5. Trend vrijednost broja dolazaka u RH u ishodišnoj 2013. godini koji iznosi 13,98 milijuna. Broj dolazaka se svake godine u prosjeku povećavao za 0,315 milijuna. Koeficijent determinacije iznosi: $R^2 = 0,0986$ pri čemu niski koeficijent determinacije ukazuje na veliku promjenu koja je posljedica globalne pandemije 2020. i 2021. Zato bi bilo poželjno prikupljati empirijske podaci za RH za duži period kako bi se utvrdila veća mogućnost prognoze i pravilnijeg trenda za nastupajuće razdoblje. Kod promatranja parametara trenda vrijednost broja dolazaka za CG, ona u ishodišnoj 2013. godini iznosi 1,6 milijuna. Broj dolazaka u CG svake se godine u prosjeku povećavao za 0,065 milijuna. Koeficijent determinacije iznosi: $R^2 = 0,1938$ što znači 19,38 posto periodičnih promjena broja dolazaka u CG u promatranom razdoblju objašnjeno je linearnim trend-modelom. Pri tome znatno veći koeficijent determinacije u odnosu na RH u većoj mjeri opravdava mogućnost prognoze za nastupajuće razdoblje.

Grafikon 3. Kretanje broja dolazaka RH i CG za 2013. - 2021.



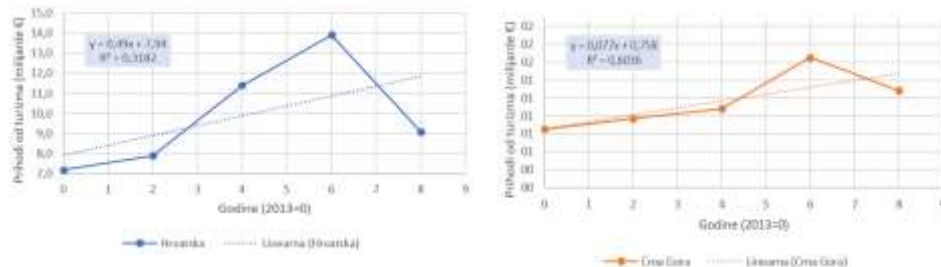
Izvor: Oblikovao autor prema tablici 2. i 3.

RH je u 2022. godini ostvarila 18,9 milijuna dolazaka turista što predstavlja povećanje od 2,1 milijuna turista više od vrijednosti (16,8 milijuna) utvrđene jednadžbom linearnog-trend modela. S druge strane, u CG se u 2022. godini ostvarilo 2,2 milijuna dolazaka što je istovjetno sa vrijednošću koja je utvrđena jednadžbom linearnog-trend modela. Zbog toga se može zaključiti kako je CG Gora od 2013. do 2021. bilježila vrijednosti koje ukazuju na veću pravilnost trenda u kojemu viši koeficijent determinacije opravdava mogućnost prognoze za nastupajuće razdoblje. Takav rezultat je u suprotnosti s onim dobivenim za RH.

Kod sljedećeg sektorskog pokazatelja poput prihoda od turizma može se zaključiti kako je pravilnost trenda i viši koeficijent determinacije prisutan za CG u odnosu na RH.

Za RH u jednadžbi vrijednost prihoda od turizma u ishodišnoj 2013. godini iznosi 7,94 milijardi eura (€). Prihod od turizma u RH svake se godine u prosjeku povećavao za 0,49 milijardi eura (€). Koeficijent determinacije iznosi: $R^2=0,3182$. Rezultati izračuna prikazani su na grafikonu 6.

Grafikon 4. Kretanje prihoda od turizma RH i CG za 2013. - 2021.



Izvor: Oblikovao autor prema tablici 2. i 3.

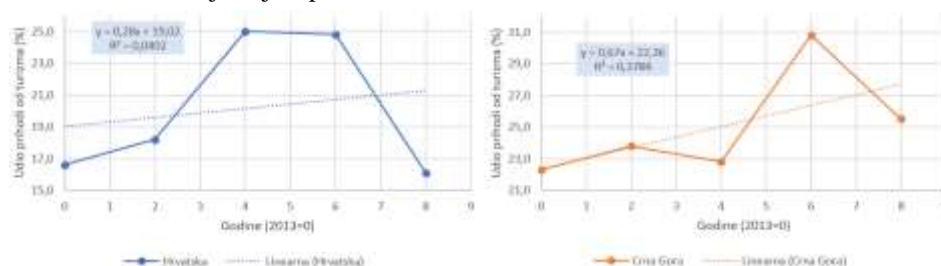
Prema prognozi procjena prihoda u 2022. godini iznosila bi 12,4 milijardi eura, dok u bi u 2025. godini iznosila 13,8 milijardi eura. Ukoliko se te procjene usporede sa rezultatima u 2022. prema priopćenju HTZ-a (2023) u prvih devet mjeseci ostvareno je ukupno 11,3 milijardi eura prihoda. Prema zadnjim objavama Ministarstva turizma i sporta (2023) u 2022. se prema istraživanjima HNB-a ostvario prihod od stranih turista u visini od 13,1 milijardi eura što je više od linearnog trenda koji je ovakav rezultat projicirao za 2024. godinu.

Za CG u jednadžbi trend vrijednost prihoda od turizma u ishodišnoj 2013. godini iznosi 0,758 milijardi eura (€). Prihod od turizma su u CG svake godine u prosjeku povećavao za 0,077 milijardi eura (€). Koeficijent determinacije iznosi: $R^2=0,6036$. Prema prognozi procjena prihoda u 2022. godini iznosila bi 1,5 milijardi eura, dok u bi u 2025. godini iznosila 1,7 milijardi eura. Prema objavama crnogorskog premijera u tehničkom mandatu CG je u 2022. godini ostvarila ukupno prihode od turizma u visini od 997 milijuna eura (Aljazeera.net, 2023) što je pad u odnosu na prognozu od 0,503 milijuna eura. Dakle, pad prihoda od turizma posljedica je pada turističkog prometa u 2022. godini, ali pravilnost trenda opravdava mogućnost prognoze za nastupajuće razdoblje.

Sljedeći važan pokazatelj je udio turizma u bruto domaćem proizvodu (BDP). Kretanje udjela prihoda u RH i CG može vidjeti na grafikonu 7. Na primjeru RH trend vrijednost udjela prihoda od turizma u BDP-u u ishodišnoj 2013. godini iznosi 19,02 posto. Udio prihoda od turizma u BDP-u svake se godine u prosjeku povećavao za 0,28 postotnih bodova. Koeficijent determinacije iznosi: $R^2=0,0402$ što je ujedno i najniža vrijednost koeficijenta determinacije do sada.

S druge strane na primjeru CG trend vrijednost udjela prihoda od turizma u BDP-u u ishodišnoj 2013. godini iznosi 22,36 posto. Udio prihoda od turizma u BDP-u svake se godine u prosjeku povećavao za 0,67 postotnih bodova. Koeficijent determinacije iznosi: $R^2=0,3784$, što je i u ovom slučaju puno veća vrijednost u usporedbi s RH.

Grafikon 5. Kretanje udjela prihoda od turizma u BDP-u RH i CG za 2013. - 2021.

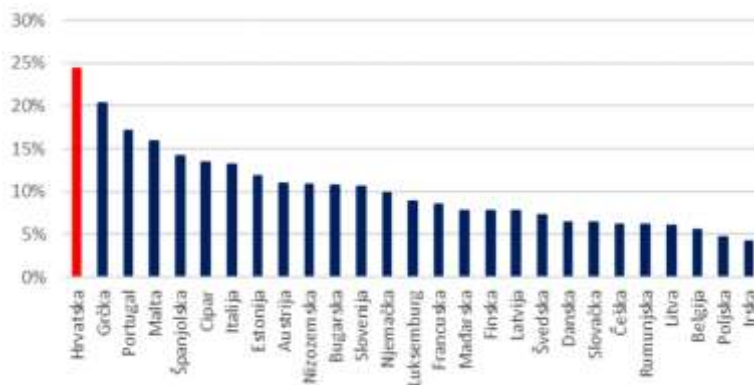


Izvor: Oblikovao autor prema tablici 2. i 3.

Kada se ti podaci usporede sa vrijednostima prikazanima u tablicama 2. i 3. tada se može zaključiti kako su od 2013. godine bilježili rast iako je on bio različit u usporedbi ove dvije turističke destinacije. Vidljivo je kako su prihodi od turizma u CG od većeg utjecaja nego za RH. Međutim, ti prihodi opet u dovoljnoj mjeri ne prezentiraju njihovu važnost jer se najčešće izračunavaju temeljem ukupnih prihoda koji se preuzimaju iz platne bilance centralne banke. Naime na ovakav način ne može se utvrditi njihov stvarni udio jer se u statističkom praćenju, turizam ne definira kao zasebna kategorija (područje, odjeljak, skupina djelatnosti ili razred) unutar neke nacionalne klasifikacije djelatnosti već se radi o skupu različitih djelatnosti, što zapravo otežava procjenu njezinog ukupnog značaja. Zbog toga se sve češće ističe potreba procjenjivanja izravnoga ekonomskog doprinosa turizma u nacionalnom gospodarstvu satelitskim izračunom turizma.

Satelitski račun turizma koristi se radi lakšeg uključivanja statističkih podataka turizma u statistici nacionalnih izračuna. Važan je jer pruža detaljan statistički pregled ekonomskog doprinosa turističkog sektora u skladu s definicijama iz Uredbe (EU) br. 549/2013 o Europskom sustavu nacionalnih i regionalnih računa. Tako je primjerice Državni zavod za statistiku Republike Hrvatske u siječnju 2019. godine objavio rezultate satelitskog izračuna za 2016. u kojoj je udio iznosio 11,4 % (Institut za turizam, 2019). Znači kako je udio turizma manji u odnosu na vrijednost udjela bruto dodane vrijednosti turističkih djelatnosti u ukupnom bruto dodanoj vrijednosti koja je iznosila 24 posto i koja se najčešće prezentira u turističkoj statistici. Primjerice takvu metodu izračuna koristi se u izvještajima Statiste koja objavila kako je Hrvatska u 2019. godini bila članica EU s najvećim udjelom turizma u BDP-u od gotovo 25 posto. Druga po redu je bila Grčka, s udjelom malo iznad 20 posto što se može vidjeti slici 4. Zaključuje se kako je ovakav poredak očekivan jer zemlje koje imaju konkurentan osnovni proizvod poput „sunca i mora“ su privlačnije turistima i logično je da će veći dio njihove proizvodne aktivnosti biti orijentiran upravo na turističku djelatnost. Iako su vrijednosti dobivene satelitskim izračunom turizma manje od onoga što se navodi u Statisti, u analizi se zaključuje kako je poredak zemalja nešto što se u konačnici ne bi trebalo značajnije mijenjati.

Slika 3. Udio turizma u BDP-u 2019. godine

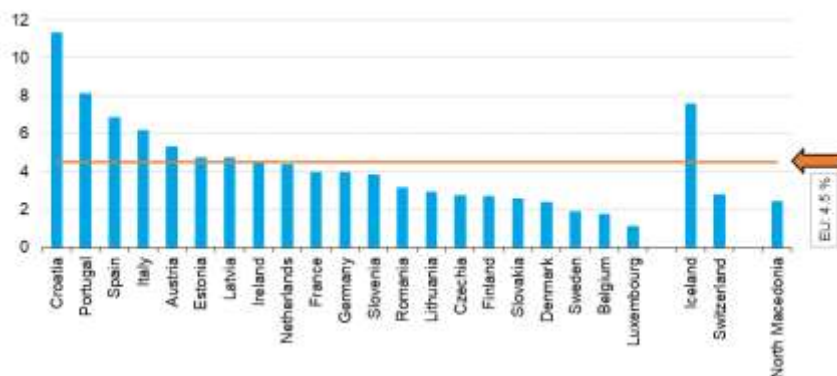


Izvor: SATISTA prilagođeno prema Ekonomika baza (2023)

Promatrajuću udio turizma u nacionalnoj ekonomiji prema Eurostatu koji se primjerice koristi satelitskom izračunom *eng. Tourism Satellite Account* (TSA) poredak RH može se vidjeti na slici 5. Može se primijetiti kako su najveće udjele turizma u ukupnom bruto dodanoj vrijednosti zabilježeni u Hrvatskoj (11 %), Portugalu (8 %), Španjolskoj (7 %), Italiji (6 %) i Austriji (5 %).

Dakle prema tom izvješću RH je po udjelu turizma u BDP-u 2019. godine na razini 11 posto, dok je prosjek EU-a 4,5 posto. Točnije, radi se o udjelu od 11,82 posto kojeg je objavio Državni zavod za statistiku gdje je bruto dodana vrijednost turističkih djelatnosti iznosila je 10.994,75 milijardi eura. Bruto dodana vrijednosti turističkih djelatnosti činila je 24,41 posto ukupno ostvarene bruto dodane vrijednosti u 2019. Nakon izračuna turističkog udjela u proizvodnji za svaku od turističkih djelatnosti i ostalih djelatnosti izračunata je izravna bruto dodana vrijednost turizma. Ona je u 2019. iznosila 5.111 milijardi eura i činila je 11,3 posto ukupne bruto dodane vrijednosti. Izravni bruto domaći proizvod turizma u 2019. iznosio je 6.469 milijardi eura i njegov udio u ukupnom bruto domaćem proizvodu iznosio je dakle konačnih 11,82 posto (Državni zavod za statistiku Republike Hrvatske, 2022.)

Slika 4. Udio bruto dodane vrijednosti turističkih djelatnosti u ukupnoj bruto dodanoj vrijednosti EU u 2019. godini



Izvor: EUROSTAT (2023)

Temeljem navedenog može se zaključiti kako se poredak zemalja unatoč različitoj metodologiji izračuna ipak nije značajnije mijenjao.

Nažalost usporedbe RH i CG temeljem metodologije satelitskog izračuna turizma nisu moguće jer takvi podaci za CG ne postoje. Zavod za statistiku Crne Gore satelitski račun u turizmu koristio je samo jednom kao pilot projekt za 2009. godinu kada se izračunalo da je bruto domaći proizvod turizma u BDP-u Crne Gore iznosio 10,0 posto (Zavod za statistiku Crne Gore - MONSTAT, 2011.) Međutim, kada bi se analizirali podaci prikazani na slici 4. tada se može zaključiti kako bi Crna Gora na toj rang ljestvici zauzela uvjerljivo prvo mjesto, jer je njezin udio prohoda u BDP u 2019. iznosio 30,8 posto što bi se vrlo vjerojatno ponovilo i kod satelitskog izračuna.

3. ZAKLJUČAK

Sustav turizma predstavlja jednu od najbrže rastućih gospodarskih aktivnosti u svijetu i za mnoge nacionalne ekonomije predstavlja jedan on najvažnijih izvora gospodarskog rasta. Dakle, konkurentnost turističkih destinacija u središtu je interesa svih dionika ali do sada je nedostajao sveukupni okvir mjerenja konkurentnosti u turizmu.

U radu se zaključilo kako se kod mjerenja konkurentnost treba usmjeriti na one podatke koji se mogu prikupljati sustavno i putem kojih se mogu usporediti turističke zemlje i prometi. U usporedbi Hrvatske i Crne Gore kao turističke destinacije koristio se TTCI pokazatelj koji danas predstavlja referentnu točku u proučavanju konkurentnosti. Osim toga kvantitativna dimenzija ocjenjivanja destinacijske konkurentnosti provodila se prikupljanjem statističkih podataka iz sekundarne baze podataka gdje su se pratili glavni pokazatelji turizma: broj noćenja i dolazaka turista, prihodi od turizma, te udio turizma u BDP-u.

Zaključilo se kako su rezultati analize TTCI-a pokazali kako je pozicija Republike Hrvatske i Crne Gore i dalje manje turistički konkurentna u odnosu na baznu 2013. godinu.

Kod usporedbe noćenja i dolazaka utvrdilo se da bi bilo poželjno i dalje sustavno prikupljati empirijske podatke za obje destinacije jer je uslijed pandemije došlo do poremećaja trenda i evidentnog niskog koeficijenta determinacije koji se posebno ističe za Hrvatsku. S druge strane za Crnu Goru u jednadžbi linearnog trenda vrijednost koeficijenta determinacije je veća što znači kako se u većoj mjeri opravdava mogućnost prognoze za nastupajuće razdoblje, a koju su dodatno potvrdili rezultati analize TTCI-a i turističkog prometa.

Kod sljedećeg sektorskog pokazatelja poput prihoda od turizma zaključilo se kako je pravilnost trenda i viši koeficijent determinacije značajniji za Crnu Goru u odnosu na Hrvatsku. U Hrvatskoj je koeficijent determinacije iznosio $R^2=0,3182$ zbog čega se prognoza prihoda od stranih turista pokazala pogrešnom u rasponu od dvije godine u odnosu na ostvarenje 2022. godine. U slučaju Crne Gore koeficijent determinacije iznosio je $R^2=0,6036$ te je pokazao kako se 60,36 posto periodičnih promjena prihoda od turizma može prognozirati jednadžbom linearnog trend modela. Zaključilo se kako je pad prihoda u odnosu na prognozu u 2022. godini bio uvjetovan padom turističkog prometa, ali pravilnost trenda opravdava mogućnost prognoze za nastupajuće razdoblje.

Posljednji važan pokazatelj koji se analizirao bio je udio turizma u bruto domaćem proizvodu. Zaključilo se kako podaci o udjelu prihoda turizma u BDP-u od bazne godine bilježe rast iako je on bio različit u usporedbi ove dvije destinacije. Procjena reprezentativnosti trend modela je i u ovom slučaju za Crnu Goru bila puno veća u usporedbi s Hrvatskom koja je zabilježila najnižu vrijednost koeficijenta determinacije. Prihodi od turizma u Crnoj Gori od većeg su utjecaja nego za Hrvatsku. Opet oni u dovoljnoj mjeri ne prezentiraju njihovu važnost jer se razlikuju u vrijednostima ovisno o tome koja metodologija izračuna se koristi. Naime, utvrdilo se kako se satelitski račun turizma sve češće koristi. Prema tome udjel turizma u BDP Hrvatske je u 2019. godini iznosio 11,82 posto što je manje od 24,8 posto koliko se vodi u većini statističkih izvještaja. Na kraju se opet zaključilo kako se usporedba i poredak zemalja unatoč različitoj metodologiji izračuna ne bi značajnije mijenjala. Također se zaključilo kako bi Crna Gora u usporedbi zemalja zauzela prvo mjesto, jer je njezin udio prihoda u BDP u 2019. iznosio 30,8 što je predstavlja uvjerljivo najveću vrijednost.

Temeljem svega navedenog može se utvrditi kako je sustavno prikupljanje ovakvih podataka važan korak prema kreiranju okvira za buduća istraživanja. Dakle kriterij kod odabira pokazatelja treba se temeljiti na opravdanosti upotrebe takvih pokazatelja kao što je to slučaj kod usporedbe Hrvatske i Crne Gore. Naravno, istraživanje se može proširiti uključivanjem i drugih glavnih pokazatelja turizma poput broja kreveta koji se zatim mogu analizirati pokazateljem turističkog intenziteta i gustoće kreveta u odnosu na broj stanovništva. Na takav način može se usporediti turistički promet i primjerice njegova produktivnost, te utvrditi povezanost i utjecaj broja kreveta na konkurentnost pojedine turističke destinacije.

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COMPETITIVENESS OF THE REPUBLIC OF CROATIA AS A TOURIST DESTINATION AND COMPARISON WITH MONTENEGRO

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ABSTRACT:

The competitiveness of a tourist destinations can be monitored through the constant growth of statistical data on the number of tourist arrivals and overnights, as well as the growth of the national gross domestic product caused by the growth of traffic in the tourism system. For this reason, competitiveness becomes a key concept of approach and research in this article.

Over the years, indicators have been developed by various organizations that deal with certain aspects of competitiveness, but an overall framework for measuring competitiveness in tourism is still missing. It was concluded that it is actually difficult to standardize an ideal set of indicators, therefore the measurement of the competitiveness of tourist destinations should be approached as a systematic process.

This article will present and analyze secondary data collected from The Travel & Tourism Competitiveness Reports of the World Economic Forum, publication Tourism in figures published by the Ministry of Tourism and Sports of Republic of Croatia and TOMAS - attitudes and expenditures of tourists in Croatia reports by the Institute for Tourism Zagreb and compare it with secondary data on tourism traffic in Montenegro.

The aim of the paper is to determine the competitiveness of two tourist destinations by comparing statistical data that measure national tourism competitiveness from various reports and to assess the value of selected indicators as important elements in the creation of the future models for systematic monitoring of competitiveness.

Keywords: *indicators of competitiveness of tourist destinations, measurement of competitiveness*

SPECIFIČNOSTI POSLOVANJA HOTELSKIH KOMPANIJA U CRNOJ GORI

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SAŽETAK:

Značaj koji turizam ima za privredni i društveni razvoj Crne Gore, poslovanju hotelskih kompanija, kod nas, daje poseban značaj. Imajući u vidu da je hotelijerstvo jedan od značajnih generatora turističkog rasta i razvoja, a da uprkos toj činjenici ne bilježi očekivane rezultate, u radu ćemo se fokusirati na potencijalne razloge takvom stanju. Pri tome, analiziraćemo specifičnosti poslovanja hotelskih kompanija kod nas kao i osobenosti hotelskog biznisa per se, sve sa ciljem da damo moguće odgovore na prisutne dileme i ukažemo na neka od mogućih rješenja.

Ključne riječi: turizam, analiza, profitabilnost, hotelijerstvo

UVOD

Turizam u Crnoj Gori predstavlja jedan od najvažnijih sektora, koji ima značajne potencijale za dalji rast i razvoj sa višestrukim multiplikativnim efektima. Stoga je potrebno analizirati faktore koji doprinose daljem rastu i razvoju ovog sektora, a posebno hotelijerstvu kao najzačajnijoj grani turizma. Ključni pokazatelji iz Izvještaja Svjetskog savjeta za putovanja i turizam (World Travel and Tourism Council - WTTC) za Crnu Goru, koji se odnose na 2019. godinu su sljedeći: ukupni (direktni i indirektni) doprinos sektora turizma i putovanja BDP-u iznosio je 30,9%, ukupni doprinos zaposlenosti bio je 31,9%, a učešće turizma u izvozu iznosilo je 52,6% ¹.

Zbog značaja koji hotelijerstvo ima za turizam i generalno ekonomiju Crne Gore, nije samo poželjno već i nužno pratiti poslovanje ove grane. Zato ćemo u radu analizirati finansijske pokazatelje hotelske industrije u Crnoj gori, identifikovati uzroke trenutnog

¹ Turizam Crne Gore- Komparativna analiza od 2019.do 2021.godine, Skupština Crne Gore, Parlamentarna budžetska kancelarija, str.1

položaja ove grane i dati preporuke za unapređenje privrednog ambijenta koji bi doprinio boljem položaju hotelske industrije u Crnoj Gori.

Ako se sagledaju podaci za period od 2009. do 2019. godine, može se konstatovati da je broj turista povećan za 119%, broj noćenja za 91%, a ukupno ostvareni prihodi za 92%. Statistike pokazuju i da se preko 90% turističkih posjeta realizuje u primorskoj regiji i uglavnom tokom kratkog ljetnjeg perioda (jun-septembar).¹

Uprkos stalnom rastu broja noćenja, dolazaka gostiju i prihoda od turizma, zbog relativno kratkog perioda poslovne aktivnosti većine hotelskih kompanija i visokih fiksnih troškova poslovanja hotelijerstvo je nisko profitabilna grana privrede. Kao rezultat toga imamo činjenicu da su stope prinosa na uložena sredstva u hotelijerstvu niske, a period povrata uložених sredstava izuzetno visok. Shodno tome, tema poslovanja hotelskih kompanija je predmet stalnih analiza, preispitivanja, te sagledavanja mogućnosti kako povećati profitabilnost ove grane. Pri analizi isplativosti ulaganja u hotele treba uzeti u obzir i druge značajne faktore kao što su: lokaciju hotela, konkurenciju, perspektive turizma na datom području, infrastrukturna uređenost područja i slično. Shodno svemu navedenom, postavili smo sledeću hipotezu: „Hotelijerstvo u Crnoj Gori je niskoprofitabilna grana privrede.“

1. KARAKTERISTIKE POSLOVANJA HOTELSKIH KOMPANIJA

Hotelsko preduzeće je složen organizacioni sistem koji posluje u promjenljivim internim i eksternim uslovima turističkog tržišta. Specifičnosti turističkog poslovanja ogledaju se u relativno kratkom vremenu trajanja proizvodnih i uslužnih procesa, diskontinuiranom toku radnih procesa, proizvodnji za „nepotrebnu potrošnju“ (ne proizvodi se za skladište, nema zaliha), stalnoj pripravnosti zaposlenih i sredstava za proizvodnju i obavljanje usluga koje počinju mnogo prije dolaska gosta – potrošača. Pored navedenog, poslovanje hotelskih kompanija karakteriše: raznovrsnost proizvoda i usluga, neposredna komunikacija sa gostima i potreba stalnog prilagođavanja njihovom zahtjevima, specifični uslovi rada (dugo stajanje, dugo hodanje, visoke/niske temperature i sl.). Usled toga, upravljanje hotelskim kompanijama otežava nemogućnost preciznog planiranja i raspodjele proizvodnje, krutost obima i strukture sredstava koja uslovljavaju dominantno učešće fiksnih troškova u ukupnim troškovima hotela, nemogućnost potpunog

¹ Strategija razvoja turizma Crne Gore 2022. do 2025. godine, (2022), <https://www.gov.me/dokumenta/db71ea87-f50f-4aca-98ae-91d8af502816>

i stalnog usklađivanja broja zaposlenih i nivoa uposlenosti kapaciteta, sezonski rad i potreba diferenciranja prodajnih cijena hotelskih usluga.

Sektor turizma, naročito hotelijerstvo, karakterišu visoka investiciona ulaganja u fiksne fondove (objekte za obavljanje djelatnosti: hotele, restorane, kafiće i prateće turističko- ugostiteljske sadržaje). Rezultati dobijeni na osnovu uzorka iz Amadeus baze podataka¹ pokazuju da kompanije iz sektora hotela i restorana u Evropi imaju udio fiksne imovine od 65-75% u zavisnosti od veličine kompanije, dok je taj udio kod kompanija u drugim sektorima između 35 i 50%, u zavisnosti od veličine kompanije.² Stoga je za realizaciju investicija u turizmu potrebno angažovati pozajmljena sredstva sa dugim periodom otplate, što onda podrazumjeva troškove kamata, opterećen novčani tok i ograničenu finansijsku samostalnost. Sektor turizma karakteriše i sezonski karakter u poslovanja, što takođe stvara potrebu za tuđim izvorima finansiranja, ali sa kraćim periodom otplate, kako bi se riješio problem novačnog jaza.

U velikom broju analiza hotelskih kompanija, koje se vrše iz različitih interesa, analiza novčanog jaza zauzima posebno važno mjesto, zbog sezonskog karaktera turizma. Kako je upravljanje likvidnošću jedan od najvažnijih zadataka kod upravljanja preduzećem, za upravu turističkog preduzeća važno je imati dobru podlogu za analizu upravljanja obrtnim kapitalom u cilju rješavanja problema "cash gap". Istraživanje koje su izvršili „Fakultet za biznis i turizam“- Budva, Fakultet „Montenegro tourism school“- Bar i agencija Horwath consulting Zagreb, pokazalo je da se u 2014. godini čak 64,50% ukupnog godišnjeg prometa u hotelijerstvu Crne Gore ostvarilo tokom dva mjeseca (jul i avgust), a svega 35,50% prometa tokom ostalih deset mjeseci u godini.³

Hotelijerstvo je radno intenzivna djelatnost, pa uspješnost hotelskih kompanija u velikoj mjeri zavisi od kvaliteta i optimalnog broja zaposlenih. Shodno tome, hotelijerstvo karakteriše visoko učešće troškova radne snage u ukupnim troškovima pa i ukupnom prihodu. Tokom 2022. godine, učešće troškova radne snage u ukupnom prihodu u hotelskoj industriji Crne Gore je iznosilo 25,46%, dok je tokom 2021.godine učešće iznosilo 27,51%. Pored navedenog, zanimljivo je pratiti i kretanje prihoda po zaposlenom, budući da ovaj pokazatelj govori o efikasnosti radne snage, a zavisi kako od obučenosti i obrazovanja zaposlenih, tako i od postavljene organizacije i tehnologije procesa. Tokom

¹ Amadeus je baza podataka koja obuhvata uporedne finansijske i poslovne informacije o preko 19 miliona kompanija iz Evrope.

² Torluccio, G., (2012.), Financial menu at European restaurants“, str. 323-342

³ Istraživanje koje su sproveli: agencija Horwath HTL Zagreb, Fakulteta za biznis i turizam- Budva, Fakulteta za turizam „Montenegro tourism school“ – Bar, (2015), str. 9

2022. godine prihod po zaposlenom u hotelskoj industriji Crne Gore je iznosio 50.141 euro dok je u 2021.godini iznosio 37.731 euro. ¹

Jedna od osnovnih ekonomskih zakonitosti koja se ispoljava u hotelijerstvu je da za preduzeća s visokom fiksnim troškovima, stepen korišćenja kapaciteta predstavlja najvažniji faktor koji determiniše njihov poslovni uspjeh. Ova preduzeća su izložena većem riziku u toku poslovanja zbog variranja tražnje i obima prodaje i za menadžent ovih preduzeća prioritet predstavljaju aktivnosti na obezbjeđenju većeg stepena korišćenja kapaciteta. Preduzeća sa nižim učešćem fiksnih troškova su pod manjim uticajem rizika koji je posljedica variranja tražnje, ali u osnovi nemaju ni iste potencijale za povećanje poslovnih rezultata.

Struktura troškova je u osnovi determinisana karakteristikama same djelatnosti. Za djelatnosti u okviru turizma karakteristično je da hoteli imaju visoko učešće fiksnih troškova u odnosu na restorane, dok prevozne kompanije imaju veće učešće u odnosu na turističke agencije. Ipak, razlike postoje i u okviru samih djelatnosti, pa tako *budget* hoteli imaju niže učešće fiksnih troškova u odnosu na hotele visokih kategorija.

Tabela 1 daje prikaz kompanija koje su vezane za turizam, pri čemu su za svaku od kompanija navedna obilježja troškova.

Tabela 1: Primjeri turističkih djelatnosti sa tipičnom strukturom troškova²

Preduzeća	Obilježja troškova
Avio kompanije	Visoki fiksni troškovi goriva i posade za svaki let Niski varijabilni troškovi za obroke i slične usluge po putniku
Luksuzni hoteli	Visoki fiksni troškovi usljed skupih lokacija, izgrađenog prostora i broja i kvaliteta zaposlenih Niski varijabilni troškovi za konzumiranje proizvoda i usluga
Turistički centri	Visoki fiksni troškovi izgradnje, opremanja i zaposlenih Nisko učešće varijabilnih troškova za mali broj korišćenih resursa

¹ Analiza portala Business intelligence consulting na osnovu zvaničnih finansijskih izvještaja svih kompanija iz sektora hotelijerstva, predatih Poreskoj upravi Crne Gore

² Spasić, V., Čerović, S., (2013), „Ekonomsko finansijska analiza poslovanja preduzeća u hotelijerstvu i turizmu“, str. 105

Restorani	Niski fiksni troškovi (objekti često uzeti u zakup) Visoko učešće varijabilnih troškova hrane i pića po jedinici proizvoda
Turističke agencije	Niski fiksni troškovi (objekti često uzeti u zakup) Visoki varijabilni troškovi po jedinici pruženih usluga

Iz tabele se vidi da veliki broj kompanija koje su vezane za turizam imaju visoko učešće fiksnih troškova. Ta činjenica znatno otežava poslovanje kompanija u turizmu, pa prilikom anize isplativosti ulaganja treba biti posebno oprezan.

2. FINANSIJSKI POKAZATELJI POSLOVANJA HOTELSKIH KOMPANIJA

Da bi turističko preduzeće moglo da ide ka ostvarenju svojih ciljeva, pogotovo povećanju prihoda, kao osnovnom uslovu za obezbjeđenje rasta profita, neophodno je da raspolaže podacima iz ranijeg perioda, pa da na osnovu tih pokazatelja donese konkretan plan aktivnosti i krene u njegovo sprovođenje. Analiza finansiranja poslovnog ciklusa i implikacija koje nastaju usljed poslovnih ciklusa, omogućava shvatanje važnosti visine adekvatnog zaduženja, imovine, potraživanja, ukupne likvidnosti, zaduženosti, profitabilnosti, te njihovih korelacija sa finansiranjem poslovnog ciklusa. Zbog toga ćemo u radu analizirati tri grupe pokazatelja crnogorskih hotelijerstva: profitabilnost, likvidnost i solventnost i efikasnost.

2.1. Analiza profitabilnosti

Finansijska isplativost, odnosno profitabilnost ulaganja u hotele, često je predmet rasprava među investicionim projektantima, ulagačima i bankarima. Činjenica je da je hotelska industrija u Crnoj Gori niskoprofitabilna djelatnost, što je posljedica visokih ulaganja, visokih fiksnih troškova i generalno posmatrano niskog nivoa zauzetosti smještajnih kapaciteta, odnosno sezonskog karaktera poslovanja.

Profitabilnost, odnosno rentabilnost, primarna je motivacija svih investitora, pa i onih koji posluju u segmentu hotelijerstva i turizma, a karakteriše je sposobnost privrednog društva da u posmatranom periodu ostvari pozitivnu razliku između prihoda i rashoda.

Nominalna vrijednost rezultata nije posebno informativna bez spoznaje o veličini, strukturi i nivou organizovanosti privrednog društva koje je ostvarilo taj rezultat. U cilju standardizovanja i poređenja sa drugim privrednim društvima, rezultat se stavlja u odnos sa nekim od pokazatelja obima poslovanja (prihodima) ili uloženim sredstvima (kapital, poslovna imovina, investirani kapital).

Sektor pružanja usluga smještaja i ishrane u Crnoj Gori je svake godine do 2020.godine, kada je nastupila pandemija virusa Covid 19 bilježio rast prihoda, pa se kao rekordna godina za naš tuizam posmatra 2019. godina. Crna Gora je u 2019. godini ostvarila prihode od turizma na nivou od 1,14 milijardi eura. U 2020. godini ostvareni prihodi su na znatno nižem nivou (oko 159 miliona), što je svega oko 15% u odnosu na 2019.godinu. U 2021. godini ostvaren je oporavak ekonomske aktivnosti u sektoru turizma i ostvaren je prihod od 834 miliona (oko 74% u odnosu na 2019. godinu).¹ Prema procjenama Ministarstva ekonomskog razvoja i turizma, tokom 2022.godine ostvareno je oko 95% prihoda u odnosu na rekordnu 2019. godinu.

Postoje dvije grupe faktora koji utiču na visinu prihoda u kompanijama koje se bave turizmom:

- Unutrašnji faktori na koje zaposleni u turističkim kompanijama mogu uticati: struktura i kvalitet uslužnog programa, obim i kvalitet ljudskih resura, veličina kapaciteta i tehnička opremljenost, tehnološki proces, sistem organizacije poslovanja, sistem vrednovanja rada, razvojna politika i slični faktori.
- Spoljašnji faktori su faktori iz tržišnog, tehnološkog, prirodnog i ekološkog, pa i ukupnog društveno-ekonomskog okruženja na koje zaposleni u turističkim kompanijama ne mogu uticati direktno. Jedan od najizraženijih spoljašnjih faktora, naročito u primorskim gradovima i ski centrima je faktor vremenskih prilika.

Međutim, jedno od ključnih pitanja odnosi se na strukturu troškova preduzeća u turizmu. Naročito je prisutno visoko procentualno učešće fiksnih troškova kod hotelskih kompanija, jer su velika sredstva uložena u obezbjeđivanje potrebnog zemljišta, izgradnju objekata i nabavku opreme, a karakteristično je i visoko učešće troškova zaposlenih. Dodatni faktor koji otežava poslovanje je činjenica da ne postoji mogućnost da se pripremljeni proizvodi (hotelske sobe) skladište na zalihama radi prodaje u narednom periodu. Zapravo, neprodati kapaciteti predstavljaju zauvijek izgublenu zaradu, te se nekada za turističke usluge kaže da su „izuzetno kvarljive“. To ukazuje da je osnovni cilj ovih kompanija obezbijediti maksimalni broj potrošača, odnosno što veći procenat

¹ Turizam Crne Gore- Komparativna analiza od 2019.do 2021.godine, Skupština Crne Gore, Parlamentarna budžetska kancelarija, str.1

korišćenja kapaciteta jer će to obezbijediti pokrivanje fiksnih troškova i maksimiziranje profita. Ekonomija obima ima veliki značaj u postizanju pozitivnih ekonomskih rezultata, pa je ekonomija obima uticala na intenziviranje procesa vertikalne i horizontalne integracije na turističkom tržištu.

Kada je u pitanju profitabilnost hotelskih kompanija u Crnoj Gori, ista je prethodne dvije godine bila negativna, pa je tokom 2022.godine ostvaren gubitak na nivou grane od 8,9 miliona eura, dok je tokom 2021.godine ostvaren gubitak od 35,7 miliona eura.¹

Značajan uticaj na ostvareni rezultat u hotelskoj industriji ima visok trošak amortizacije koji je povezan sa visokim ulaganjima u fiksne fondove. Prema istraživanju Fakulteta za biznis i turizam - Budva, Fakulteta Montenegro bussines school - Bar i agencije Horwath consalting Zagreb, trošak amortizacije učestvuje sa čak 16% u ostvarenim prihodima anketiranih hotelijera.² Stoga je zanimljivo pratiti i druge pokazatelje rentabilnosti, prije svega EBITDA (dobit prije troškova kamate, poreza i troškova amortizacije). Hotelska industrija u Crnoj Gori je tokom 2022. godine ostvarila EBITDA u iznosu od 75,2 miliona eura, dok je na kraju 2021.godine EBITDA iznosila 35,78 miliona eura.³

Budući da je cilj kompanija koje posluju u sektoru turizma maksimiziranje dobiti na dugi rok, cilj praćenja indikatora rentabilnosti je sagledavanje stepena ostvarenja ciljeva. Rentabilnost, kao princip ostvarenja maksimalne dobiti sa što manje angažovanih sredstava može biti prikazana kroz:

- parcijalne pokazatelje: bruto profitna marža i stopa neto dobiti
- sitnетиčke pokazatelje: stopu prinosa na kapital i stopu prinosa na imovinu.

Bruto profitna marža se dobija kao odnos bruto dobiti (poslovni prihodi umanjeni za varijabilne troskove nabavke robe i materijalne troskove) sa poslovnim prihodima. Optimalna veličina se razlikuje po djelatnostima, a poređenjem u okviru grane dobija se slika o optimizaciji poslovnog procesa. Bruto profitna marža hotelske industrije u Crnoj Gori u 2022. godini je iznosila 65,55%, dok je u 2021. godini iznosila 66.99%.⁴

Stopa neto dobiti se dobija kao količnik neto rezultata i prihoda od prodaje. Ovaj pokazatelj nam govori koliki procenat prihoda od prodaje ostaje kao dobit nakon izmirenja

¹ Analiza portala Business intelligence consalting na osnovu zvaničnih finansijkih izvještaja svih kompanija iz sektora hotelijerstva, predatih Poreskoj upravi Crne Gore

² Istraživanje agencije Horwath HTL Zagreb, Fakulteta za biznis i turizam - Budva, Fakulteta Montenegro bussines school- Bar, 2015, str. 13

³ Analiza portala Business intelligence consalting na osnovu zvaničnih finansijkih izvještaja svih kompanija iz sektora hotelijerstva, predatih Poreskoj upravi Crne Gore

⁴ Analiza portala Business intelligence consalting na osnovu zvaničnih finansijkih izvještaja svih kompanija iz sektora hotelijerstva, predatih Poreskoj upravi Crne Gore

svih troškova. Kako je hotelska industrija u Crnoj Gori u prethodne dvije godine poslovala negativno, grana nije ostvarila neto dobit.

Prinos na aktivu- ROA (Return on Assets) dobija se kao odnos neto rezultata i ukupne aktive, pa govori koliki je povrat ostvaren na ukupno angažovana sredstva.

Prinos na kapital- ROE (Return on Equity) dobija se kao količnik neto rezultata i ukupnog kapitala, pa pokazuje koliki povrat su ostvarili vlasnici ili akcionari na uloženi kapital. Kako je hotelska industrija u Crnoj Gori u 2022. i 2021.godini poslovala sa gubitkom, to nisu ostvareni prinosi na aktivnu, niti kapital.

2.2. Analiza likvidnosti i solventnosti

Kompanije iz sektora hotelijerstva se po pravilu suočavaju s problemima koji su posljedica sezonskog kretanja turističke tražnje, odnosno prometa. To za posljedicu ima različit intezitet poslovnih operacija u pojedinim periodima godine i angažovanje sezonske radne snage, a posebni problemi se javljaju u kretanju prihoda i troškova i njihovom usklađivanju tokom godine. Na tipičnim tursitičkim destinacijama (primorska područja, zimski centri) tražnja je najčešće skoncentisana tokom 3 ili 4 mjeseca do 6 mjeseci, što uzrokuje teškoće subjektima koji posluju na takvim područjima. Nešto je drugačija situacija u velikim gradskim centrima koji obično imaju značajno učešće poslovnih putnika i turističku ponudu koja je atraktivna za posjetioce tokom čitave godine, pa promet ne pokazuje značajne oscilacije tokom godine. Iz tog razloga (ne) likvidnost tokom određenog perioda godine je jedan od najvećih problema sa kojima se susreću kompanije u turizmu. Kako bi taj problem ublažili, u vansezonskom periodu hoteli preduzimaju razne poslovne poteze kako bi poboljšali poslovanje: proširuju asortman usluga kako bi produžili broj dana boravka gosta u hotelu, daju popuste, besplatne (gratis) dane boravka, prave specijelne ponude za kongresni turizam i slično. Neke hotelske kompanije na taj način uspijevaju više, a neke manje da ublaže sezonalnost u poslovanju.

Shodno gore navedenom, upravljanje likvidnošću je jedan od najvećih izazova menadženta turističkih kompanija. Pojam likvidnosti se često poistovjećuje sa pojmom solventnosti, što nije ispravno. Ljudi koji solventnost izjednačavaju sa likvidnošću preduzeća, a insolventnost sa nelikvidnošću preduzeća podrazumijevaju da se pojam "likvidnost" odnosi samo na brzinu unovčenja nenovčanih oblika imovine, što takođe nije ispravno. Likvidnost ima dva značenja:¹

¹ Dobrović, Ž., Tomović M., (2013), „Performance measurement in Public sector organization”, str. 96

- Likvidnost preduzeća (često se kaže i relativna likvidnost) podrazumijeva da preduzeće u svakom momentu može da plati dospjele obaveze, što znači da likvidna sredstva (gotovina u blagajni i na depozitnim računima po viđenju) moraju da budu viša ili barem jednaka dospjelim obavezama za plaćanje,
- likvidnost nenovčane imovine podrazumijeva brzinu (vrijeme) u kome se ona može transformisati u gotovinu. Zavisno od dužine vremena transformacije imovine u gotovinu, postoje stepeni likvidnosti te imovine. Gotovina u blagajni i na depozitnim računima po viđenju su likvidni i svrstavaju se u prvi stepen likvidne imovine. Kratkoročne hartije od vrijednosti i potraživanja od kupaca su drugog stepena likvidne imovine jer je potrebno kratko vrijeme da se oni unovče. Kratkoročni finansijski plasmani su trećeg stepena likvidne imovine jer je potrebno duže vrijeme da se oni unovče. Gotovi proizvodi i roba su četvrtog stepena likvidne imovine jer je potrebno još duže vrijeme da se unovče (treba naći kupca i prodati gotovi proizvod odnosno robu i treba naplatiti potraživanje od kupca) i tako redom, imovina se grupiše po stepenu likvidnosti pri čemu najniži stepen likvidnosti ima zemljište jer se ne amortizuje i time ne transformiše u gotovinu.

Na drugoj strani, solventnost označava sposobnost preduzeća da plati sve obaveze (dugove) ne o roku njihovog dospijea za plaćanje, već kad-tad, makar iz stečajne, odnosno likvidacione mase. Dakle, nelikvidnost preduzeća znači da preduzeće nije sposobno da plati dospjele obaveze, a insolventno preduzeće znači da preduzeće nije sposobno da plati dugove ni iz stečajne odnosno likvidacione mase, jer je stečajna (likvidaciona) masa manja od ukupnih dugova.

Iz predhodnog se može zaključiti:¹ likvidnost preduzeća podrazumijeva sposobnost preduzeća da plaća dugove u onom trenutku kada oni dospijevaju za plaćanje, a solventnost preduzeća podrazumijeva da je preduzeće sposobno platiti ukupne dugove ne o roku njihovog dospijea već kad- tad, makar iz stečajne (likvidacione) mase.

Problem nelikvidnosti sa sobom nosi određene troškove (kamata na pozajmljena sredstva), pa Padachi (2006) i Anup i Suman (2010) navode pozitivnu korelaciju između likvidnosti i profitabilnosti.²

¹ Matić, A., (2013), Analiza finansijskih izvještaja i projekcija budućeg poslovanja hotela Moskva”, str. 107

² Škufić, L., Mlinarić, D., (2015.) „Mikroekonomske determinante profitabilnosti hrvatske hotelske industrije“

Solventnost se mjeri odnosom poslovne imovine (poslovna imovina je manja od poslovne aktive za iznos gubitka) i ukupnih dugova (obaveza). Nema pravila koliki taj odnos treba da bude da bi se preduzeće smatralo solventnim. Ako je odnos poslovne imovine i ukupnih dugova manji od jedan, preduzeće je insolventno, jer ono, kada bi unovčilo svu svoju imovinu po vrijednostima iskazanim u bilansu (knjigovodstvena vrijednost imovine)¹, ne može da plati ukupne dugove u visini razlike između ukupnih dugova i poslovne imovine.

Kao pokazatelji likvidnosti najčešće se koriste:

- Tekući racio likvidnosti
- Racio ubrzane likvidnosti
- Trenutni pokazatelj likvidnosti
- Koeficijent finansijke stabilnosti.

Tekući pokazatelj likvidnosti pokazuje koliko su kratkoročne obaveze pokrivene kratkoročnim sredstvima, odnosno da li je moguće platiti sve kratkoročne obaveze raspoloživim kratkoročnim sredstvima. Dobija se kao količnik pozicija kratkoročnih sredstava i kratkoročnih obaveza iz bilansa stanja. Vrijednost ovog pokazatelja iznad 1 znači da kompanija u kratkom roku može izmiriti svoje kratkoročne obaveze.

Racio tekuće likvidnosti u hotelskoj industriji u Crnoj Gori u 2022. godini je iznosio 0,66, dok je na kraju 2021. godine iznosio 0,67.² Navedeni pokazatelji ukazuju na ugroženu sposobnost hotelskih kompanija da redovno izmiruju dospjele obaveze.

Ubrzani racio likvidnosti preciznije definiše mogućnost preduzeća da plaća svoje kratkoročne obaveze. Izračunava se kao količnik kratkoročnih sredstava umanjениh za zalihe, i kratkoročnih obaveza. Ubrzani pokazatelj izostavlja zalihe iz tekućih sredstava zbog toga što dio zaliha ima karakter trajno vezanih sredstava i kao takve ne mogu služiti za izmirenje tekućih obaveza, osim u slučaju prekida poslovne aktivnosti. Ubrzani racio likvidnosti u hotelskoj industriji u Crnoj Gori u 2022. godini je iznosio 0,51, dok je na kraju 2021. godine iznosio 0,50.³

Trenutni pokazatelj likvidnosti pokazuje kolika je pokrivenost kratkoročnih obaveza likvidnom kratkotrajnom imovinom, odnosno novčanim sredstvima, tačnije koliko kratkoročnih obaveza može biti odmah plaćeno raspoloživim novčanim sredstvima. Poželjno

¹ Miljević, M., (2007), Metodologija naučnog rada“, str. 147

² Analiza portala “Business intelligence consulting“ na osnovu zvaničnih finansijskih izvještaja dostavljenih Poreskoj upravi Crne Gore, <http://www.binfo.me>

³ Analiza portala “Business intelligence consulting“ na osnovu zvaničnih finansijskih izvještaja dostavljenih Poreskoj upravi Crne Gore, <http://www.binfo.me>

je da ovaj koeficijent bude veći od 0,10. Trenutni pokazatelj likvidnosti u hotelskoj industriji u Crnoj Gori u 2022. godini je iznosio 0,14, dok je na kraju 2021. godine iznosio 0,13.¹

Koeficijent finansijske stabilnosti pokazuje horizontalnu uskladenost sredstava i izvora sredstava preduzeća. Izračunava se kao odnos dugoročnih izvora i stalne imovine, a pokazuje u kojoj mjeri su stalna sredstva finansirana dugoročnim izvorima. Ovaj pokazatelj bi trebao biti veći od 1, jer se iz dijela dugoročnih izvora trebaju finansirati ne samo stalna sredstva, već i dio zaliha (trajna obrtna sredstva). Koeficijent finansijske stabilnosti manji od 1 znači da se dio stalnih sredstava finansira iz kratkoročnih obaveza, te može doći do problema u njihovom urednom servisiranju. Koeficijent finansijske stabilnosti u hotelskoj industriji u 2022. godini je iznosio 0,91, dok je u 2021. godini iznosio 0,92.

2.3. Analiza zaduženosti

Većina kompanija u hotelijerstvu tokom svog poslovanja ima potrebu za tuđim izvorima finansiranja kroz klasičan odnos s nekom finansijskom institucijom ili kroz odloženo plaćanje obaveza prema dobavljačima ili drugim povjeriocima. Ako se uzmu u obzir specifičnosti poslovanja u turizmu, a prije svega sezonski karakter poslovanja, onda je upravljanje dugom veoma značajan posao menadžmenta hotelskih kompanija, a sve u cilju normalnog odvijanja poslovnog procesa. Zaduženost preduzeća ispituje se analizom pasive bilansa stanja, s aspekta vlasništva nad izvorima finansiranja. Izvori finansiranja (pasiva) preduzeća s vlasničkog aspekta dijele se na sopstvene i pozajmljene izvore.

Najznačajniji pokazatelji zaduženosti su:

- Koeficijent zaduženosti (procenat eksternog finansiranja)
- Koeficijent samostalnosti (procenat sopstvenog finansiranja)
- Finansijska poluga (finansijska struktura)
- Odnos neto kredita i EBITDA.

Procenat eksternog finansiranja pokazuje nivo eksternog finansiranja u ukupnom finansiranju, pa se izračunava kao količnik pozajmljenih izvora (ukupnih obaveza) i ukupnih izvora (obaveze + kapital). Što je veći procenat eksternih izvora to je kompanija rizičnija i ima veći rizik solventnosti. Ranije se smatralo da optimalan iznos eksternog finansiranja kod kompanija do 50%, dok se u posljednje vrijeme ova granica ne definiše precizno, već je teorijski određena graničnom cijenom kapitala: “dodatno zaduženje je optimalno sve dok je cijena dodatne jedinice kapitala manja od graničnog prinosa

¹ Analiza portala “Business intelligence consulting“ na osnovu zvaničnih finansijskih izvještaja dostavljenih Poreskoj upravi Crne Gore, <http://www.binfo.me>

kapitala“. U hotelskoj industriji u 2022.godini ovaj pokazatelj je iznosio 56,25%, dok je u 2021. godini iznosio 56,21%.¹

Koeficijent samostalnosti, pokazuje stepen sopstvenog finansiranja, odnosno finansijsku samostalnosti kompanije izraženu kroz nivo učešća sopstvenih izvora finansiranja u ukupnim izvorima. Ovaj koeficijent na kraju 2022.godine iznosi 42,96%, dok je na kraju 2021.godine iznosio 42,49%.²

Finansijska poluga je odnos sopstvenih i tuđih izvora finansiranja, odnosno to je prikaz finansijske strukture iskazan u procentu. Vrijednost 100 znači da je odnos sopstvenih i tuđih izvora ujednačen (50:50), pa vrijednost preko 100 ukazuje na veću stabilnost i samostalnost u finansiranju. Finansijska poluga hotelske industrije u Crnoj Gori u 2022.godini je iznosila 76,36, dok je na kraju 2021. godine iznosila 75,59.

Odnos neto kredita i EBITDA je jedan od najznačajnijih pokazatelja solventnosti i nivoa kreditnog zaduženja, kao i kapaciteta za dodatnim zaduženjem. Izračunava se kao količnik svih kreditnih zaduženja umanjениh za raspoloživa novčana sredstva i dobiti prije poreza, kamata i amortizacije (EBITDA). Ovaj pokazatelj nam pokazuje odnos neto kreditne zaduženosti i izvora za otplatu tih kredita. Može se tumačiti i kao broj godina za koji kompanija može otplatiti kreditne obaveze zadržavanjem dobiti amortizacijom. Optimalna vrijednost zavisi od industrije, ali opšte je mišljenje da vrijednost preko 5 ukazuje na značajnu zaduženost. Kada je u pitanju hotelska industrija u Crnoj Gori, odnos neto kredita i EBITDA, ovaj pokazatelj na kraju 2022.godine iznosio -26,85, dok je na kraju 2021.godine iznosio 16,10.³

2.4. Analiza efikasnosti

Pri ulaganju u poslovna sredstva, preduzeće ima za cilj da obezbijedi njihovo efikasno korišćenje, odnosno da sa što manje uloženih sredstava ostvari što veći obim poslovnih aktivnosti. Finansijski aspekt obima poslovnih aktivnosti izražen je prihodima i rashodima u bilansu uspjeha, a uspostavljanjem relativnih odnosa između pojedinih pozicija prihoda i rashoda i ulaganja u poslovna sredstva dobijaju se koeficijenti obrta poslovnih sredstava. Ovih pokazatelja ima više, a u nastavku će biti objašnjeni:

- koeficijent obrta kupaca,
- koeficijent obrta dobavljača,
- koeficijent obrta zaliha,
- koeficijent obrta fiksnih sredstava

¹ Analiza portala “Business intelligence consulting“ na osnovu zvaničnih finansijskih izvještaja dostavljenih Poreskoj upravi Crne Gore, <http://www.binfo.me>

² Analiza portala “Business intelligence consulting“ na osnovu zvaničnih finansijskih izvještaja dostavljenih Poreskoj upravi Crne Gore, <http://www.binfo.me>

³ Analiza portala “Business intelligence consulting“ na osnovu zvaničnih finansijskih izvještaja dostavljenih Poreskoj upravi Crne Gore, <http://www.binfo.me>

Koficijent obrta kupaca pokazuje efikasnost u naplati potraživanja i poziciju koju kompanija ima u odnosu sa svojim kupcima. Izračunava se kao odnos broja dana u godini $(365)/(\text{Prihod od prodaje/Potraživanja od kupaca})$, pa manji broj dana doprinosi boljoj poziciji likvidnosti. Ovaj koeficijent na nivou hotelske industrije u Crnoj Gori u 2022.godini je iznosio 82, dok je u 2021.godini iznosio 91.¹

Koeficijent obrta dobavljača pokazuje stepen u kojem se kompanija može osloniti na svoje dobavljače u pri finansiranju svojih aktivnosti. Kako su odloženi rokovi plaćanja najčešće besplatni izvori finansiranja, svaka kompanija teži da ih produžiti. Koliko će u tome uspjeti zavisi od veličine kompanije, njenog položaja na tržištu i odnosa sa dobavljačima. Veći broj dana plaćanja dobavljačima znači manju potrebu za eksternim izvorima finansiranja, što u konačnom znači manje finansijske troškove. Ovaj koeficijent na nivou hotelske industrije u Crnoj Gori u 2022.godini je iznosio 123, dok je u 2021.godini iznosio 161. Upoređujući koeficijent naplate potraživanja sa koeficijentom obrta dobavljača vidimo da hotelska industrija brže naplaćuje potraživanja nego što plaća obaveze, što je odraz problema likvidnosti, kao što je prethodno opisano.

Koeficijent obrta zaliha pokazuje efikasnosti organizovanja operativnih procesa, odnosno stepen optimizacije trajnih obrtnih sredstava. Otimalan broj dana vezivanja zaliha razlikuje se među industrijama, a u okviru iste grane može se razlikovati zbog organizacije procesa, tehnoloških rješenja i slično. Manji broj dana vezivanja zaliha znači brži obrt, manju potrebu za obrtnim sredstvima, samim tim i manje finansijsko opterećenje. Koeficijent obrta zaliha u hotelskoj industriji u Crnoj Gori je visok i u 2022.godini je iznosio 220 a u 2021.godini je iznosio 285.

Koeficijent obrta (fiksnih) stalnih sredstava se izračunava kao količnik prihoda i stalnih sredstava, a još se naziva i koeficijent obrta stalnih sredstava. Govori nam o tome koliko jedinica prihoda je bilo ostvareno svakom jediniciom stalnih sredstava. Ukoliko je znatno ispod prosjeka industrijske grane u kojoj kompanija posluje to može upućivati na neiskorištenost kapaciteta, zastarjelu tehnologiju, neobučenu radnu snagu i slično. Budući da poslovanje hotelskih kompanija karakteriše visok iznos angažovanja stalnih sredstava, ovaj pokazatelj je nizak i u hotelskoj industriji Crne Gore, pa u 2022.godini iznosi 0,19, dok u 2021.godini iznosi 0,13.²

¹ Analiza portala “Business intelligence consulting“ na osnovu zvaničnih finansijskih izvještaja dostavljenih Poreskoj upravi Crne Gore, <http://www.binfo.me>

² Analiza portala “Business intelligence consulting“ na osnovu zvaničnih finansijskih izvještaja dostavljenih Poreskoj upravi Crne Gore, <http://www.binfo.me>

3. NEFINANSIJSKI POKAZATELJI USPJEŠNOSTI POSLOVANJA HOTELSKIH KOMPANIJA SA SUMARNIM FINANSIJSKIM POKAZATELJIMA

Turizam može značajno da doprinese ekonomskom položaju zemlje i blagostanju njenih građana, bazirajući se na održivom korišćenju prirodnih i kulturno-istorijskih potencijala, aktivno učestvujući u njihovom očuvanju i razvoju i stvarajući okruženje privlačno za investitore. Iz tog razloga treba brinuti o ulaganjima u turistički sektor i brzo rješavati problematična područja, kako bi nedostaci bili što manji, a sve sa ciljem unaprijeđenja turizma i turističke ponude. U sektoru turizma, najznačajnija djelatnost je hotelijerstvo. Ova djelatnost pojedinačno generiše najveći prihod i angažuje najveći broj zaposlenih. Iz tog razloga potrebno je navesti indikatore uspješnosti koji su karakteristični za hotelijerstvo.

U hotelskom poslovanju se upotrebljavaju standardizovani pokazatelji radi analize poslovanja i radi praćenja samog poslovnog rezultata. Za ove potrebe se najčešće koristi metod Jedinstveni sistem računa za hotelijerstvo (*Uniform System Accounts for the Lodging Industry*).¹ Ovaj sistem se temelji na finansijskom izvještavanju po centrima odgovornosti u hotelijerstvu, a čini ga sistemu identifikacije, razvrstavanja, organizovanja i objavljivanja podataka za sledeće poslovne segmente: sobe, hrana i piće, ostali operativni sektori, iznajmljivanje i ostali prihodi, administracija i opšti poslovi, prodaja i marketing, upravljanje nekretninama i održavanje, uslužni program, naknade menadžmentu, naknade za zakup i osiguranje, vešeraj, kafiterija za zaposlene i troškovi zarada.²

Pored finansijskih pokazatelja koji su detaljno objašnjeni u prethodnom dijelu rada, slijede pokazatelji koji se ne mogu naći u bilansima stanja i uspjeha, ali zato utiču na nivo prihoda, troškova, potraživanja, obaveza, te ostale bilansne kategorije koje se nalaze u ovim finansijskim izvještajima:

- ostvareni broj noćenja gostiju,
- ostvareni broj dolazaka/ odlazaka,
- prosječan broj dana boravka gosta u hotelu,
- prosječna (vanpansionska) potrošnja gosta,
- struktura gostiju,
- prosječna cijena noćenja,
- prosječna zauzetost kapaciteta,
- ADR (prosječna cijena smještajne jedinice),

¹ Vrtiprah, V., Pavlić I., (2005), „Menadžerska ekonomija u hotelijerstvu“, str. 228

² Mirceska, I., (2014), „Financial reporting by segments of the hotel industry“, str. 287-288

- RevPAR (prihod po raspoloživoj sobi).

Svaki od navedenih pokazatelja utiče pozitivno ili negativno na poslovni rezultat kompanije u oblasti turizma. Veći broj noćenja je pretpostavka većeg prihoda hotelske kompanije. Isto tako, veći broj dolazaka gosta pretpostavlja ostvarenje većeg prihoda. Ipak, svaki hotel teži da gost koji dođe ostane što duže u hotelu jer pored toga što se time povećava prihod od svakog gosta pojedinačno, to utiče i na smanjenje troškova. Hotelska kompanija će imati manje troškove ako jedan gost ostane u hotelu dva dana, nego dva gosta po jedan dan, što je rezultat troškova koji nastaju nakon svakog odlaska gosta (generalno čišćenje soba).

Hotelske kompanije u cilju zadovoljenja potreba gosta imaju brojne dodatne sadržaje koji su na raspolaganju gostu. Neki od tih sadržaja su besplatni za gosta, a neki ne. Sadržaji tipa wellness & spa centra, teretane, parkinga najčešće su besplatni, mada ima primjera da se ti sadržaji dodatno naplaćuju. Dok se ugostiteljske usluge, takozvanih *ala cart* restorana, koji postoje u svim hoteima, po pravilu dodatno naplaćuju. Shodno tome, kompanija nastoji da poveća potrošnju gosta, te ga na razne načine motiviše da što više novca potroši na sadržaje u hotelu u kome odsjedne. Ovi sadržaji su najčešće dostupni i za goste koji nijesu smješteni u hotelu, pri čemu se tada uvijek plaćaju.

Struktura gostiju (strani i domaći gosti) može, ali ne mora, biti faktor uspješnosti poslovanja. Ipak, turizam kao grana nastoji da privuče što veći broj stranih gostiju, čime se ostvaruje pozitivan efekat, kroz priliv deviza. Smatra se da je bolje da kompanija ostvari što više noćenja i prihoda od stranih gostiju, mada to, ne znači veći prihod jer se najčešće ne vodi cjenovno diskriminatorska politika po kojoj strani gosti plaćaju višu cijenu.

Prosječna cijena noćenja je nešto što, bez izuzetka, utiče na veći prihod, pri istom ostvarenom broju noćenja. Tako da svaka kompanija nastoji da postigne što veću prosječnu cijenu. Ipak, kada su u pitanju hoteli na primorju i u zimskim ski centrima, u periodima van sezone, hotelske kompanije daju značajne popuste kako bi privukle goste odnosno pridružile period rada hotela. Hoteli u velikim gradovima najčešće ne moraju da vrše prilagođavanja kao rezultat posjete velikog broja poslovnih gostiju, te kontinuirane atraktivnosti velikih gradskih centara za goste.

Prosječna zauzetost kapaciteta je takođe jedan od najvažnijih faktora uspješnosti hotelske kompanije. Ako u obzir uzmemo ranije navedenu činjenicu da hotelske kompanije ostvaruju izuzetno visoko učešće fiksnih troškova u ukupnim troškovima, onda očekivano veća popunjenost kapaciteta pod uticajem ekonomije obima znači bolje poslovne rezultate za hotel.

ADR (prosječna cijena smještajne jedinice) – izračunava se stavljanjem u odnos godišnjeg prihoda smještaja i godišnjeg broja prodajnih smještajnih jedinica.¹

RevPAR (prihod po raspoloživoj sobi) – izračunava se kao proizvod ADR-a i godišnje zauzetosti soba.

U ranijem izlaganju istaknut je značaj adekvantnog broja i strukture zaposlenih i turizmu i hotelijerstvu, jer oni u znatnoj mjeri utiču na zadovoljstvo gosta, te njegovu odluku da ponovo koristi usluge iste hotelske kompanije. Kako je hotelijerstvo izuzetno sezonalnog karaktera, preduzeće treba da odredi broj zaposlenih shodno obimu posla u hotelu, odnosno shodno popunjenosti kapaciteta. Tako će za vrijeme ljetne sezone hotel zapošljavati veći broj zaposlenih, jer u tom periodu očekuju veću uposlenost, a samim tim i prihod. Takođe, treba voditi računa o strukturi zaposlenih, odnosno o stručnoj spremi, te potrebnim kvalifikacijama koje treba da imaju za obavljanje određene vrste posla. Često nije lako naći zaposlene, naročito one koji se angažuju tokom ljetnje sezone sa potrebnim kvalifikacijama, pa je adekvatna ravnoteža između stalnih i sezonskih zaposlenih veoma bitna za uspješno poslovanje, a imajući u vidu i najnovije trendove u problemima sa obezbjeđivanjem kvalifikovane radne snage, treba već sada ozbiljno pristupiti rješavanju tog problema koji je dobrim dijelom opšteg karaktera.

Konačno, možemo zaključiti da su za hotelsko poslovanje od suštinskog značaja sljedeći kvalitativni i kvantitativni faktori:

- briga o gostima, kako bi oni bili maksimalno zadovoljni,
- kvalitetna radna snaga i svakako
- ostavereenje pozitivnog neto rezultata.

Ukoliko su zadovoljena sva tri faktora, može se smatrati da hotelska kompanija, ne samo što pozitivno posluje, već ima preduslove za uspješno i odživo poslovanje.

Poslovanje hotelskih kompanija u Crnoj Gori sumirano je u tabeli koja slijedi:

Tabela 2: Pokazatelji uspješnosti poslovanja hotelskih kompanija u Crnoj Gori

Pokazatelj	2022.g.	2021.g.
EBITDA	75,20 miliona	35,78 miliona
Bruto profitna marža	65,55%	66,99%

¹ Pletikosa, D., Akalović-Antić, J., (2015), “Investicije i profitabilnost hotela u Hrvatskoj”, str. 102

Dobit	- 8,9 miliona	- 35,70 miliona
ROA	Bez prinosa	Bez prinosa
ROE	Bez prinosa	Bez prinosa
Racio tekuće likvidnosti	0,66	0,67
Trenutni racio likvidnost	0,14	0,13
Ubrzani racio likvidnosti	0,5	0,51
Koeficijent zaduženosti	56,25	56,21
Koeficijent samostalnosti	42,96	42,49
Koeficijent obrta kupaca	82	91
Koeficijent obrta dobavljača	123	161
Koeficijent obrta zaliha	220	285
Koeficijent obrta fiksnih sredstava	0,19	0,13

Kao što se može vidjeti u tabeli, hotelska industrija u Crnoj Gori je u prethodne dvije godine ostvarila negativan rezultat (poslovanje sa gubitkom), pa nije ostvarne prinos na aktivu, niti prinos na kapital. Kao rezultat izrazite sezonalnosti, koeficijenti likvidnosti su vrlo niski i kao takvi ispod poželjnih vrijednosti. Kada je u pitanju struktura pasive, odnos sopstvenih i pozajmljenih sredstva je umjereno u korist pozajmljenih sredstva. Kada su u pitanju pokazatelji aktivnosti, isti su odraz problema nelikvidnosti, pa su koeficijenti obrta dobavljača značajno veći od koeficijenta obrta kupaca. Koeficijent obrta fiksnih sredstava je nizak i rezultat je izuzetno velikih ulaganja hotelskih kompanija u fiksna sredstva.

ZAKLJUČAK

Turizam je u Crnoj Gori strateška grana privrede, usljed koje zemlja svake godine ostvari sve veći priliv sredstava. Ukupan doprinos turizma BDP-u Crne Gore iznosi oko 30%. Međutim, turizam u Crnoj Gori je niskoprofitabilna grana, a naročito hotelijerstvo kao djelatnost sa izuzetno visokom iznosima ulaganja u osnovna sredstva, te visokom fiksnim troškovima poslovanja. Specifičnost turističkog poslovanja ogleda se u relativno kratkom vremenu trajanja proizvodnih i uslužnih procesa, diskontinuiranom toku radnih procesa, proizvodnji za potrošnju koja će se odmah izvršiti ili u kratkom roku. Jedan od glavnih problema u poslovanju kompanija iz sektora turizma je i nemogućnost stalnoga

usklađivanja broja zaposlenih i nivoa uposlenosti kapaciteta, elastičnosti radnog vremena, sezonskom radu, potrebi diferenciranja prodajnih cijena hotelskih usluga, tj. stalno prilagođavanje potrošnje, a sve u cilju što efikasnije uposlenosti poslovnih sredstava.

Poslovanje ove grane otežava sezonski karakter djelatnosti, usljed koga dolazi do problema novčanog jaza. Sezonalnost turizma Crne Gore je izražena više nego kod ostalih mediteranskih zemalja. Prema zvaničnim podacima, tokom jula i avgusta ostvari se blizu 65% ukupnog godišnjeg prometa u hotelijerstvu, dok se tokom ostalih 10 mjeseci ostvari oko 35% ukupnog godišnjeg prometa. Problem novčanog jaza odražava se u nezadovoljavajućim pokazateljima likvidnosti kompanija koje posluju u sektoru hotelijerstva. Kao rezultat toga imamo izuzetno dug period plaćanja dobavljačima i potrebu za finansijskim sredstvima kako bi se prevazišao problem novčanog jaza. Turizam, a naročito hotelijerstvo, karakterišu i visoki iznosi ulaganja u stalnu imovinu usled čega se takođe stvara potreba za finansijskim sredstvima. Turizam generalno, pa i u Crnoj Gori, karakteriše nizak koeficijent obrta stalnih sredstava, što je rezultat visokih ulaganja u stalna sredstva i visok stepen učešća troškova radne snage u ostvarenom prihodu, što je rezultat činjenice da je turizam radno intenzivna djelatnost. Pored standardnih pokazatelja uspješnosti, u sagledavanju hotelskog poslovanja upotrebljavaju se još neki pokazatelji koji se ne mogu naći u bilansima stanja i uspjeha, ali utiču na nivo prihoda, troškova, potraživanja, obaveza, te ostalih bilansnih kategorija: ostvareni broj noćenja gostiju, ostvareni broj dolazaka/odlazaka, prosječan broj dana boravka gosta u hotelu, prosječna (vanpansionska) potrošnja gosta, prosječna cijena noćenja, prosječna zauzetost kapaciteta, ADR (prosječna cijena smještajne jedinice), RevPAR (prihod po raspoloživoj sobi).

Shodno svemu navedenom, za dalji razvoj i rast hotelske industrije potrebna je snažnija podrška države kako bi se riješili sistemski problemi, prije svega izražena sezonalnost. Kako se naš turizam oslanja dominantno na prirodne resurse (sunce i snijeg), uspješnost ljetnje, a posebno zimske sezone zavisi od vremenskih faktora. S toga je potrebno više raditi na diversifikaciji turističke ponude i osmišljavanju sadržaja koji bi privlačili goste tokom čitave godine. Pored navedenog, za uspješnost poslovanja našeg turizma, a samim tim i hotelskih kompanija od velikog uticaja je saobraćajna dostupnost i komunalna infrastruktura. U prethodnom periodu nije dovoljno rađeno kako bi se otklonila uska grla u tom pogledu, usled čega kvalitet usluge koju gost, naročito visoko platežni, očekuje u Crnoj Gori nije na zadovoljavajućem nivou. Rješavanje ovih problema pozitivno bi uticalo na turistički sektor generalno, a naročito na hotelijerstvo.

Shodno svemu prethodno navedenom, hipoteza koju smo postavili na početku rada: „Hotelijerstvo u Crnoj Gori je niskoprofitabilna grana privrede“ se potvrđuje.

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SPECIFICITY OF BUSINESS OF HOTEL COMPANIES IN MONTENEGRO

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ABSTRACT:

The importance of tourism for the economic and social development of Montenegro gives special importance to the business of hotel companies in our country. Bearing in mind that the hotel industry is one of the significant generators of tourism growth and development, and that despite this fact it is not recording the expected results, in this paper we will focus on the potential reasons for such a situation. At the same time, we will analyze the specifics of the business of hotel companies in our country as well as the peculiarities of the hotel business, all with the aim of providing possible answers to the present dilemmas and pointing out some of the possible solutions.

Keywords: tourism, analysis, profitability, hotel industry

SAVREMENE TEMDENCIJE U TURIZMU

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SAŽETAK: *Savremeni razvoj turizma uslovljen je naglim i kontinuiranim promjenama turističke tražnje. Nosioci turističke ponude imaju zadatak da se konstantno prilagođavaju novonastalim izazovnim situacijama na turističkom tržištu. Savremene tehnologije, prije svega internet, dovele su do promjene u načinu poslovanja i omogućile postojećim i potencijalnim korisnicima turističkih usluga lakšu i bržu dostupnost neophodnim informacijama.*

Postojeći selektivni vidovi turizma sve više dobijaju prostor na dinamičnom turističkom tržištu, dok se otvara prostor za afirmaciju novih selektivnih vidova turizma, u skladu sa inoviranim i istraživački podstaknutim željama i potrebama turista. Savremeni potrošač na turističkom tržištu postaje sve zahtjevniji, što nastaje kao posljedica djelovanja savremenih tehnologija.

Distribucija informacija širom svijeta, vršenje promocije i druge marketinške aktivnosti, pojednostavljene su korišćenjem online mogućnosti koje era digitalizacije donosi sa sobom.

U radu će biti ukazano na promjene koje je era digitalizacije donijela, povlačeći paralelu između tradicionalnog, masovnog vida turizma i selektivnih vidova turizma.

Ključne riječi: *digitalizacija, savremeni trendovi, selektivni vidovi turizma*

1. UVOD

Promjene turističke tražnje uslovile su promjene u turističkoj ponudi, što je dalje uslovalo savremeni razvoj turizma. Tržišni izazovi zbog naglih i kontinuiranih promjena na ovom polju, a prvenstveno zbog sve veće primjene informacione tehnologije i uspostavljanja elektronskog vida turističkog poslovanja, zahtijevali su prilagođavanje istim u svrhu zadovoljavanja potreba turista. Imajući u vidu ne samo zadržavanje postojećih već i privlačenje novih turista, nosioci turističke ponude su „dotakli vrh“ konkurentskim nadmetanjima, ali ovog puta u svrhu prevazilaženja očekivanja turista. U pomenutom je značajnu ulogu odigrala upravo primjena informacionih tehnologija, koja im je omogućila daleko doseganje „dobrog glasa“, pa samim tim učinila uslugu lakše promotivnom i dostupnom.

Funkcionisanje turističke djelatnosti je u XXI vijeku doživjelo snažne transformacije. Od privilegije elitne klase pa do primarne potrebe da se otputuje, putovanje je postalo selekcija niza individualnih zamisli, prohtjeva, težnji i potreba. Da bi doživljaj turiste bio

upotpunjen, a imajući u vidu individualnost njegovih želja i htjenja, pored masovnog turizma razvijen je i selektivni turizam kroz mnoštvo svojih oblika. Kao takav, kreirao je dinamično turističko tržište želeći da udovolji sve zahtjevnijim potrebama savremenih potrošača, što se opet dovodi u vezu sa konkurencijom kao posledicom djelovanja i primjene informacionog poslovanja. Brza distribucija, takoreći „on-line“ distribucija informacija širom svijeta i globalna promocija rezultat su ere digitalizacije, čije su posledice ne samo vidne već i osjetne.

Da bi rad u ovom kontekstu bio sveobuhvatan, segmentiran je kroz opšte savremene tendencije na polju turizma, kao vodećoj grani XXI vijeka, a potom primjenu informacionih tehnologija i uticaj istih na konkurenciju između nosioca turističke ponude i, na kraju, uzroke pojave i, uopšte, otvaranje prostora za afirmaciju selektovanih vidova turizma.

2. KARAKTERISTIKE SAVREMENOG TURIZMA

Male mogućnosti za putovanjima, kao privilegija određenih društvenih klasa, u periodu između kraja XIX i početka XX vijeka, doživljavaju prve značajne promjene sredinom XX vijeka. Masovna putovanja postaju okosnica turizma i sve više se stavlja akcenat na socijalnu potrebu za putovanjem, što dalje razvija ovu privrednu granu do nivoa najznačajnije grane za rast državnih prihoda.

Situacija se još drastičnije mijenja u XXI vijeku, kada dolazi do segmentacije turističkog tržišta. Primorje više nema primat jer razvoj selektivnih oblika turizma, sa svrhom kreiranja što specifičnijih ponuda, prevazilazi želje i očekivanja potrošača.

2.1. Turizam kao vodeća grana XXI vijeka

Tek početkom XXI vijeka, turizam poprima srazmjere savremenog turizma, što podrazumijeva porast segmentacije turističkog tržišta, prvenstveno kroz razvoj specifičnih oblika turističke ponude. Težnjama da se promovišu specifične destinacije, odnosno „nikad viđena odredišta“, neafirmisana i potpuno turistički diskriminisana područja, preuzelo je primat u realizaciji turističkih ciljeva, što je dalje uslovalo razvoj ekstremnog turizma. Upravo ovakvim turističkim ponudama se na najbolji način odgovorilo na potrebe potrošača, prvenstveno zbog razlika u turisti potrošači nekad i sad. Tačnije, savremeni turista-potrošač ima mnogo veće zahtjeve i prohtjeve a prije svega „vapi“ za većim brojem informacija u svrhu traganja za najpoželjnijom i najprimamljivijom a uz to i povoljnom destinacijom.

Nesumnjivo je uticaj informacione tehnologije ostavio efektivne posledice na turizam, jer savremene turiste interesuje upoznavanje destinacije i prije samog putovanja. Turistička ponuda posredstvom turističkih agencija je značajno unaprijeđena pa je razvojem turističke inicijative i receptive na jednostavniji, efikasniji i turistima prihvatljiviji a ujedno i savremeniji način, prošireno turističko tržište. Uticaj tehnologije je nesumnjivo umanjio turističke troškove, ali i savremenost „nosi sa sobom“ potencijalne posledice ukoliko se turističko mjesto ne ispromoviše na realan i objektivan način. Konkretno,

subjektivnost podrazumijeva „lične percepcije potencijalnih turista, koje je moguće predvidjeti samo kontinuiranim istraživanjem njihovih stavova”¹, zbog čega “predstavljaju izuzetno nestabilnu kategoriju, jer učesnici turističkih kretanja predstavljaju ljude sa različitim karakteristikama ličnosti”².

Krajnje posmatrano, globalne tendencije u svrhu turističkog razvoja fokusirale su sve snage ka preferencijama savremenih turista, a kako turističko mjesto kao „kreacija doživljaja i događaja“ odgovara potrebama savremenih potrošača, to je i turizam postao vodeća grana XXI vijeka. Kompleksnost u dijelu savremene konotacije je očita u potrebi pronalaska integrisanog pristupa potrošaču kako bi se ponudio vrhunski kvalitet, dijametralan i izazovan u odnosu na neku drugu turističku ponudu, jer „danas gost traži „ono nešto više“ što zahtijeva integrisan pristup u traženju ličnog identiteta, na putu od prepoznavanja sopstvenih komparativnih prednosti, preko izbora atraktivnog asortimana ponude, kroz oblikovanje prodajne poruke i zaštitnog znaka, pa sve do pronalaska tržišno prihvaćenog i prepoznatljivog brenda”³.

2.1.1. Uticaj primjene ISO standarda u savremenoj konotaciji razvoja turizma

Kao najbrže rastući ekonomski sektor u svijetu, sa kontinuiranim rastom koji ostvaruje na svom turističkom tržištu, a posmatrajući na međunarodnom i svjetskom nivou, savremeni turizam je „povlačio za sobom“ potrebu za inovacijama i brojnim poslovnim izmjenama. Razlog tome je upravo u praćenju savremenih trendova, što je prvenstveno bilo uslovljeno zahtjevima potrošača, odnosno obavezama stavljanja klijenta u fokus. Pružanjem kvalitetne usluge, sa jedne strane i dobrim rukovođenjem, sa druge strane, turistički agensi su vršili i vrše uticaj na dalji razvoj turističkih proizvoda u okviru sopstvene ponude, što je u globalu izvršilo uticaj na nastanak i razvoj brojnih destinacija.

Međutim, ako uzmemo konkurenciju i posledice iste kao izazov i analiziramo značaj kvaliteta za turistički doživljaj klijenta i turistički profit, to je uvođenje ISO 9001 standarda podrazumijevalo uvođenje „sigurnog kvaliteta“ u turističku ponudu i rad nosilaca turizma. Tačnije, definisan je kao „standard koji se može primijeniti na organizaciju bilo koje veličine, bez obzira na oblast poslovanja”⁴ i za koji se mogu podjednako opredijeliti turističke agencije, wellness i spa centri, veliki hotelski lanci i kompanije, hoteli koji posluju samostalno kao i manji ugostiteljski objekti. Prvenstveno,

¹ Stojanović, J. (2014) Savremene tendencije u turizmu, *Sinteza (Međunarodna naučna konferencija Univerziteta Singidunum*, Beograd: Univerzitet Singidunum, str. 739.

² Ibid.

³ Damjanović, A. i Ristić, Z. (2017) Savremeni trendovi koji utiču na izbor turističke destinacije, *Naučna Konferencija sa međunarodnim učešćem – Jahorinski Poslovni Forum – Strateški izbori i održivi razvoj turističkih destinacija*, Jahorina, str. 345.

⁴ Preuzeto sa: [ISO standardi u turizmu](#) | [TT Group](#) | [TT Group \(tt-group.net\)](#)

posmatrajući poglavlja¹ ovog standarda, ako uzmemo u obzir obavezivanje organizacije da odredi važna unutrašnja i spoljašnja pitanja, od značaja za planiranje sistema kvaliteta, a potom i odrede ulogu posloводства u stvaranju i podržavanju opstanka samog kvaliteta, to ukazuje na kvalitet liderstva i konteksta jedne turističke organizacije odnosno nosioca turističke ponude. Postavljanjem zahtjeva da planiraju svaku promjenu sistemski i analitično, imajući u vidu kompleksnost iste kroz infrastrukturu, sredstva, osposobljenost i svijest zaposlenih, komunikaciju i dokumentovane informacije, neminovno je kvalitetno funkcionisanje kroz operativno djelovanje i nadzor.

Međutim, svaka organizacija mora vršiti i vrednovanje svojih performansi, odnosno zadovoljstva potrošača, usklađenosti proizvoda sa uslugama, usklađenosti sistema upravljanja, sprovođenja samog procesa, jer ovom analizom mogu utvrditi pojavu potencijalnih rizika ali i postojeće rizike. Sve navedeni elementi, kao poglavlja koja nameću ISO standardi, obavezuju nosiociće, u ovom slučaju turističke djelatnosti, da konstantno poboljšavaju uspostavljeni sistem kvaliteta. Stoga su, kao primjenljivi u turizmu, definisani sledeći ISO standardi:

- ISO 9001 – međunarodni standard koji se bavi kvalitetom poslovanja;
- ISO 14001 – međunarodni standard koji se bavi zaštitom životne sredine;
- ISO 22000 – međunarodni standard za upravljanje bezbjednošću hrane;
- ISO 27000 – međunarodni standard koji se odnosi na zaštitu i bezbjednost informacija;
- ISO 13810 – specijalizovani standard za turizam.²

Standardizacijom kriterijuma za obavljanje djelatnosti povezale su se brojne turističke organizacije širom svijeta, što je osiguralo kvalitet ponude, a raznolikost u pogledu izbora destinacije ostala je samo „puki“ izbor potrošača usklađen sa njegovim prohtjevima, potrebama i željama.

Kvalitetan menadžmenta, a potom i kvalitet usluge, presudni su činioci opstanka turističkih agencija i nosilaca turističke ponude uopšte. Konkurencija je dovela do brojnih izazova na ovom polju, zbog čega je orijentir sa zadovoljstva potreba potrošača pretočen u orijentir prevazilaženja očekivanja potrošača, odnosno konzumenata turističkih usluga.

¹ Oruč, M., Agić, D. i Delić, N. (2016) Značaj i promjene ISO 9001, *XI Naučno/stručni simpozij sa međunarodnim učešćem „Metalni i nemetalni materijali“*, Zenica, BIH, str. 3. Preuzeto sa: [\(PDF\) ZNAČAJ I PROMJENE STANDARDA ISO 9001 SIGNIFICANCE AND CHANGES OF THE STANDARD ISO 9001 \(researchgate.net\)](#)

² Preuzeto sa: [ISO 9001 QMS | ISO STANDARD](#); [ISO standardi u turizmu | TT Group | TT Group \(tt-group.net\)](#)

Međutim, zajednička odrednica svih jeste upravo u usmjerenosti na korisnika i definisanje kvaliteta rada shodno zadovoljavanju potreba i očekivanja istih. Objektivno posmatranje sopstvenog poslovanja i reakcije na uočene nedostatke okidač su napretka ukoliko organizacija djeluje ka otklanjanju istih i unapređenju sopstvenog poslovanja. Rezultat takvog djelovanja su dugotrajno kvalitetni učinci poslovanja, poput povećane potrošačke vrijednosti i zadovoljstva klijenata, poboljšanog ugleda turističkog nosioca kroz lojalnost klijenta i proširenu bazu istih, a potom i kroz prihod, kao krajnji benefit.

Imajući u vidu da je prikupljanje podataka za analizu trenutnog statusa poslovanja i kreiranje koraka za dalji napredak od ključne važnosti, primjenom ISO standarda se podrazumijeva da sistem djeluje kao preventivno sredstvo, a ne kao sistem koji kreira preventivne mjere, što dalje uslovljava nosioca turističke ponude da definiše i sprovodi takve mjere da se rizici dovedu na prihvatljiv nivo.¹ Konstantna razmjena informacija, znanja i iskustava, uz statističke analize poslovanja, uvode nosioca turističke ponude u plansko kreiranje aranžmana, a uz efikasnu eksploataciju resursa u svrhu kvalitetnog upravljanja procesom. Kompleksnost kreiranja aranžmana koji će donijeti benefite i „namamiti“ potrošače, pa potom održati njihovu lojalnost, ogleda se u prevashodnoj analizi ciljne grupe ka kojoj treba da se usmjeri, izboru kvaliteta na koji želi da se usredsredi kako bi istakla kvalitet same turističke destinacije i konkretizaciji ponude kroz „balans planske i dostupne“ vrste usluga.

Ukoliko primjenu ovog standard posmatramo sa aspekta savremenosti, a imajući u vidu globalni značaj turizma, razlog kako uvođenja a tako i primjene standarda u savremenom poslovanju posledica je uvida turističkih menadžera da je kvalitet primarni i strateški cilj. Kako konkurencija i kvalitet usluga prelaze granice zemalja, odnosno kako je trend turističkih usluga, na globalnom tržištu, takav da je konkurencija sve veća, a zahtjevi korisnika promijenjeni, brz rast je uveo nove perspektive za upravljanje kvalitetom, odnosno nove standard.²

2.2. Uticaj savremene tehnologije na razvoj turizma

Turistička djelatnost se značajno mijenjala sa tehnološkim promjenama, kako sa aspekta povoljnosti po same turiste u pogledu izbora destinacije, tako i sa aspekta poslovanja subjekata turističkog sektora. Plasirane „internet informacije“ objedinile su brojne turističke ponude u smjeru ranog ostavljanja utiska na turiste, bilo da se radi o vizuelnom utisku o destinaciji ili auditivnom utisku o kvalitetu usluga iste. Nekada razgledani

¹ Marković, B. (2014) Slijedeća verzija standarda ISO 9001: 2015-Refleksije na QMS Vazduhoplovne kompanije, *2nd International-Scientific Conference, COMET-a 2014*, Jahorina, BiH, str. 613-620.

² Lazić, J., Cvijanović, J. i Ljumović, I. (2013) *Međunarodni standardi upravljanja kvalitetom u turizmu*. HiT menadžment: menadžment u hotelijerstvu i turizmu, str. 36-46. Preuzeto sa: [Međunarodni standardi upravljanja kvalitetom u turizmu | Semantic Scholar](#)

turistički vodiči, razglednice, katalozi sa sajмова ili prezentacije raznog vida zamijenjeni su sveobuhvatnim pregledom usluge jedne turističke destinacije putem web sajta ili društvenih mreža. Rastom konkurencije a većim zahtjevima od strane turista, destinacije kreiraju svoju web sajt viziju, u zavisnosti od specifičnosti koje žele da istaknu, segmenata koje žele da ispromovišu i momenata koje žele da podijele. Možda je najbolji opis sadašnje mogućnosti izbora destinacije upravo nikad realniji uvid u neku od njih, a bez prethodne posjete istoj.

Poseban izazov promotivnog tipa jeste internet forum, jer su, bez obzira na različitost turista, mišljenja, savjeti i preporuke, potencijalnim turistima od presudne važnosti pri izboru lokacije odnosno destinacije. Tuđi proživljen izazov je uglavnom motiv više za obilazak neke od njih ili okidač za orijentaciju ka drugoj turističkoj adresi, ali ono što je neminovno jeste da su „online“ rezervacioni sistemi olakšali proces kupovine turističkih aranžmana¹. Efektivno širenje turističkog tržišta, na osnovu intenzivne upotrebe savremene tehnologije od strane turističkih subjekata, podrazumijeva proširen plasman turističkih proizvoda, što je ujedno i posledica velike konkurencije. Karakteristična crta promjene, a i dalje opstanka u digitalizovanom svijetu, je postepeni prelazak sa intermedijacije, odnosno globalnog distribucionog sistema, na dezintermedijaciju, odnosno primjenu brendiranih web sajtova i sistema za bukiranje.² Sopstvene investicije u digitalni marketing su uslov kontinuiranog napretka današnjice. Posmatrajući primjenu informacione tehnologije kao segment organizacije, a kako svaka turistička organizacija ili agencija teži unapređenju organizacionih sposobnosti u cilju poboljšanja performansi, to i kvalitet primjene treba svesti na savremeno-prihvatljiv nivo. Kako savremene tehnologije igraju vrlo važnu ulogu u promociji jedne turističke destinacije, a tržište sve više zahtijeva inovativnost i diferentnost, to kreativnost i originalnost turističke ponude dolaze do izražaja.

Najčešće primjenjivani jesu elektronski kanali distribucije, čija primjena jeste koliko izazov toliko i prijetnja, ukoliko se ne primjenjuju i dalje tradicionalni posrednici turističke razmjene informacija. „Pakovanje“ usluge elektronski danas podrazumijeva ponudu brojnih povlastica, nagrada, iznenađenja, sa jedne strane, ali i promociju destinacije na nesvakidašnji način, sa druge strane. Biti interesantan i primamljiv potrošačima je možda jedan od primarnih ciljeva, ali se nikako ne smije zaobići razvoj odnosa zasnovanog na povjerenju i obostranoj koristi. Čak i u težnji da se savremena tehnološka sredstva maksimalno iskoriste na neuobičajen i svrsishodan način, mora se ispoštovati jasan pravac koji nosilac turističke ponude zauzima odnosno mora se ispoštovati realno putovanje ka realizaciji definisane misije i vizije.

Novi elektronski posrednici, a biće ih još, treba da „podstaknu“ nosioca turističke ponude da kreira poželjan ambijent i poželjnu turističku uslugu, a nikako da ispromoviše

¹ Stojanović, J. (2014) Savremene tendencije u turizmu, *Sinteza (Međunarodna naučna konferencija Univerziteta Singidunum*, Beograd: Univerzitet Singidunum, str. 740.

² Thakran, K., & Verma, R. (2013) The Emergence of Hybrid Online Distribution Channels in Travel, *Tourism and Hospitality*. Cornell Hospitality Quarterly, 54, str. 240-247.

postojeći/u na nerealan i imaginaran način. Ono što je značajno jeste baš to da su informaciono-komunikacione tehnologije dovele do značajnog poboljšanja interne organizacije turističkog agenasa, jer je došlo do integracije njihovih back-office funkcija, odnosno računovodstva, praćenje provizija, personala, sa jedne i front-office funkcija, odnosno istorije klijenata, sastavljanja maršuta, izdavanja karata i komunikacije sa dobavljačima, sa druge strane.¹ Nekada „štura“ a danas bogata ponuda informacijama, koliko je promovisala brojne turističke aranžmane i same destinacije, toliko je ozbiljno ugrozila poslovanje tradicionalnog tipa. Krupne promjene je uslovlila primjena informacione tehnologije na turističkom tržištu, a najviše u distribucije proizvoda i usluga potrošačima. Tačnije, alati informacionih tehnologija, u zavisnosti od vrste primjene istih od strane turističke agencije, organizacije ili samog preduzeća, omogućili su onlajn pristup informacijama, a i bukiranje smeštaja, avionskih karata i izvršavanja brojnih drugih aktivnosti on-line putem.² Udar na tradicionalni način poslovanja je bio neminovan, a u najavi je i dalje.

Savremene tehnologije su preoblikovale turističko tržište, a što su se dinamičnije razvijale to je i dinamičnije bilo oblikovanje turističke ponude. On-line distribucija je potpuno izbrisala razlike u geografskom dometu između globalnih trendova, jer je direktni marketing putem interneta, kao globalnog distribucionog sistema, popularizovao turističke usluge.³ Da „teret“ savremenog, po štetu tradicionalnog, bude veći, kreirane su i brojne aplikacije koje su olakšale pristup izboru i kupovini turističkih usluga, čineći neke nosioce turističke ponude većim liderima u odnosu na druge i zadajući zadatak drugima da jasno kreiraju lidersku viziju. Shodno navedenom, turističko tržište nije samo preoblikovano već je i znatno izmijenjena konkurentska struktura istog. „Dok se internet, sam po sebi, sa skoro besplatnim pristupom i standardizovanim tehničkim znanjem ne može smatrati izvorom konkurentске prednosti, ono što značajno utiče na sticanje iste, jeste onlajn vidljivost koju može imati samo ograničeni broj kompanija koje se nalaze u vrhu liste rezultata na pretraživačima, prilikom pretrage turističkih sadržaja.“⁴

Indirektno su savremene tehnologije, a zbog kreiranje konkurentnog ambijenta i rasta inovativnih potreba, nosioce turističke ponude stavile na provjeru:

¹ Bethapudi, A. (2013) The Role of ICT in Tourism Industry. *Journal of Applied Economics and Business*, p.p. 67-79.

² De Carlos, P., Araujo, N., & Fraiz, J. (2015) The New Intermediaries of Tourist Distribution: Analysis of Online Accommodation Booking Sites. *The International Journal of Management Science and Information Technology (IJCSIT)*, p.p. 39.

³ Thakran, K., & Verma, R. (2013). The Emergence of Hybrid Online Distribution Channels in Travel, *Tourism and Hospitality*. *Cornell Hospitality Quarterly*, 54, 241-242.

⁴ Smithson's, S., Device, C., & Lapiedra, R. (2011) Online visibility as a source of competitive advantage for small- and medium-sized tourism accommodation enterprises. *The Service Industries Journal*, p.p. 1573-1587. In: Jović, J. (2017) *The impact of ICTs on re-shaping of tourism market in Serbia*, Novi Sad: Fakultet za sport i turizam, TIMS Acta 11, str. 8.

- adekvatne i pravovremene usmjerenosti na realne, jasne i precizne poslovne ciljeve;
- efektivne mjerljive pokazatelje zadovoljstva postojećih klijenata u svrhu sticanja i učvršćavanje povjerenja kod njih i sticanja potencijalnih klijenata;
- sopstvene potencijalne i prednosti u skladu sa tržišnom tražnjom i mogućnostima;
- postojeće motivacije za daljim razvojem i provjere odgovornosti zaposlenih i
- realnih pokazatelja ostvarenih troškova i profita.

2.2.1. Pojačana konkurencija na turističkom tržištu kao posledica primjene savremenih informaciono-komunikacionih tehnologija

Da klijenti sve veći dio svojih turističkih potreba zadovoljavaju preko internet je očita slika, koja pretenduje daljem razvoju inovacija na ovom polju. S tim u vezi, dovodi se u pitanje djelovanje tradicionalnih turističkih agencija, odnosno agencija koje nijesu u stanju da se prilagode izazovima savremenom doba i izazovima dinamičnog tehnološko-informacionog okruženja, zbog čega će vjerovatno biti istisnute sa turističkog tržišta. Razlozi otežanog prilagođavanja, bez obzira na volju i želju da se prilagode, jesu i manjak finansijskih sredstava za značajna ulaganja u hardver, softver, obuku zaposlenih za rad sa novim tehnologijama ili angažovanje stručnih lica. Njihov defanzivan stav prema uvođenju novih tehnologija se ogleda u povećanju troškova, padu profitabilnosti, bez osvrta na potencijalnu kasnu profitabilnost, a zbog tržišnih rizika i jake konkurencije. Stoga, „istiskivajući“ jedne sa tržišne mape, drugi nosioci turističke ponude se bore za bolju konkurentsku poziciju zbog prethodno uloženog u iste te tehnologije i zbog vjere da će zauzimanje ofanzivnog stava „uroditi plodom“.

Istorijski i vremenski slijed razvoja međunarodne infrastrukture javnih računarskih mreža je bio progresivan, a i sada je. Sa uvođenjem komercijalizacije interneta otišlo se još dalje, pa je širenjem efektivnog dometa tržišta elektronski kanal distribucije postao okosnica elektronskog turističkog poslovanja i digitalizacije turističke ponude. Intenzivna informatička era uticala je na sve subjekte na turističkom tržištu, što je za posledicu imalo proširenje tržišta, značajno povećanje plasmana turističkih aranžmana i povećanje efikasnosti poslovanja. Tačnije, konkurentski podsticaj uslovljen inovativnim tehnologijama je i u turističkom pogledu bio uslovljen globalnim konkurentskim podsticajima, poput:

- “Globalizacija i koncentracija turističke ponude;
- Jaka globalna konkurencija;
- Efikasnost u komunikacijama i operacijama;
- Razvoj sistema upravljanja prinosima;

- Revolucioniranje kanala distribucije i kontrola troškova;
- Konkurentska prednost kroz smanjenje troškova i jačanje diferenciranja;
- Fleksibilni i prilagođeni turistički proizvodi;
- Razvoj i obezbeđenje inovativnih proizvoda i usluga;
- Kreiranje „bešavnih“ turističkih iskustava;
- Bliska interakcija sa potrošačima;
- Razvoj odnosa i marketinga „jedan ka jednom“.”¹

Informaciono-tehnološke inovacije su, u krajnjem, postale podrška turističkom upravljanju jer je značajno unaprijeđen stepen informatizacije poslovnih procesa u cilju ostvarenja konkurentске prednosti. Tačnije, informacioni sistemi su omogućili nosiocima turističke ponude sledeće:

- da svoju ponudu plasiraju na cjelokupnom svjetskom tržištu;
- da usluge prodaju na preko nekoliko stotina hiljada prodajnih mjesta;
- da su sve informacije o ponudi dostupne „on-line“, 24 časa, 7 dana u nedelji;
- da su sve promjene/izmjene u ponudi istog trenutka dostupne korisnicima;
- neograničen broj informacija koje pružalac želi da uputi/prenese;
- uštedu u troškovima poslovanja;
- generisanje prihoda.²

3. SELEKTIVNI VIDOVI TURIZMA

Traženi turistički proizvod, poslednjih godina, je bilo koji oblik selektivnog turizma atraktivnog i nesvakidašnjeg tipa. Noviji trend turističkih putovanja i brojne nove i atraktivne destinacije promijenile su pravac turističke tražnje, ali i proširile i svakodnevno šire turističku ponudu. Imajući u vidu raznolike ljudske potrebe, od potrebe za putovanjem, preko želje za otkrivanjem, upoznavanjem, učenjem, pa do želje za avanturom, estetskim nadahnućem i nadahnućem mira, nosioci turističke ponude su stavili

¹ Buhalis, D, O'Connor, P. (2005) Information Communication Technology Revolutionizing Tourism, *Tourism Recreation Research*, Vol. 30(3), pp. 7. Preuzeto sa: <http://epubs.surrey.ac.uk/1130/1/fulltext.pdf>.

² Tošutović, T. Mrdaković, J., (2007) Globalni rezervacioni i distribicioni sistemi u industriji putovanja u Poslovanje turističkih agencija – Zbornik radova, *Projekat: Edukacija zaposlenih u turizmu*, Beograd: Univerzitet Singidunum, Fakultet za turistički i hotelijerski menadžment, str. 15-17.

akcenat na ekstremni turizam. Međutim, o bilo kom vidu selektivnog turizma da je riječ, svaki zavisi od komponenti kojima raspolaže, a među kojima se u obzir uzimaju sledeće:

- turističke atrakcije: prirodne, stvorene, posebne vrste namjenski stvorenih atrakcija, kulturne, socijalne;
- oprema destinacije: obuhvata elemente koji omogućavaju boravak na destinaciji, aktivnosti i uživanje u atrakcijama i
- pristupacnost: obuhvata brzinu, komfor, lakoću ili težinu kako bi posjetioci stigli do destinacije.¹

Želja ljudskog bića za autentičnim turističkim doživljajem uslovia je pojavu selektivnog turizma. Razlika u odnosu na masovni, koji je skoncentrisan na zabavu i odmor, je upravo u specifičnoj želji za doživljajem i težnji ka ostvarenju nesvakidašnjeg osjećaja. Takav pristup planiranju odnosa je posledica upravo selektivnih procjena i pristupa, a s obzirom na konstantan rast potreba za nestandardiziranim turističkim uslugama i individualiziranim ponašanjem turista, značajno je istaći komponente koje utiču na pomenuti rast, poput:

- potrage za samoodređenjem odnosno emancipacijom i načelom „uradi sam“, a sve u svrhu jedinstvenosti;
- postojećeg iskustva u putovanjima kod stanovništva, što dalje razvija „teži“ kritički stav, pa samim tim i selektivniji, ali u granicama sve veće rafiniranosti potražnje i racionalnog izbora;
- rastuće želje za povezivanjem s prirodom, za sticanjem ličnog iskustva i iskustva iz prve ruke i za aktivnim odmorom;
- veće ekološke svijesti i osjetljivosti prema kvalitetu života;
- sve većeg nastojanja za učenjem, kroz pokušaje upoznavanja stranih kultura, širenja spoznaja i samospoznaja u okviru istog.²

Suštinsko je ipak to da je turista u fokusu selektivnog turizma i da se naspram njegovih potreba i želja oblikuje sama ponuda. Tematika koju destinacija “nosi” u sebi je okidač za ispunjen doživljaj turista, a isto tako ta tematika kreira imidž destinacije. Pozicioniranje atrakcije je izazov za nosioca turističke ponude i pružaoca turističke usluge, zbog čega je prethodno potrebno ispitati koja tematika turistima jeste atraktivna, kako bi i njihov ugođaj

¹ Vrtiprah, V. (2006) Kulturni resursi kao činitelj turističke ponude u 21. stoljeću, *Ekonomski misao Praksa DBK god. XV. br. 2*, Dubrovnik: Univerzitet u Dubrovniku, str. 282.

² Moutinho, L. (2005) *Strateški menadžment u turizmu*, Zagreb: Masmedia, str. 19. U: Vrtiprah, V. (2006) Kulturni resursi kao činitelj turističke ponude u 21. stoljeću, *Ekonomski misao Praksa DBK god. XV. br. 2*, Dubrovnik: Univerzitet u Dubrovniku, str. 281.

bio potpun. Bilo da se radi o tematskom, specifičnom, alternativnom turizmu ili turizmu niše ili drugih interesovanja, nije rijetkost da se radi o selektivnom obliku turizma koji je primamljiv manjem broju turista. Kako god posmatrano, akcenat može biti različit, poput:

- akcentovanja aktivnosti u okviru turističkog mjesta,
- proizvoda, bilo tradicionalnih bilo savremenih,
- ambijenta i atmosfere,
- socijalnog okruženja,
- biljnog i životinjskog svijeta,
- istorijskih i kulturnih znamenitosti i drugih.

3.1. Savremeni turista kao „kreator“ savremenih kriterijuma i razvoja selektivnih vidova turizma

Potreba za afirmacijom raznolikih i, možemo reći, nikad viđenih oblika turističkog prometa nastala je kao posledica nedovoljnog zadovoljstva potrošača isključivom usmjerenošću na turizam kao odmor i rekreaciju umjesto na turizam kao doživljaj. Kao „subjekat“ turističkih kretanja, turista po osnovu sopstvenog osjećaja, prezentovanih informacija i vjerovanja vrši izbor destinacije, jer sam konzumerizam turističkih usluga podrazumijeva potencijalno poželjan i neizvjestan izbor za potrošača, oivičen stvarnim potrebama sa jedne i nametnutim potrebama sa druge strane. Kako želje turista nijesu jedina prekretnica izbora destinacije, već su to i stavovi i percepcije kreirane na osnovu multimedijalnih i drugih sadržaja, prethodna iskustva (ukoliko ih je bilo), socio-ekonomski momenat (bilo da se radi o ličnom ili turističkom), neminovno je dobar transformacioni lider ona koji pokazuje „spremnost na prihvatanje izazova i stalna riješenost na prilagođavanje načina upravljanja datim situacijama“¹.

Posmatrajući potrošače sve više kao individue sa specijalizovanim prohtjevima savremenog doba, raste i izazov razvoja turizma i turističkih oblika, pa se kvalitetom u turizmu smatra „rezultat procesa koji implicira zadovoljstvo svim legitimnim potrebama za proizvodima i uslugama u turističkim destinacijama, zadovoljstvo koje nastaje ispunjenjem zahtjeva i očekivanja korisnika/turista, te zadovoljstvo odnosom cijene i vrijednosti“². Novi segmenti tražnje uslovljavaju nove oblike turističke ponude, a sve u jednom istom cilju – biti lojalan potrošaču ili održati lojalnost istom. Naravno, to nije jedini orijentir jer se koncentracija uporedo usmjerava i na kreaciju pozitivnih asocijacija

¹ Stefanović, V. (2017) *Uticaj transformacionih liderstva na motivaciju zaposlenih u turizmu*. Monografija. Niš: Prirodno matematički fakultet, str. 45.

² Golob, M., Golob, M. i Sirotić, T. (2014) Istraživanje kvalitete i razine zadovoljstva turista turističkom ponudom. *Zbornik Veleučilišta u Rijeci*, Vol. 2, No. 1, str. 28. Preuzeto sa: [946553.3_turisticka_destinacijaUMAG.pdf](#)

između zadovoljstva turista i dugoročnog ekonomskog uspjeha turističke destinacije.¹ Međutim, kako svaki izazov „sa sobom nosi“ i potencijalne kritične zone, tako je sama identifikacija trenda potrošača, u globalu, srazmjerna kreaciji savremene turističke ponude. Eksploatacija marketinških mogućnosti bi, u tom pogledu, trebala biti vrlo realna kako bi se prikazale i realne turističke mogućnosti, što za posledicu sveukupno ima segmentaciju turističkog tržišta. Navedeno je dalje uslovalo pojavu selektivnih oblika turizma, a može se reći da je varijabilnost odnosno nestabilnost turističke tražnje „okidač“ konstantnog rada na promociji novih, drugačijih i nesvakidašnjih oblika turističke ponude. Pojava mega-trendova u turističkoj ponudi se predviđa u skorijoj budućnosti, odnosno istu predviđa Svjetska turistička organizacija kroz sledeće turističke oblike: ekoturizam, kulturni turizam, tematski turizam, avanturistički turizam, zdravstveni turizam, kružna putovanja, nautički turizam i drugi oblici.² Shodno svrsi putovanja, isključivo turističkoj ili nadasve istraživačkoj, poslednjih godina su lične percepcije potencijalnih turista izuzetno nestabilne „jer učesnici turističkih kretanja predstavljaju ljude sa različitim karakteristikama ličnosti“³. Ukoliko se analizira zadovoljstvo turista i na osnovu iste analize kreiraju savremeni kriterijumi turizma, odnosno kreiraju turistički proizvodi, to su svi oblici turizma, manje ili više, proizvod očekivanja turista kao krajnjeg potrošača. „Trka“ turističkih preduzeća, agencija i svih nosilaca turističke ponude ima osnov u prevazilaženju inicijalnih očekivanja potrošača jer je zadovoljan turista „preporuka više“. Shodno tome, „zadovoljstvo turista smatra se jednom od primarnih varijabli održavanja kompetitivnosti u turističkom sektoru, budući da utiče na izbor destinacije te potrošnju proizvoda i usluga i odluku o ponovnom vraćanju u turističku destinaciju“⁴. Nekadašnja i sadašnja očekivanja turista su dijametralna. Neminovno i vrlo primjetno jeste marketinško upravljanje ovom privrednom granom. Tačnije, multimedijalni sadržaji sada, način predstavljanja turističkog mjesta i svih segmenata istog, oblik eksploatacije društvenih mreža u navedene svrhe, samo su neki od pokazatelja pomenutih dijametralnih potreba turista. Kako „u potrebama savremenih turista preovladavaju različitost, kontrast, bogatstvo sadržaja i oblika, noviteti i inovativni proizvodi s naglaskom na kvalitet“⁵, to je kvalitet turističke ponude preoblikovan kroz brojne selektivne vidove turizma. Pored uticaja očekivanja i potreba potrošača, imidžu turističke destinacije i samoj profitabilnosti ne može doprinijeti isključiva ispunjenost očekivanja niti zadovoljstvo potrošača u pogledu potreba, već vremenski izgrađena reputacija uz konstantu praćenja prohtjeva, stepena ispunjenosti istih kroz dalju lojalnost turista toj turističkoj destinaciji.

¹ Hapenciuc, C. V., Condratov, I. (2007) Theoretical Framework for Quality Evaluation of Tourism-Related Websites Services, *Economy Informatics*, Vol. 1-4, p.p. 52-58.

² www.world-tourism.org

³ Jovičić, Ž. (1993) *Fenomenologija turizma*. Beograd: Naučna knjiga, str. 93.

⁴ Kozak, M., Rimmington, M. (2000) Tourist Satisfaction with Mallorca, Spain as an Off-Season Holiday Destination, *Journal of Travel Research*, Vol. 38(3), p.p. 260-269.

⁵ Pirija, D. (2003) *Standardi u turističkom ugostiteljstvu*, Šibenik: Visoka škola za turizam Šibenik, p. 35.

4. ZAKLJUČAK

Savremeni turizam je uslovio brojne promjene, kako kvalitativnog tako i kvantitativnog tipa. Usklađivanje ponude sa tražnjom pretrpjelo je velike izazove, ali je neminovno ostavilo trag na obim turističkog prometa i državni profit. Konkurentnost raste iz dana u dan, a prethodno je uslovljena primjenom informacionih tehnologija u sve većoj mjeri, promjenom pravca „jednostavnih potreba“ potrošača u kreiranje želja, prohtjeva i potreba diferentnog tipa, kao i pojavom selektivnih odnosno specifičnih oblika turizma.

Širenje turističkog tržišta ima uzročno posledičnu vezu sa inovativnim pogledima potrošača, odnosno turista, za turističkim poduhvatima. Iako je on-line poslovanje dovelo do ekspanzije informacija i olakšane promocije različitih turističkih destinacija, sa akcentom na nove i specifične, zadovoljan turista je ostao osnovni promoter kvalitetnog turističkog poslovanja. Shodno tome, izbor informacija koje se plasiraju elektronskim putem utiče na turiste, izgradnju njihovog povjerenja i dalju promotivnu kampanju turističke ponude, potencijalnim turistima, preko stalnih turista.

Široka paleta aranžmana u okviru turističke ponude je oličenje savremenog turizma, podjednako važno kao i iskustvo turista i utisci sa kojima odlazi. Traganje za novitetima je permanentno aktuelno, zbog čega je neophodno konstatno upotpunjavanje turističke ponude. Sa jedne strane, informacione tehnologije su donijele brojne prednosti, a sa druge strane uslovile konkurentne izazove, poput porasta udjela selektivnih oblika turizma. Postavljanje tradicionalnog, masovnog turizma u zonu zapostavljenog a opet nikad prevaziđenog i zauvijek postojanog kao osnovnog, podijelilo je turistički sektor.

Tačnije, poslovanje subjekata turističkog sektora je postalo šarenoliko u traganju za inovacijama i uporednoj težnji da kreiraju svoju ponudu na sveobuhvatan način, sa pozitivnim efektima u pogledu održive posjećenosti, ostvarenih prihoda i minimalnih troškova.

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ASSESSMENT OF DIGITAL ECONOMY AND SOCIETY INDEX (DESI) DIMENSIONS USING MCDM METHODS

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ABSTRACT:

The concept of a digital economy has recently been developing due to the multiple and dynamic nature and transformations of digital technologies. The digital economy is the most important global driver of innovation, competitiveness, and growth. For Europe and business entities that operate in its market, digital technologies are key determinants for their further economic development. Hence, this paper aims to analyze and compare two clusters, European countries (EU-27) and Southeast Europe non-EU countries (SEE-5), according to indicators of four key dimensions of the Digital Economy and Society Index (DESI). For this analysis, data from the Eurostat database have been applied. The ranking and selection process of European countries was carried out application of the multi-criteria method EDAS (Evaluation Based on Distance from Average Solution). The result obtained from the EDAS method shows consistency with that generated using the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method. This paper extends existing studies by focusing on applying a broad range of indicators regarding DESI dimensions and shows the level of digitization's process application. The results provide valuable insights into evaluating the technological progress in European countries individually.

Keywords: Digital Economy and Society Index, MCDM methods, European countries ranking, EDAS, TOPSIS

1. INTRODUCTION

The globalization process and social development toward new technologies changed the economy. Digitization has quickly entered different sectors of the economy, and industries that fast have adapted to the changes are still developing on the market and represent carriers of competitive advantage. Fernández-Portillo et al. (2020) and Borowiecki et al. (2021) highlighted that Information and Communication Technology (ICT) is a significant driver of social, economic, and even civilizational progress. ICT is an essential component of the digital economy, which has radically changed how people live, work, interact with each other, and obtain information (Stavytskyy et al., 2019). Digital technologies

encourage new types of interactions and business practices (Borowiecki et al., 2021), eliminate spatial limitations, overcome barriers to market access, revs the progress of various transactions, encourage the development of new industries which generate new employment opportunities (Servoz, 2019), and develop new digital commercial platforms. In 2017 the World Economic Forum considered the economy's future in the newly digitization period. This Forum established targets for adopting the „digital economy and society“ to speed up its progress (Zerhouni & Özari, 2022). The term „digital economy“ was defined first time by Nicholas Negroponte (1995) of Massachusetts University (Stavytskyy et al., 2019). The „digital economy“ appears in research several definitions. Considered that “the digital economy is the share of total economic output derived from a number of broad digital inputs“. Digital inputs refer to digital skills and digital equipment such as hardware, software, and communications equipment, as well as the intermediate digital goods and services used in production systems. These issues reflect the foundations of the digital economy (Knickrehm et al., 2016). On the other hand, the European Parliament, in its study, defines the digital economy as “a complex structure of several levels/layers connected with each other by an almost endless and always growing number of nodes. Platforms are stacked on each other, allowing for multiple routes to reach end-users and making it difficult to exclude certain players, i.e., competitors” (Zerhouni & Özari, 2022).

Taking into account the multidisciplinary nature of ICT, various theoretical paths have been analyzed in scientific research to explore the adoption, use, and impact of ICT on the development of enterprises in different economies (Pramanik et al., 2017; Alshubiri et al., 2019). As a result, it has been determined that this topic is an important component of current management practice, as well as research connected to the broadly understood growth of the economy and societies in the twenty-first century. However, scholarly literature has also dealt with doubts about the success of ICT-led efforts and worries about their existing and potential challenges (Thapa & Saeb, 2014; Dey & Ali, 2016).

Regarding the importance that the European Union (EU) places on digital development among all member countries, the essential issue is to examine how is the situation in EU countries generally and other less developed non-EU countries. Keeping in mind the challenges and dilemmas that emerge in economies, which are critical for achieving and maintaining a competitive position, the transition process from an industrial-based economy to an economy based on digital products and services is very demanding. Therefore, this paper provides an up-to-date and comprehensive analysis of the digital economy and social development within the two analyzed clusters. The first cluster represents 27 Member States of the European Union (EU-27), while the second cluster refers to five countries of Southeast Europe that are non-EU countries (SEE-5).

The research has been conducted in two phases. First, from the Eurostat database for 2018-2022, basic time series dynamics measurements of key indicators of four main DESI dimensions were utilized using the Entropy method to determine the criteria objective weights. Then, using the multi-criteria decision-making EDAS (Evaluation Based on Distance from Average Solution) method, countries' rankings within two considered clusters were compared. Additionally, In order to validate the obtained results, the multi-

criteria TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method was used.

The rest of this paper is organized through follow sections. Section 2 elaborates literature review about DESI. In section 3, the methodology applied is discussed. Section 4 exhibits the results and includes a discussion of the findings. Finally, section 5 concludes the paper and highlights important limitations, and points out some of the future research.

2. THE DESI

The Digital Economy and Society Index (DESI) assesses the progress of European countries in their digital competitiveness. Since 2014, the EU began to monitor this index, which has been updated yearly (Bánhidi et al., 2020; Borowiecki et al., 2021).

Dimension		Sub-dimension		Indicator	
ID	Name	ID	Name	ID	Name
1	Human capital	1a	Internet user skills	1a1	At least basics digital skills
				1a2	Above basic overall digital skills
				1a3	Advanced computer skills (software skills)
		1b	Advanced skills and development	1b1	ICT specialists
				1b2	Enterprises that provided training
2	Connectivity	2a	Broadband take-up	2a1	Overall fixed Broadband take-up
				2a2	Enterprises with broadband access
		2b	Broadband coverage	2b1	At least 100 Mbps fixed broadband take-up
				2b2	Broadband internet coverage by technology
3	Integration of digital technology	3a	Digital intensity	3a1	Enterprises with very high digital intensity index
		3b	Digital technologies for business	3b1	Social media
				3b2	Big data
				3b3	Cloud services
				3b4	Artificial intelligence
				3b5	3D printing and robotics
				3b6	Automated business processes
				3b7	RFID technologies
				3b8	CRM software solutions

4	Digital public services	3c	E-commerce	3c1	E-commerce sales
				3c2	E-commerce purchases
				3c3	E-commerce turnover
		4a	E-Government	4a1	E-government users
				4a2	Digital public services for citizens
				4a3	Interaction with public authorities

Table 1. DESI framework

Source: Digital Economy and Society Index (DESI) 2022 DESI methodological note

Table 2 depicts how the DESI combines relevant indicators (24 in total) classified into four dimensions (Human capital, Connectivity, Integration of digital technology and Digital public services) and eight sub-dimensions (Internet user skills, Advanced skills and development, Broadband take-up, Broadband coverage, Digital intensity, Digital technologies for business, E-commerce, E-Government) (Bruno et al., 2023). Sub-dimensions and indicators in Table 1 are marked with an individual ID code for clarity.

Digital transformation, which presents a multidimensional phenomenon, is frequently subject to change. Therefore, this study is not focused on new metrics for measuring digital transformation but on analyzing selected indicators of digital development according to which European countries were ranked.

The DESI includes up-to-date dimensions such as Connectivity and Human Capital, Integrating digital technology and Digital public services. For example, concerning traditional infrastructural aspects, the DESI dimension of Human capital focuses on users' skills, distinguishing between basic digital skills and advanced competencies, the number of ICT specialists, and enterprises that provide employee training. The dimension of Connectivity considers the evolution of ICT technology by including indicators related to fixed broadband take-up and coverage. The dimension Integration of digital technology accounts for the digital transformation perspective into digital intensity, businesses, and E-commerce. Considered indicators assess, among others, the levels of social media and enabling Industry 4.0 technologies' usage in enterprises (big data, cloud services, artificial intelligence, 3D printing and robotics, automated business processes, RFID technologies, CRM software solutions), the overall sales, purchases, and turnover of the E-commerce sector. Finally, the dimension of Digital public services evaluates digital penetration in public administrations through, for instance, the number of actual E-government digital services users, the availability of digital public services for citizens, and its interaction with public authorities (Bruno et al., 2023).

3. METHODOLOGY

Over the years, numerous Multi-Criteria Decision-Making (MCDM) methods have been proposed in the literature. MCDM can be defined as a process of determining the most appropriate solution from a set of available alternatives based on their performances in

relation to a set of evaluation criteria (Stanujkić et al., 2017). These methods differ depending on which research questions are being considered, the type of problem, the theoretical basis, and the type of results obtained. For now, there is no method that can be applied to all types of problems, primarily due to the fact that the methods are created for specific cases, with their certain advantages and limitations. The proposed multi-criteria model consisted of four steps: 1. Identification and definition of the considered problem; 2. Formation of a decision-making model; 3. Application of multi-criteria decision-making method and analysis of possible alternatives; 4. Selection of the most acceptable alternative.

This section provides information about the EDAS (method, which is the MCDM techniques used to rank the countries according to different criteria.

3.1. EDAS method

This efficient and relatively new method was proposed by Keshavarz Ghorabae et al. (2015) as a ranking method to tackle complicated decision-making problems where several alternatives should be prioritized concerning multiple criteria (Keshavarz Ghorabae et al., 2015). Although the method is relatively new, it has so far been successfully applied to solve problems in different uncertain environments, such as engineering problems (Tang, 2017); supplier selection (Ghorabae et al., 2016; Ecer, 2018; Stević et al., 2019); personnel selection (Turskis et al., 2017); selection of a location for waste disposal (Kahraman et al., 2017); renewable energy (Asante et al., 2020).

The major difference between the EDAS method in comparison to other methods is reflected in its normalization process. Unlike traditional methods such as VIKOR and TOPSIS (Hezer et al., 2021), which are designed to determine the best alternative based on ideal and anti-ideal solutions, a lower distance to the ideal solution and a higher distance to the anti-ideal solution would not guarantee getting the most suitable solution in real-life decision-making problems (Torkayesh et al., 2023). Hence, according to the average solution-based normalization technique, the EDAS method determines the best alternative. In order to define each alternative's score and their relative ranking order, the EDAS method employs a positive distance from the average value (PDA) and a negative distance from the average value (NDA). For a complicated and multi-aspect MCDM problem with n criteria and m alternatives, EDAS method can be used according to the next steps (Keshavarz Ghorabae et al., 2015; Torkayesh et al., 2023).

Step 1. Selection of alternatives and criteria that describe the alternatives and formation of the decision matrix X , as follows:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{12} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{1n} & x_{2n} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

where x_{ij} represents the values of alternative i for criterion j .

Step 2. Determining the average solution according to all criteria, as shown below:

$$x_j^* = (x_1, x_2, \dots, x_n) \quad (2)$$

where is:

29.

$$x_j^* = \frac{\sum_{i=1}^m x_{ij}}{m} \quad (3)$$

Step 3. Calculation of the positive distance from the average – PDA d_{ij}^+ and the negative distance from the average – NDA d_{ij}^- , according to the type of criteria (income or expenditure), as shown below:

$$d_{ij}^+ = \begin{cases} \frac{\max(0, (x_{ij} - x_j^*))}{x_j^*}; & j \in \Omega_{\max} \\ \frac{\max(0, (x_j^* - x_{ij}))}{x_j^*}; & j \in \Omega_{\min} \end{cases} \quad (4)$$

$$d_{ij}^- = \begin{cases} \frac{\max(0, (x_j^* - x_{ij}))}{x_j^*}; & j \in \Omega_{\max} \\ \frac{\max(0, (x_{ij} - x_j^*))}{x_j^*}; & j \in \Omega_{\min} \end{cases} \quad (5)$$

where Ω_{\max} Ω_{\min} and represent the set of income and expenditure criteria, respectively.

Step 4. Determination of weighted sum PDA, Q_i^+ , and weighted sum NDA, Q_i^- , for all alternatives as shown below:

$$Q_i^+ = \sum_{j=1}^n w_j d_{ij}^+ \quad (6)$$

$$Q_i^- = \sum_{j=1}^n w_j d_{ij}^- \quad (7)$$

Step 5. Normalization of weighted sum PDA and weighted sum NDA values for all alternatives as shown below:

$$S_i^+ = \frac{Q_i^+}{\max_i Q_i^+} \quad (8)$$

$$S_i^- = 1 - \frac{Q_i^-}{\max_i Q_i^-} \quad (9)$$

where S_i^+ and S_i^- represent the normalized weighted sum of PDA and NDA, respectively.

Step 6. Calculating the importance of S_i for all alternatives as follows:

$$S_i = \frac{1}{2}(S_i^+ + S_i^-) \quad (10)$$

Step 7. Rank the alternatives according to decreasing values of the appraisal scores. Alternatives are ranked by their compromise score from higher values to lower values, where an alternative with a higher score is considered the best alternative.

4. APPLICATION OF METHODOLOGIES

The current state of DESI provides European countries with the analysis they need to identify priority areas for action. Simultaneously, the dimensions provide a European-level analysis of key digital areas for details and methodological explanations, such as connectivity, human capital, digital technology integration, and digital public services (European Commission, 2022). In this paper, reports from 2018-2022 were evaluated. The analysis included 33 European countries separated into two clusters, which are shown in Figure 1. Within the first cluster, a total of 27 EU member states were considered and ranked, while Switzerland, England, Iceland, and Norway were not considered because they do not belong to the EU. Albania was not considered within the second SEE-5 cluster because the data needed for the EDAS method were insufficient.

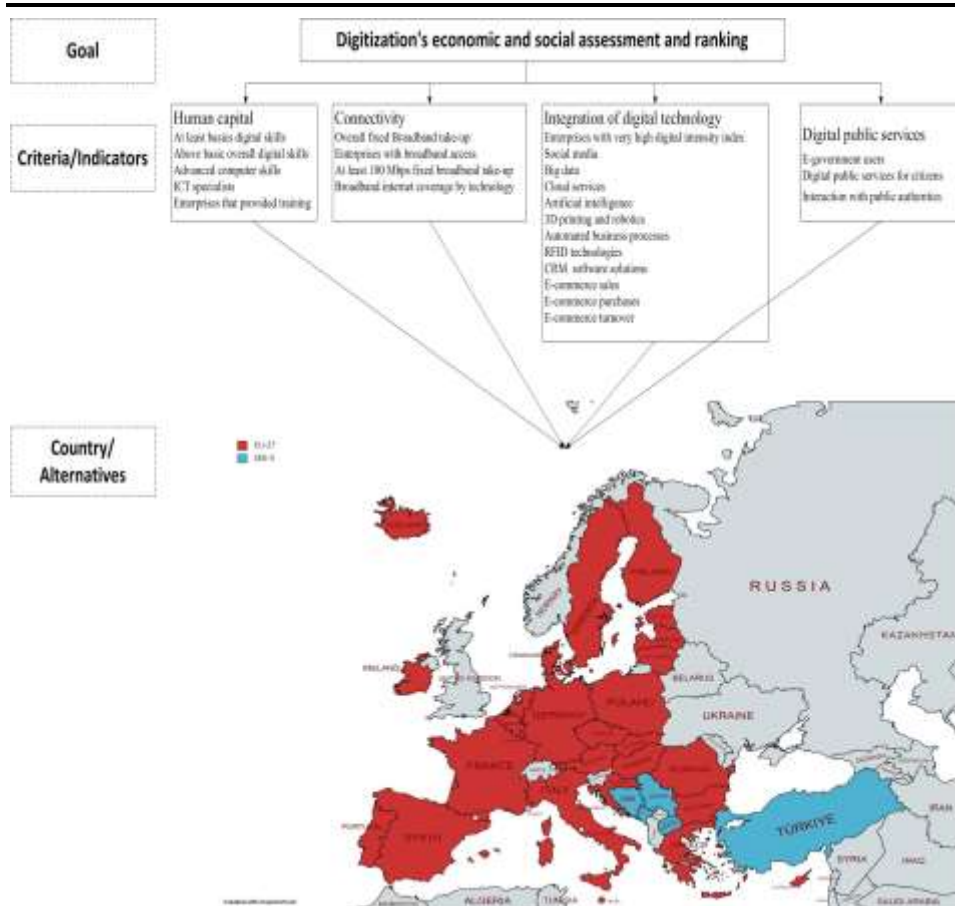


Fig. 1. Analysed countries

In this research, the EDAS method was used for selecting European countries according to indicators of DESI. The criteria represent DESI indicators in the proposed model, while the alternatives refer to European countries which rank according to that indicators.

4.1. Evaluation criteria and data

The evaluation criteria used for this research were based on the 24 indicators within four DESI dimensions. This analysis takes into account two distinct scenarios. The suggested criterion weights are objective in the first scenario calculating by Entropy method (Zerhouni & Özari, 2022), while the analyses are performed in the second scenario with

the premise that all criteria weights are equal (0.4). The obtained results for both scenarios are present in the Table 2.

Criteria											
1a1	1a2	1a3	1b1	1b2	2a1	2a2	2a3	2a4	3a1	3b1	3b2
Objective weight (OW)											
0.05	0.04	0.03	0.03	0.04	0.06	0.06	0.06	0.06	0.03	0.05	0.03
Equal weight (EW)											
0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Criteria											
3b3	3b4	3b5	3b6	3b7	3b8	3c1	3c2	3c3	4a1	4a2	4a3
Objective weight (NW)											
0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05
Equal weight (EW)											
0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

Table 2. Values of weighting coefficients

Results of indicators objective weights calculated by the Entropy method indicate that the highest weights have indicators 2a1, 2a2, 2a3, 2a4 (0.06) and 1a1, 3b1, 4a1, 4a2, 4a3 (0.05).

4.2. Findings

This section applies the EDAS method to compare and rank the alternatives. The ranking results obtained were analyzed for the method used and compared with the ranking results given in the report presented by European Commission. Two applications (EDAS NW and EDAS EW) were applied because the method considers two scenarios. Each application is used by considering two clusters (EU-27 and SEE-5) independent of each other. The results obtained for EU-27 AND SEE-5 are in Tables 3 and 4, respectively, and in Figures 2 and 3. Also, the validation process results obtained using the TOPSIS NW and TOPSIS EW are presented in the same tables, respectively.

Table 3. Final results and ranking of the EU-27 countries using EDAS and TOPSIS methods

Alternatives	EDAS				TOPSIS			
	OW		EW		OW		EW	
	S _i	R _n	S _i	R _n	C _i ⁺	R _n	Φ _j	R _n
Belgium	0.751	5	0.745	5	0.625	5	0.618	5
Bulgaria	0.106	26	0.101	26	0.191	26	0.182	26

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Czechia	0.455	14	0.474	12	0.453	13	0.408	15
Denmark	0.988	1	0.990	1	0.795	1	0.789	1
Germany	0.509	11	0.501	11	0.454	11	0.448	11
Estonia	0.433	16	0.450	16	0.429	16	0.381	17
Ireland	0.710	6	0.736	6	0.616	6	0.571	6
Greece	0.198	25	0.214	25	0.287	25	0.241	25
Spain	0.556	10	0.565	10	0.493	10	0.465	10
France	0.452	15	0.464	13	0.453	12	0.410	14
Croatia	0.414	18	0.407	18	0.400	18	0.385	16
Italy	0.347	21	0.336	23	0.331	23	0.331	21
Cyprus	0.365	20	0.389	19	0.379	20	0.334	20
Latvia	0.310	23	0.340	22	0.362	22	0.302	24
Lithuania	0.419	17	0.422	17	0.406	17	0.381	18
Luxembourg	0.634	8	0.652	8	0.558	8	0.522	8
Hungary	0.332	22	0.364	21	0.381	19	0.322	22
Malta	0.670	7	0.670	7	0.562	7	0.553	7
Netherlands	0.836	4	0.861	3	0.706	3	0.666	3
Austria	0.577	9	0.590	9	0.522	9	0.486	9
Poland	0.308	24	0.302	24	0.320	24	0.306	23
Portugal	0.476	12	0.458	15	0.431	15	0.442	12
Romania	0.003	27	0.005	27	0.116	27	0.088	27
Slovenia	0.464	13	0.462	14	0.435	14	0.419	13
Slovakia	0.368	19	0.369	20	0.372	21	0.346	19
Finland	0.905	2	0.902	2	0.743	2	0.741	2
Sweden	0.836	3	0.851	4	0.694	4	0.661	4

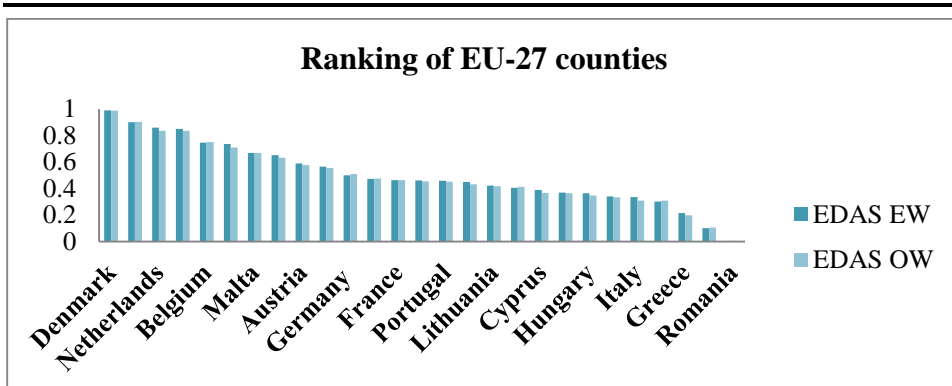


Fig. 2. Evaluation of methods in terms of objective and equal weights for EU-27 countries

According to the European Commission report, Finland, Denmark, Netherlands, and Sweden ranked in the first four positions respectively. Unlike them, according to the EDAS method analysis, the two first-ranked countries, Denmark and Finland, have switched positions. The same situation is in the third (Sweden) and fourth positions (Netherlands), which can also be seen in Figure 2. There are no deviations when it comes to the analysis of the countries in the last four positions. The orders of the countries are as follows Poland, Greece, Bulgaria, and Romania, respectively. In these countries, a significant effort should be made in order to reduce the perceived disparity between countries and raise the level of digitization to a higher level. When comparing the obtained results between the objective and the equal weights, it can be seen that the minimum deviation exists in the following countries: Czech, France, Italy, Cyprus, Hungary, Latvia, Netherlands, and Sweden.

The second part of the analysis in the paper ranks the five countries of Southeast Europe in order to see the detailed state and level of development of their digital competitiveness (Table 4). The obtained results in both scenarios (Figure 3) are the same, with minimal deviation in weights, and indicate that the following rank is obtained: Serbia, Montenegro, North Macedonia, Turkey and Bosnia and Herzegovina

Table 4. Final results and ranking of the SEE-5 countries using EDAS and TOPSIS methods

Alternatives	EDAS				TOPSIS			
	OW		EW		OW		EW	
	S_i	Rn	S_i	Rn	C_i^+	Rn	Φ_j	Rn
Bosnia and Herzegovina	0.338	5	0.350	5	0.626	2	0.626	2
Montenegro	0.959	2	0.947	2	0.127	5	0.127	5
North Macedonia	0.624	3	0.548	3	0.425	4	0.425	4

Serbia	1.000	1	1.000	1	0.846	1	0.846	1
Turkiye	0.495	4	0.392	4	0.428	3	0.428	3

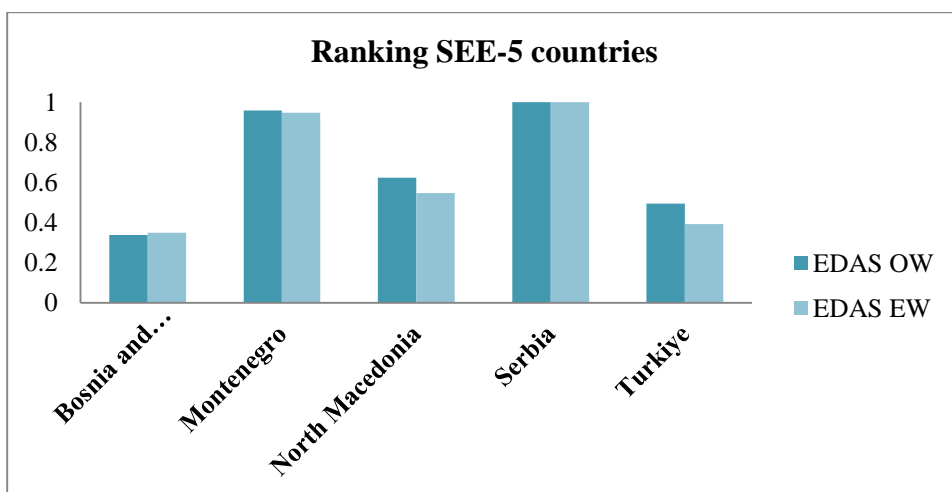


Fig. 3. Evaluation of methods in terms of objective and equal weights for SEE-5 countries

To determine whether there are any notable differences in the relative rankings of the EU-27 and SEE-5 countries, the EDAS method findings in both scenarios (objective and equal weights) are compared to other widely used distance-based MCDM methods (Pamučar et al., 2017; Biswas & Pamučar, 2021). For this aim, the same set of countries is ranked using the TOPSIS method (Hwang & Yoon, 1981; Arsić et al., 2022). The ranking results contrast is highlighted in red color in Tables 3 and 4. The aforementioned data for EU-27 makes it clear that the ranking is pretty consistent, except for small deviations in the final ranking order that occurs in the following countries: Czechia, France, Italy, Latvia, and Hungary. When it comes to the validation of the obtained results for the SEE-5 countries, the only deviation occurs in the rank between 2 and 5 positions, i.e., according to the EDAS method, Montenegro is in the second position, while Bosnia and Herzegovina is on the fifth position. Using the TOSPIIS method, the calculated positions are opposite.

5. CONCLUSION

In this research, DESI was utilized to analyze digitization's economic and social aspects in the two considered clusters (27 European countries and 5 SEE non-EU countries). MCDM techniques are a handy tool for decision-makers when deciding where several criteria are involved. In this research, policymakers in considered European countries primarily assess the results of the EDAS method. They should also take into account the

TOPSIS method findings, though. The analysis findings can influence how Europe's economic policy is formulated. They highlight the advantages and disadvantages of each European country's digital development strategy. They also highlight the areas where the disparity between countries with more and less established digital infrastructure is still clearly visible in the dynamics of digitization. It is additionally applicable in SEE countries, where the observed digital gap is more visible. Generally, DESI can be regarded as an effective mechanism for forming a comprehensive view of the complex dynamics of digitization processes in Europe today. Hence, this paper's added value is filling the research gap on the dynamics of digitization's economic and social aspects in European countries and non-EU SEE countries.

This research has some limitations. This study does not clarify the reason for differences between considered countries within clusters. The presented analysis focused on the four DESI dimensions: Human Capital, Connectivity, Integration of Digital Technology, and Digital Public Services. A more detailed picture of the dynamics of digital development in future research can be obtained by referring to aspects of the process that are more specific than those mentioned in this research, using second-level data for each dimension. Additionally, future research may consider MCDM methods other than the ones employed in this study. Also, the digital economy and society Index and their current situation in considered countries can be examined by adding new indicators to the criteria list presented in this study, or MCDM methods can be applied by removing some hands from the existing criteria (which is often the case due to lack of data in the certain countries). Additionally, in future research, it is possible to use fuzzy data to reflect the uncertainty of real problems using fuzzy MCDM techniques.

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THE ACQUISITION OF INTERCULTURAL COMMUNICATION AND COMPETENCE OF TOURISM MANAGERS

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ABSTRACT:

The subject area of intercultural communication and competence is large. The aim of this work is to give a comprehensible overview of the relevant aspects of intercultural competence. Globalization and internationalization have progressed with increased intensity in recent years and the increase in international business activities will remain an unbroken trend in the 21st century.

The present work deals with the acquisition of intercultural communication and competence of tourism managers at the Faculty of Tourism and Hospitality in Ohrid. The acquisition of intercultural competence is presented as the ability to easily and respectfully communicate and work with tourists from other cultures - therefore this is a highly sought-after quality in the tourism job market. As part of the course, intercultural communication and competence are first defined and future tourism managers are taught from various perspectives that cultural competence is a decisive component of international competence. This type of approach forms the basis for intercultural knowledge transfer. Intercultural communication and competence provides the opportunity to build lasting business relationships, which give tourism managers a competitive advantage over threatened competition.

Therefore, intercultural competence is a decisive factor in the success of tourism and it is becoming more and more important for tourist workforce, therefore it is increasingly becoming a requirement by employers.. Intercultural competence of tourism managers is a prerequisite for integration, because it helps to eliminate misunderstandings and promotes sensitivity, understanding of other cultures and personal development.

Keywords: *intercultural communication, intercultural competence, foreign languages, tourism manager, teaching*

Introduction

"Intercultural competence" is certainly one of the most successful "soft skills" of recent years. The Bertelsmann Foundation even calls it the "key competence of the 21st century". Intercultural competence is one of the key issues for communication in tourism based on cultural differences. In a globalized world of tourism, a manager must be able to deal with the clients with different cultural background, habits and traditions. The need for intercultural competence is increasing due to the fact that this type of guests are constantly increasing. Therefore, tourism companies should systematically promote intercultural competence among their employees.

The work is divided into a theoretical and a practical part. The first part of the work presents theoretical foundations and offers a more detailed explanation of the key terms related to the topic. The practical part describes the preparation phase, the process and the requirements for tourism students and managers in hotels in Ohrid - Prespa area in terms of their intercultural competence and communication.

1. Foreign language teaching and intercultural learning

The teaching of the German as a foreign language is very important in Macedonia because of the political, economic and cultural relation of Macedonia with Germany. This paper deals with the study of the strategic acquisition of intercultural communication and competence of the students that study "Tourism Management" and are enrolled in foreign language classes of the Faculty at Tourism and Hospitality in Ohrid / University of Sv. Kliment Ohridski Bitola.

In foreign language didactics, these new developments led to a use of language that integratively combines the various skills.¹ A communicative turn took place in foreign language didactics and the term communicative and intercultural competence became a buzzword in foreign language teaching.

Foreign language teaching is a very suitable environment to replace intercultural communicative learning. For example, Krumm comments on interculturally influenced foreign language teaching: "Foreign language teaching must be intercultural in principle, insofar as it's topic is the encounter (confrontation) with another language and culture".²

Intercultural learning, understood as learning at intercultural environment and active learning between people from different cultures.

According to Thomas, intercultural learning takes place when "a person strives to deal with people from another culture, to understand their specific orientation system of perception, thinking, evaluating and acting, to integrate it into their own cultural orientation system and to focus on their thinking and acting and needs . In addition, understanding other cultures, intercultural learning requires, a reflection on the native culture and tradition. Intercultural learning is successful when an action-effective

¹ MULLER-HARTMANN Andreas; SCHOCKER von Ditforth Marita (2004) Projektorientiertes Lernen mit neuen Medien in der fremdsprachlichen Lehrerbildung. In: Barkowski Hans, Funk Hermann (Hgg.)

Lernerautonomie und Fremdsprachenunterricht. Berlin: Cornelsen. S.89-108

²

KRUMM, Hans-Jürgen (2003): Curriculare Aspekte des interkulturellen Lernens und der interkulturellen Kommunikation. In: Bausch, Karl-Richard; Christ, Herbert & Krumm, Hans-Jürgen (Hrsg.) (2003): *Handbuch Fremdsprachenunterricht*. Tübingen/Basel: Francke, S.

synthesis between culturally divergent orientation systems (cultural standards) is achieved, which allows successful action in one's culture and in the foreign culture."¹

According to Bredella and Delanoy, intercultural learning is a process that takes place in dialogue, in which own ideas are solved and modified and other new ones are adopted. So there is a confrontation between the other and what is own one, and in the process what is own is put into perspective, reflected or changed. The prerequisite for this is the ability to empathize, tolerance and openness for new looks².

Lusebrink sees intercultural learning as "one of the most intensively discussed problem areas in the field of education on international level." He adds: "Intercultural learning (...) can take place inside or outside of institutions and in the second case coincides with the processing of intercultural life experience, which can be imparted and acquired through tourism, migration, school and youth exchanges, intercultural partner relationships and marriages, the posting of workers abroad and encounters with members of foreign societies and cultures."³

2. Intercultural communication and competence

In general, there is no uniform definition and conception of intercultural competence in the relevant literature. With a focus on intercultural communication, Erl and Gymnich point the term "intercultural competence": The concept of 'intercultural competence' encompasses a whole spectrum of individual abilities and characteristics for successfully dealing with people from other cultures, or at least proving to be conducive to interactions with members of other cultures.

Intercultural communication is a process of interaction between people from different cultural backgrounds.

Factual regional and cultural information about the target country is not an end in itself, but serves as a means of general communication skills. Knowing a foreign language is only part of the package - the other party's cultural background, values and beliefs must also be understood. This is where intercultural communication skills come into play. They are required to successfully communicate with people from other cultures and social groups. In addition, intercultural communication skills also involve a willingness to adapt and accept that other cultures and act differently.

3. Promotion of intercultural competence in tourism

Tourism describes the global intercultural communication as an important motor and direct with an impact and it is important for the economic sector too.

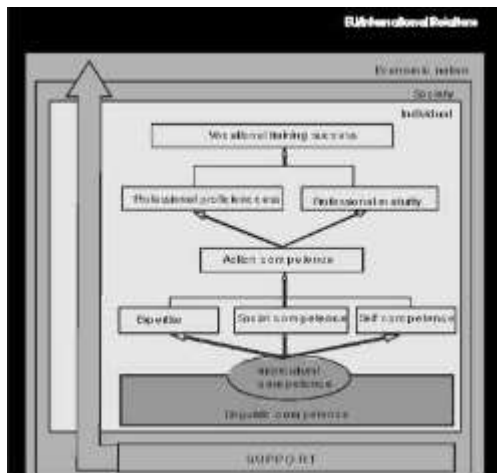
"Expansion of competences and the teaching of key qualifications represent the basis of interdisciplinary vocational training, whereby competencies relate more to the general

¹ THOMAS, Alexander.: *Psychologie interkulturellen Lernens und Handelns*. In: Alexander Thomas (Hrsg.): *Kulturvergleichende Psychologie*. Göttingen: Hogrefe Verlag für Psychologie 1993. S. 382

Vgl. BREDELLA, L.; DELANOY, W. (1999): Einleitung: Was ist interkultureller Fremdsprachenunterricht? In: Bredella/Delanoy (Hrsg.): *Interkultureller Fremdsprachenunterricht*. Tübingen: Gunter Narr. S.13

LUSEBRINK, Hans-Jürgen: *Interkulturelle Kommunikation, Interaktion, Fremdwahrnehmung, Kulturtransfer*. Stuttgart / Weimar: Metzler 2008. S. 65

individual ability and key qualifications can be defined as interdisciplinary performance-related characteristics with regard to the development of a specific task."



III Nr.1.: Classification of language and intercultural competence

The students during their studies have to build up technical, social and personal skills. Therefore, the ability to act could develop in language skills.

4 Practical part

Aim of the study and formulation of hypotheses

The objects of investigation are the experience reports of Macedonian students and tourism managers on the subject of intercultural competence and communication. The data collection process lasted from the beginning of November to the end of December 2022. The questionnaire was completed by 80 students from different academic years. This made it possible to compare the results in different study years as well as tourism managers, e.x. Interviews were made in Ohrid-Prespa region.

The data collection technique was online survey, meaning that the research instrument was online survey questionnaire. The students filled out an online survey questionnaire, which was forwarded to their email addresses. All respondents were informed that completing the online questionnaire is completely anonymous and that the data collected through this research will be used solely for the purpose of preparing a scientific paper.

Based on the general objective of the study, three hypotheses are to be generated that represent expectations based on the current state of knowledge and personal experience. Two perspectives - students and managers - should be taken into account.

HYPOTHESIS 1

The first hypothesis deals with the general understanding of the meaning of the term intercultural competence.

STUDENT PERSPECTIVE

Students understand the term intercultural competence to mean the acquisition of general knowledge of German culture, which, however, is more geared towards imparting "traditional" regional studies, i.e. the geographical, political and historical facts about Germany and other German-speaking countries.

MANAGER PERSPECTIVE.

Managers understand the term intercultural competence not only as the acquisition of knowledge about the target country, but they see intercultural competence in a more complex way. They also recognize affective and pragmatic aspects of intercultural competence and consider these components to be important.

HYPOTHESE 2

The second hypothesis concerns the students' and managers' attitudes towards the use of intercultural learning and the treatment of intercultural issues in the context of German lessons.

STUDENT PERSPECTIVE

The students consider intercultural learning to be important in German lessons and would like to learn more about German culture as part of the German lessons.

MANAGER PERSPECTIVE

Managers are of the opinion that intercultural engagement is difficult to realize in Macedonian conditions and that students and managers have to deal more often with topics related to everyday communication situations and especially business communication.

HYPOTHESE3

The third hypothesis deals with the possibilities of the students to experience intercultural communication within the framework of German lessons.

STUDENT PERSPECTIVE

The students have relatively little experience in intercultural encounters. Although they travel abroad, face-to-face intercultural interactions are rare. In the context of German lessons, intercultural communication only takes place through simulated conversations between the students or between the teacher and the students.

MANAGER PERSPECTIVE.

The majority of the lessons consist of traditional lessons in the classroom, without contact with the people who speak German as native speakers.

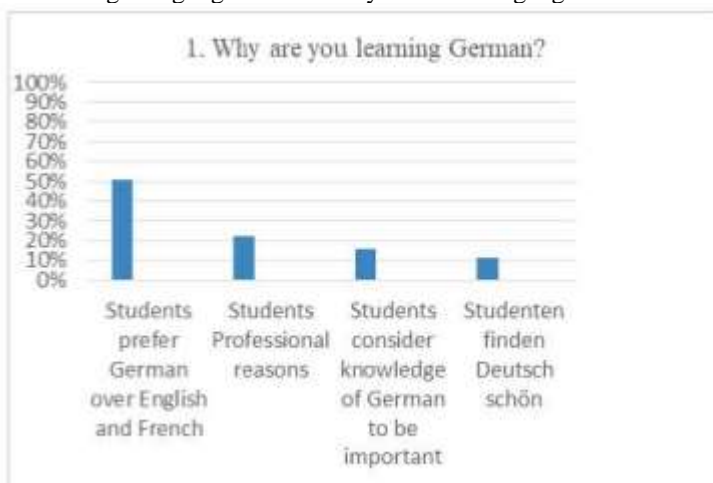
Evaluation of the research and analysis of the questionnaire results.

As already mentioned, 80 students and 25 managers were surveyed in the online questionnaire survey. The questionnaire consisted of 11 questions. Here are the results:

Thematic block 1

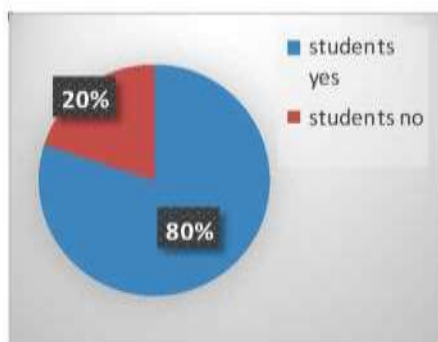
1. Why are you learning German?

Most students admit that they preferred the choice of German as a second foreign language. Some students consider learning German important because knowledge of German can be useful for their future job. A small number of students have chosen German as their second foreign language because they find this language beautiful.

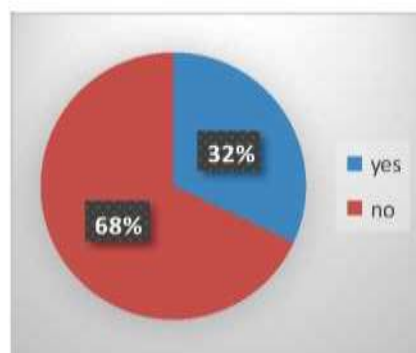


Graph. Nr. 1

2. Have you already visited Germany or other German-speaking countries?		3. Have you spoken to a native German speaker in person?
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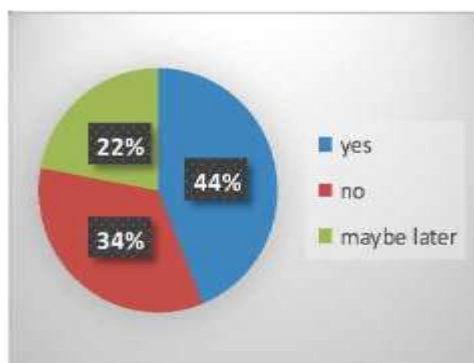


Grap Nr. 2



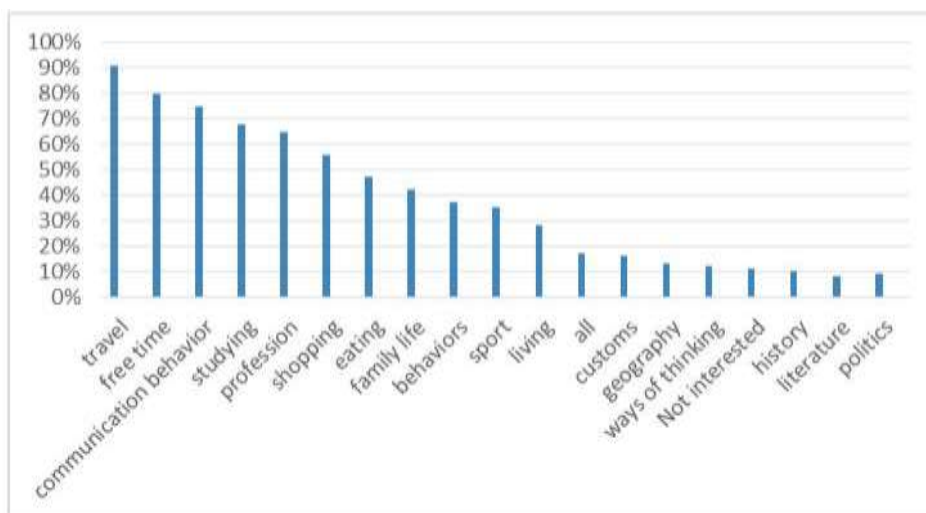
Graph Nr. 3

4. Would you like to go to Germany for an internship?



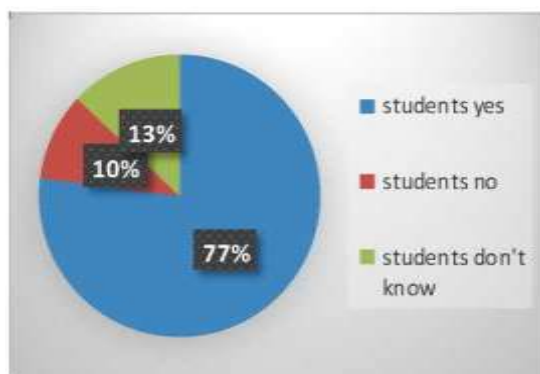
Graph Nr. 4

5. Which topics from German culture would you like to cover in the German class? The following themes emerged from the responses of the students surveyed:



Graph. Nr. 5

6. Do you think that you get a lot of information about German culture in the German class?

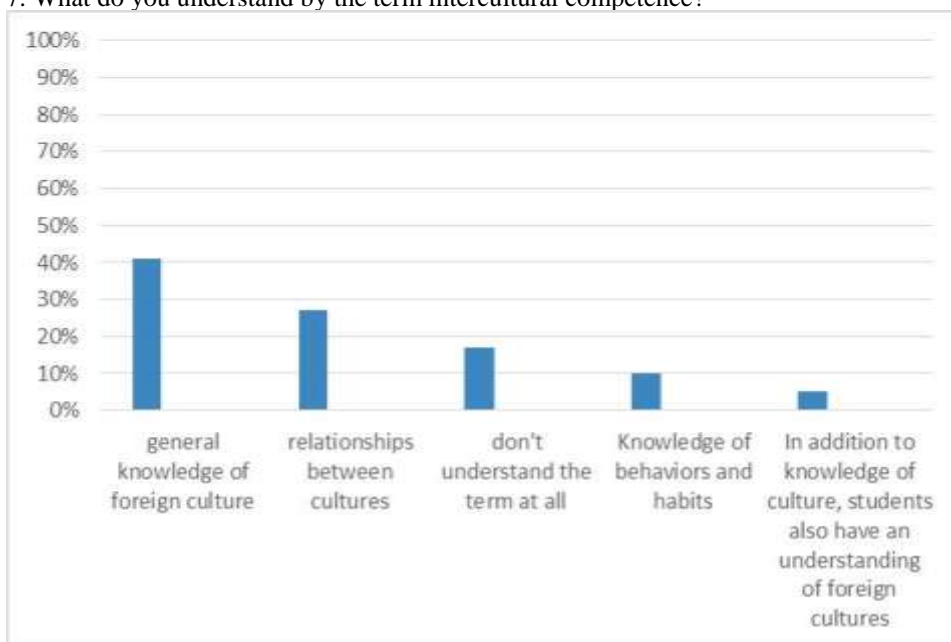


Graph. Nr.6

Thematic block 2

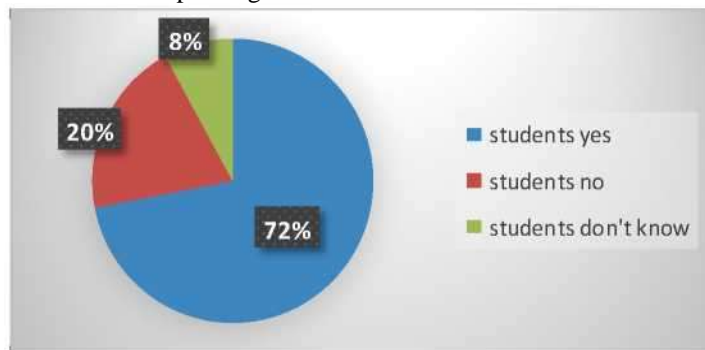
In this block of questions, it is to be explored what the managers mean by the term intercultural competence and whether they feel competent in their everyday intercultural encounters in the job.

7. What do you understand by the term intercultural competence?



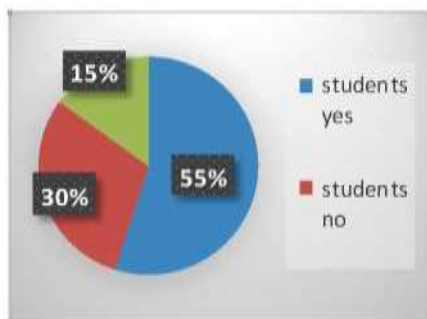
Graph. Nr. 7

8. In addition to developing language skills, do you also find it important to impart cultural knowledge about German-speaking countries?

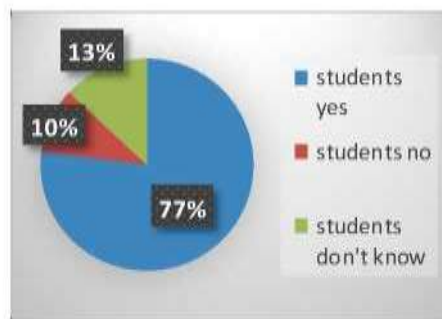


Graph. Nr. 8

9. Do you feel well prepared for intercultural encounters with German native speakers?	10. In addition to developing language skills, do you also find it important to impart cultural knowledge about German-speaking countries
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Graph Nr. 9



Graph. Nr. 10

Evaluation of the hypotheses

At the beginning of the present study, 3 hypotheses were made. In this chapter, the results of the investigation are discussed with regard to the hypotheses made.

The first hypothesis deals with the general understanding of students and managers of the meaning of the term intercultural competence. Based on the responses from all respondents, the first hypothesis can only be partially confirmed. Although the ideal learning environment for intercultural communication would be a situation where regular

face-to-face encounters with the target culture are possible, German lessons are based on classroom work; student and manager visits to the target country or culture are rare. Although there are Erasmus programs for study visits and other scholarships for the German language, the students do not show much interest in participating in these projects. Based on these findings, it can be stated that the third hypothesis was also confirmed.

Summary

Managers in tourism in other service providers should be aware of other cultures and traditions. In addition to language skills, there must be openness, acceptance and respect for other cultures. The conclusions drawn here cannot claim to be exhaustive, because the study within a faculty and the interview of a limited number of managers and students may not be sufficient and representative enough for a generalization.

Rather, the data are intended to stimulate larger empirical follow-up studies in which the questions posed here can be further developed and the results checked and expanded.

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MANAGING THE CHANGES IN OHRID'S HOTEL OFFER THROUGH BOUTIQUE HOTELS

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ABSTRACT:

Ohrid is the most attractive tourist destination of the Republic of North Macedonia. With its natural and anthropogenic values, it has always been interesting and attractive to tourists, especially foreign visitors. The characteristics and beauties of Lake Ohrid, the cultural-historical heritage as well as the natural, environmental and ethno-social motives are factors that make Ohrid the largest and most famous tourist center of the Republic of Macedonia. Against the significant tourist values, the content of Ohrid's hotel offer is not set as a factor for increasing its competitiveness on the international tourist market.

In this context, changes in the hotel offer are necessary. Managing changes through an innovative approach to the establishment of boutique hotels is a significant strategic direction towards the improvement of hotel services in Ohrid.

Starting from that, this paper will carry out a theoretical and empirical investigation of the concept of boutique hotels and three basic aspects related to them: the brand, the formation of an appropriate organizational structure and the communications that employees make with each other and with guests. For this purpose, an analysis of these elements will be carried out in the SU hotel, one of the most renowned hotels on the Ohrid Riviera. Through the use of the survey technique, emphasis will be placed on researching the suitability of human resources in the hotel, their loyalty to hotel activities and the satisfaction of working in the hotel.

Keywords: *boutique hotel, hotel offer, Ohrid, organizational structure, hotel workers*

1.INTRODUCTION

Although it can be said that competitiveness is not a new concept in the tourism business, however, the complexity and dynamics of the modern environment and all the influences it causes, actualize the high competition in the tourism market as an extremely important challenge of the new century. The main reasons that encourage the competitiveness of the tourist market are: the character of tourist demands expressed through their heterogeneity and elasticity and the possibility of substitution of tourist services with the same or similar ones, as well as the permanent changes in the attitudes, demands, tastes and behavior of tourists. Thus, the modern tourist is constantly looking for something new, unknown and more attractive in all areas of tourist offer. If until a decade ago the motto "It matters where you spend your vacation" was valid, now the motto is "How you spend your vacation". The tourist clientele is oversaturated with worldly resorts, hotels, commercialized summer and winter tourist destinations. A new trend is to get to know new, less known countries, their culture, tradition, return to nature and traditions. Today's tourist is looking for a stay in facilities that will offer him comfort, a pleasant atmosphere, intimacy, in which he will feel their stylistic uniqueness.

Hotel industry, as an essential part of tourism, plays a very important role in creating and satisfying tourist needs. The quality of the accommodation offer, which is determined by the hotel's capacity to provide attractive products, services and solutions for its guests, is a factor that determines the quality of the overall tourist offer. Hotels are not immune to permanent market changes. Therefore, the hotel management is faced with the need to strategically approach the changes and think about finding innovative contents of its offer that will achieve full satisfaction of the guests' expectations.

Innovation is a specialized type of change. It occurs when new ideas and behaviors are accepted in the organization¹, when a developed new idea is translated into a new business, a new product or service, a new process, a new method of work or their improvement. Success in hotel change management depends on the organization's ability to continuously transform knowledge and ideas into new products, processes and systems in order to provide benefits to stakeholders. Innovation in hotels can range from introducing new services with which they break into the market to small, insignificant improvements. But, regardless of that, they represent the most significant area for the improvement of competitive capabilities.

¹ Kontić, Lj. (2008): Inovacije – izazovi za budućnost, Beograd: Zadužbina Andrejević

Among the majority of tourist places in Macedonia, Ohrid stands out as the most attractive tourist destination. With its natural and anthropogenic values, it has always been interesting and attractive to tourists, especially foreign visitors. The characteristics and beauties of Lake Ohrid, the cultural-historical heritage as well as the natural, environmental and ethno-social motives are factors that make Ohrid the largest and most famous tourist center of the Republic of Macedonia. However, in contrast to the significant touristic values that it has, the content of the hotel offer is not set as a factor for realizing the competitiveness of this destination on the international tourist market. The hotel product should be shaped, enriched and improved with new contents and innovations, in order to make the temporary stay of the guests better and more comfortable and Ohrid a more interesting and desirable destination.

2. BOUTIQUE HOTELS AS AN INNOVATIVE FORM IN HOSPITALITY

Innovations in tourism and the hotel industry are determined by the specific character of the tourist product. Considering the nature of the hotel product, innovative changes in the hotel can refer to the creation and successful application of a new product, process, new idea, new form of knowledge, new way of delivering quality or value to the guest, or a combination of all of them. . If changes are implemented according to guest needs, then managers focus on kitchen innovations, room innovations, internet innovations, service innovations that include pets in facilities, etc.¹ Innovation also occurs in the work process of hotels. Although they have a specific technology at work, innovation in its composition can be a significant element for success. Such changes occur in the segmentation of the market and the development of ideas for the product and their materialization, the way of distribution and promotion. The different views of innovation in hospitality point to several key areas in which change can occur in the creation of the hotel offer.²

- Product innovations – represent redesigned or completely new services or products, the novelty of which should be obvious to producers, consumers, suppliers or competitors. Examples of new tourism products developed in recent years are: loyalty programs, facilities for ecologically sustainable accommodation, events based on local traditions, etc.
- Process innovation – tends to increase the efficiency of existing operations by using new or improved technologies or by redesigning the entire production line, e.g. as a result of a

¹ Jacob, M. Tintoré, J. Aguiló, E. Bravo, A. Mulet, J. (2003). Innovation in the tourism sector: results from a pilot study in the Balearic Islands. *Tourism Economics*, 9(3), 279-295

² Hjalanger, kaj Radosavljević, G. Borisavljević K. (2011). Inovacije kao faktor preduzetništva u turizmu, Naučni skup Novi metodi menadžmenta i marketinga u podizanju konkurentnosti srpske privrede, 15. oktobar, Palić, Srbija..

reengineering process. Examples of major process innovations in tourism are: computerized tracking systems, cleaning and maintenance robots, self-service appliances, etc.

- Management innovations - it means an innovative approach oriented to the management of the quality of human resources. Tpa consists of the introduction of new jobs, new organizational structures, authority system, internal competence development, team building activities, etc. They are often combined with the introduction of new products, services and production technologies. Through this type of innovation there is a tendency to increase employee satisfaction and loyalty through activity.

- Innovations in logistics, which include the establishment of new commercial links, which can affect the organization's position in the value chain. Innovations in tourism logistics include: vertical linkages in the food and beverage industry, CRS (computer reservation systems) and Internet marketing, improvement of the airport hub system, and so on.

- Institutional innovations are outside the organization that span across the public and private sectors and set new rules of the game. Examples of tourism implications include: reform of financial incentives that restructure the concepts of social or health tourism; destination management systems and units that control access to tourist areas; and establishing or changing credit institutions and changing the conditions for obtaining financial assets.

In practice, there are numerous examples of product and service innovations. In the area of hotel product innovation, the formation of a special type of hotel, such as a boutique hotel, can be emphasized. This type of hotel is due to the growing trend of demand for differentiated hotel products and the wishes of hotel companies to provide more than the usual hotel offer.

A boutique hotel is a type of hotel characterized as a small entity, creating an intimate feeling where every guest is offered personal service. It is an independent hotel or part of a "boutique only" chain. This type of hotel has a special character, design, decor and personalized service. Its specificity is that it remains faithful to the local culture and is usually in the center of the city or in a very attractive place.

As a term, "boutique hotels" haven't actually been around very long. It is considered that it appeared for the first time in the 80s of the last century. However, it is not exactly established because according to some sources Jan Schrager is credited with the term, and other sources announce that the first true boutique hotel was the Clarion Bedford Hotel, opened in San Francisco in 1981, and in 1984 with the opening of the Morgans Hotel in New York, hotelier Jan Schrager and his business partner Steve Rubel actually coined the

term boutique hotel.¹ However, from a historical point of view, it is very likely that this type of hotel can be found throughout Europe at the beginning of the 19th century, only that they did not have that name then.

At their core, boutique hotels can be described as personalized, customized, unique and individual. Their most important feature is authenticity and an established unique way of communicating with their target market, breaking the monotony and creating an atmosphere in which guests will feel special. Precisely because of the uniqueness and creativity of the services that make up the offer of boutique hotels, they cannot be unified as a standard product.

However, their essential characteristics are:

Size: Boutique hotels typically have fewer than 100 rooms, small restaurants or bars, few recreation rooms, and limited meeting space.

Theme: Each boutique hotel has a unique theme, some are historical, some are culinary focused, and some focus on specific elements. The theme is present not only in the aesthetics of the hotel, but perhaps also in its name, staff uniforms, amenities, etc.

Style: The theme cannot be expressed unless the hotel has matching decor and design. Every element of the hotel's appearance should be carefully selected, from the design of the hotel's website, through the hotel's amenities, to the standards of operation.

Service: The small scale and intimate atmosphere allows staff to focus on providing outstanding guest service.

A boutique hotel may or may not be a luxury hotel. Hotels do not become "boutique" by charging high rates or offering premium amenities. In fact, many boutique hotels are affordable and focus more on personalized service than glamorous decor or five-star facilities.

3. ANALYSIS OF THE CONDITION OF THE SU HOTEL AS A BOUTIQUE HOTEL ON THE OHRID RIVIERA

As the most important tourist center in the Republic of Macedonia, Ohrid has a large number of hotels of different sizes and other types of accommodation facilities. Their structural analysis² shows that the majority are small and medium-sized hotels and apartments. The small hotel facilities include nine attractive boutique hotels that stand out from the classic offer of other hotels with their offer. Among them, with its extraordinary

¹ https://en.wikipedia.org/wiki/Boutique_hotel; <https://skift.com/history-of-boutique-hotels>

² <https://www.booking.com/design/city/mk/ohrid.hr.html>

location, is the SU hotel, a small family hotel where guests can feel cozy and intimate in uniquely designed rooms and suites and enjoy a relaxing time with freshly brewed coffee in the lounge bar. The hotel is located on the shore of Lake Ohrid, in the center of the city so that guests can admire the beauty of the lake and experience Ohrid through the view from its restaurant.



Fig.1. View of the old town of Ohrid



Fig.2. SU hotel



Fig.3. One of the rooms of SU hotel

However, the ratings of the guests who used the offer of this hotel indicate that there are weaknesses in its operation and actions should be taken to improve the offer. For this purpose, an analysis of two groups of stakeholders of the hotel was carried out:

- the views of the guests through the level of their reputation for separate elements of the hotel's offer expressed on the booking platform.
- the attitudes of the employees through a survey of 36 employees who are not managers and a survey and interview of the 4 managers of the hotel.

Graph 1. Guests' evaluation of the hotel's offer



Source: <https://www.booking.com/searchresults.hr.html>

If the evaluation of hotel Su is compared with the evaluations of other boutique hotels in Ohrid or in the region, it can be noted that this boutique hotel should improve the comfort offered to them. The analysis of the promotional activities through the hotel's website shows weaknesses in the propaganda message, that is, the website lists only the offered values that relate more to Ohrid than to the content of the hotel's offer. The hotel does not use to a sufficient extent the possibilities in strengthening its brand, so that there is no establishment of an emotional connection with which the potential customer would be attracted and choose SU among the large number of hotels that are included in the hotel offer of Ohrid. The website is rarely updated, so there is information that is outdated, inaccurate and irrelevant.

The modern business world in the field of hospitality increasingly emphasizes the loyalty of guests and the loyalty of staff as a factor for competitiveness. In fact, guest satisfaction and hotel performance are influenced by the standards of food and beverage, accommodation and other amenities provided by the hotel. But the qualities of the hotel staff have the same influence. It can be said that the human factor plays the most important role for the hotel's success because guests will be loyal consumers only if they are satisfied with the offer and above all with the expertise and hospitality of the staff. The need for effective and efficient human resources employed in the hospitality industry stems from two vital factors, ie. it is a tourist driven and quality driven industry. Adequate knowledge, skills and expertise of the staff as well as their satisfaction are necessary to attract the guests, to create a pleasant atmosphere of commitment to fully satisfy the guests' requirements and expectations.

In order to gain knowledge about employee satisfaction and their loyalty to the hotel, a survey of the employees of Hotel Su was conducted through their recruitment. The survey was conducted with three types of questions.

The first type of questions refers to the examination of the factors that influence building the interest of employees in hotel operations. In order to achieve that, two groups of

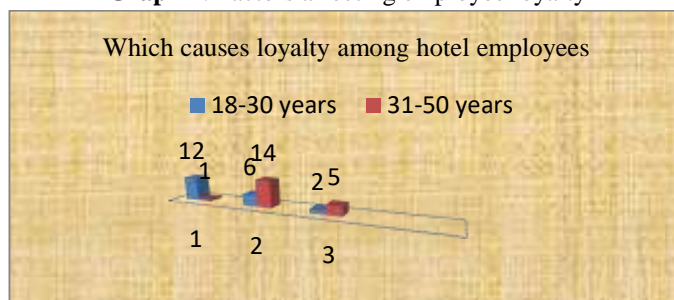
employees were examined, from 18-30 years old and 31-50 years old. Both groups are composed of 20 respondents each.

The survey questions address three basic factors:

1. Salary and other financial incentives
2. Working conditions and promotions
3. Positive working and communication climate in the hotel

The responses received are presented in Graph 2.

Graph 2. Factors affecting employee loyalty



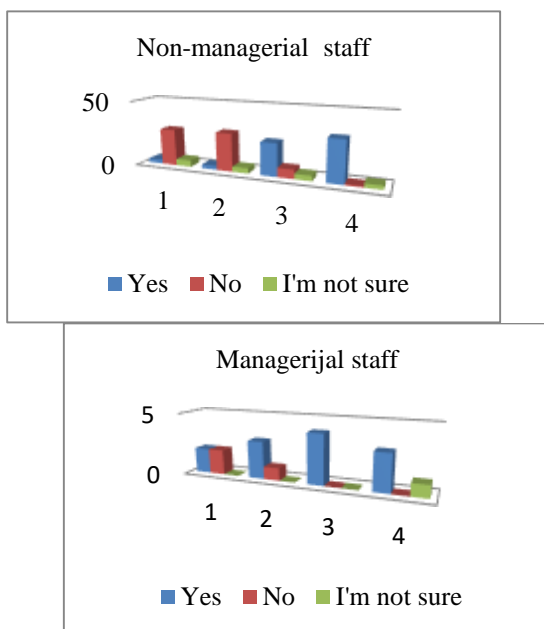
From the results presented, it can be noted that for employees up to 30 years of age, financial compensation has a key impact on their satisfaction with working in the hotel, while for employees over 30 years of age, positive working conditions and the opportunity to improve employees' knowledge and skills are essential. and their promotion.

The second type of question concerns the quality and expertise of the staff. They should be used to determine how appropriate the organizational layout of the hotel is. In order to ensure greater reliability of the obtained results, the same questions were asked to all respondents ie. of managerial and non-managerial staff, namely:

1. Does the structure of employees according to expertise meet the needs?
2. Are there enough employees in each department?
3. Are there enough managers?
4. Would the offer be better if there were more employees?

The results of the received answers are presented in Graph 3

Graph 3. Attitudes of employees about the number and expertise of the staff



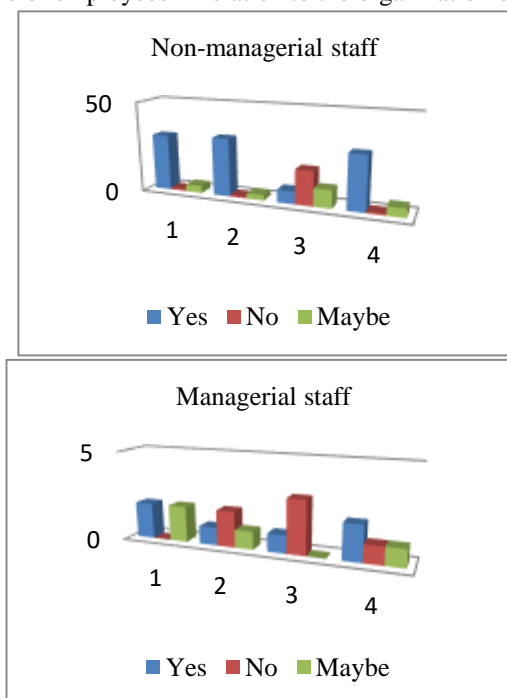
The analysis of the answers points to the conclusion that the expertise of the employees is not at a satisfactory level and needs to be improved. While the managers believe that there is enough staff, other respondents stated that the number of employees should be increased and thus the quality of the offer will be improved.

With the third type of questions, knowledge should be obtained about the organization of work in the hotel. For this purpose, answers were received to the following questions:

1. Is there a need for better organization of work?
2. Are there weaknesses in the transmission of information in the hotel?
3. Do technical means of work meet the needs?
4. Is there a need for teamwork and decision-making?

The results obtained from the survey are presented in the graph that follows.

Graph 4. Structure of employees in relation to the organization of work in the hotel



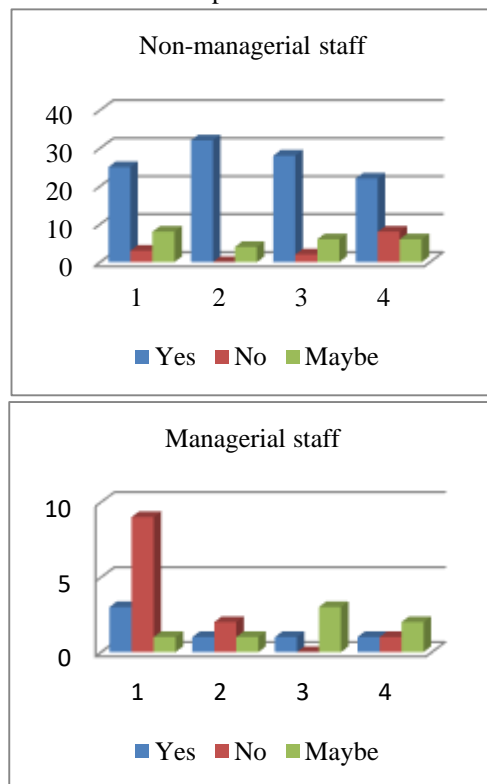
The received answers point to the conclusion that there is a lack of good organization, leadership and communication system in the hotel. Although the managers are satisfied with the existing organization, their other answers confirm that it is necessary to improve communications and advance leadership through the introduction of a team approach to work.

The fourth type of questions aims to determine the motivational climate that exists in the hotel, what is the factor that motivates employees and whether it exists as part of the operation. This was determined by answering the following questions:

1. Is it necessary to maintain annual assessments of individual operations?
2. Is it necessary to include weekly, monthly or quarterly stimulation (reward)?
3. Is it necessary to permanently improve the abilities of employees?
4. Is there a need for improvement in employee-management communication?

The results of the answered questions are as follows:

Graph 5. Structure of the respondents in terms of staff motivation



The received and presented answers indicate that there is a lack of motivation towards the employees in the hotel, and this is due to the inconstant and inadequate communication between the employees and the management, which leads to disharmony in the work. In addition to monetary incentives, employees feel the need for managers to take measures to improve the skills and professional knowledge of employees.

In order to obtain more complete results, an interview with the managers was also conducted on several essential issues, namely:

- Are you satisfied with the sale of the hotel product?
- Are you targeting new markets?
- How important is the opinion of the guests to you?
- Do you examine their satisfaction and how?
- What is your opinion about the image of the hotel among tourists?
- Are you satisfied with the expertise of your staff?
- What is your attitude towards permanent development of employees' abilities?

- Do you think that the employees are rewarded enough?
- Do you cooperate with educational institutions in the field of tourism and catering when hiring staff or on another basis?

4. CONCLUSION

From the conducted survey questionnaires as well as from the managers' answers received from their interviews, certain conclusions can be drawn and some recommendations can be proposed. The following can be stated as essential findings:

- The managers at Hotel Su have their own visions for increasing the turnover and the number of guests and overnight stays by improving the hotel offer. Their intention to create a positive image of the hotel not only in the region but also in other tourist markets is special.
- They do not make special efforts to research existing and potential tourists, their experience, satisfaction and expectations from the offer.
- The hotel has insufficient staff in terms of number and professional preparation. This applies to all employees, including the management staff. Due to the insufficient number of employees, most of the employees perform two or more roles, especially the management staff. This situation has its influence on the emergence of weaknesses in the organization of work, communication relations in the hotel as well as in the motivational climate that prevails among the employees. Thus, despite the initial enthusiasm of the employees, it has negative long-term consequences on the hotel's financial result.
- The hotel does not have significant communications with the educational institutions of tourism and hospitality from Ohrid or beyond, which contributes to the hiring of inadequate staff for the working positions, which can be said for several other hotels on the Ohrid Riviera. This may be the result of the general situation that prevails in Ohrid's hotel industry, which is the outflow of professional catering staff to work in other tourist countries.

To increase the recognition and attractiveness of the hotel, managers should focus their activities in two directions:

Introduction of an innovative approach oriented to the management of the quality of human resources, which will improve the working climate in the hotel. Their priority must be to motivate their staff both through material rewards and permanent improvement of their abilities so that they can develop their career and commitment to guests. Respecting the professional attitudes and opinions of employees will enable managers to create a positive atmosphere for building staff loyalty to the hotel. Satisfied guests will be loyal promoters of the hotel offer.

Creation of innovative solutions in the content of promotional means and media that present the hotel offer on the tourist market.

This hotel is representative of the small hotels in Ohrid, so the findings apply to all of them to the greatest extent. The possibility of them being built as boutique hotels opens up a wide space to advance the hospitality industry on the Ohrid Riviera.

In that direction is their strategic development through the introduction of various elements in the offer. Bearing in mind the role and importance of the staff in creating the hotel brand, managers must focus on retaining and developing the personnel in them.

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ZNAČAJ MANIFESTACIJSKOG TURIZMA NA PRIMJERU TENISKOG SAVEZA CRNE GORE

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SAŽETAK:

Na osnovu zahtjeva savremenih turista javljaju se razni selektivni oblici turizma među kojima je i manifestacijski turizam ili turizam događanja. Manifestacioni turizam nedvosmisleno doprinosi povećanju obima turističke potražnje. Turističke destinacije nastoje da razvijaju manifestacioni turizam sa ciljem postizanja višestrukih efekata, kao što su: produženje turističke sezone, unapređenje neophodne turističke i sportske infrastrukture, stvaranje pozitivnog imidža destinacije... Izučavanjem istorije sporta, a samim tim i sportskih događaja, otkrivamo da su sportski događaji odigrali značajnu ulogu u razvoju društva, pogotovo turističkih destinacija. Turistički i sportski radnici koji su prepoznali značaj sportskih manifestacija uspjeli su da na izgled od malog sportskog događaja pokrenu veliku industriju sportskih događaja.

Uloga tenisa u turizmu nije samo faktor unapređivanja turističke ponude, već je i generator dodatnih ekonomskih efekata. Uključivanjem tenisa u turističku ponudu Crne Gore stvara se pretpostavka za dugoročno uspješan nastup destinacije na sve zahtjevnijem turističkom tržištu. Studioznim radom teniski entuzijasti u Crnoj Gori na godišnjem nivou organizuju preko 80 turnira. Ono što je izuzetno važno je da je riječ o turnirima koji su se već čvrsto etablirali u Kalendar takmičenja Teniskog saveza Crne Gore, kao i u Kalendar Međunarodnih teniskih federacija ITF, odnosno ETA. Svi turniri funkcionišu na održivom principu, što je najbolja preporuka za višegodišnje, odnosno tradicionalno održavanje

Ključne riječi: *sportski turizam, sportski događaj, tenis, ekonomski efekti, kalendar takmičenja*

1. UVOD

Sport i turizam od davnina predstavljaju dvije moćne sile koje ujedinjuju ljude. Iako je sportski turizam relativno nov koncept razvoja turizma, njegovo djelovanje daleko je od skorašnjeg fenomena. Budući razvoj Crne Gore kao turističke destinacije neophodno je usmjeriti ka razvoju posebnih vidova selektivnog turizma. Imajući u vidu brojne prirodne i društvene resurse sa kojima raspolaže Crna Gora posebnu šansu za uspješan razvoj ima

sportski turizam. U radu smo nastojali da dokažemo da tenis kao sport u mnogo čemu može da unaprijedi turistički ponudu Crne Gore.

Zahvaljujući Teniskom savezu Crne Gore koji je organizovao prestižne teniske turnire turistička privreda Crne Gore u 2022 godini ostvareno je oko 1.800 noćenja po turniru. U radu smo dokazali da su hotelijeri prihodovali 1.836.000e. Uz pretpostavke da su učesnici turnira po danu trošili prosječno 30e za dolazak i do 918.000e vanpansionske potrošnje. Sa sigurnošću u radu smo dokazali da je turistička privreda Crne Gore od učesnika 17 međunarodnih turnira prihodovala oko 2.750.000e. Organizatori teniskih turnira uredno su izmirivali propisane zakonske obaveze plaćanja PDV-a državi. Na ime PDV-a za takmičarsku sezonu, koja traje šest mjeseci, Državi je na ime PDV-a uplaćeno 20.560,00e, izuzev prihoda od teniskih turnira koje ima hotelska industrija, avio, željeznički i drumski prevoznici, davaoci vanpansionskih usluga itd.

2. ISTORIJAT SPORTSKIH DOGAĐAJA

Izučavanje istorije sporta, a samim tim i sportskih događaja, odavno je akademska oblast. Da bi razumijeli savremene sportske događaje veoma je važno saznati kako su i kada nastali prvi događaji i kako su se oni razvijali kroz istoriju.

U naučnim krugovima još se traži svijest o tome šta se smatra izvorima organizovanog sporta. Pažljivo se proučavaju istorijske činjenice vezane za početak organizovanja sportskih događaja u drevnoj Grčkoj, Egiptu i Kini.

Postoje arheološki nalazi koji su doveli do saznanja o počecima sporta. Tako na primjer, na Zimskim olimpijskim igrama 1994. u norveškom gradu Lillehameru, komercijalno su korištene slike stare oko 4000 godina, na kojima se uklesano na stijenama ocrtavaju ljudski likovi sa sportskim motivima. Pronađeni su i nešto mlađi crteži stari 2000 godina na faraonskim spomenicima u Egiptu koji prikazuju takmičarske akcije kao što su potezanje konopa, plivanje, boks... Naučnici smatraju da su upravo Egipćani prvi postavili pravila za sportske igre, sportsku opremu i ustanovili nagrade za pobjednike. U literaturi Homer sa Ilijade izvještava o atletskom takmičenju kao dijelu pogrebnog događaja¹.

Šire priznata istorija odnosi se na porijeklo onoga što su sada Olimpijske igre. Drevne Olimpijske igre u Grčkoj su također bile dio širih svečanosti. Od skromnih početaka igre u Olimpiji su možda postojale već u X ili IX vijeku prije nove ere, gde su bile dio

¹ Graham, S. Neirotti, L. And Goldbatt, J. (2001)- The Ultimate Guide to Sports Marketing, New York, Mc Graw-Hill, Chapter 1.

religioznih svečanosti u čast Zeusa, oca mitoloških grčkih bogova. Olimpija, u grčkoj regiji Peloponez, bila je ruralno svetište, a na završnim svečanostima su prisustvovali samo oni koji su govorili isti jezik i dijelili ista vjerska uvjerenja¹.

Kako su igre postajale sve šire prihvaćenije, privlačile su sportiste iz dalekih zemalja, sve do 776. godine prije nove ere, koja je priznata kao početak organizovanja prvih drevnih Olimpijskih igara. Od tog vremena, igre su se održavale u Olimpiji svake četiri godine. Grcima ništa nije bilo važnije od Igara. Svake četiri godine se sklapalo primirje i svi ratovi su prestajali za vrijeme trajanja Igara.

Sportovi su dodavani svake godine, a u V vijeku prije nove ere i na svom vrhuncu, svečanosti su se sastojale od petodnevnog programa.² Igre su se u tom periodu sastojale od otprilike dvadeset sportskih događaja. Pobjeda u Olimpiji smatrala se najvećim počastima, i iako je vijenac od maslina bio jedina nagrada sa Igara, svaki pobjednički sportista bi dobio značajne nagrade od svoje države. Njihove pobjede bile su ponos gradu odakle su dolazili. Većina događaja održana je na glavnom stadionu, a veliki broj gledalaca sjedili su na okolnim travnatim padinama. Sportisti su bili goli, a Grci su, sa svojim istančanim estetskim uvažavanjem ljudskog tijela, bili veoma glasni u izražavanju svog divljenja.³

Niko sa sigurnošću ne može da kaže koje su sve sportske discipline bile zastupljene na Olimpijskim igrama prije 776. godine p.n.e. Zahvaljujući arheološkim nalazištima i sačuvanim spisima, pouzdano se zna da je 776. godine p.n.e na Olimpijskim igrama postojala samo jedna disciplina, a to je trčanje na jedan stadij - od riječi stadij postala je današnja riječ stadion. Prema nekim izvorima trka na jedan stadij bila je jedina disciplina na prvih 13 olimpijskih svečanosti, sve do 724. godine p.n.e, kada se uvodi i utrka na dva stadija. Na 15. igrama je uvedeno trčanje na osam stadija, a na 18. pentatlon.

Ženama nije bilo dozvoljeno da se takmiče i prisustvuju Igrama na stadionu. Jedna žena, Kallipateira, koja je željela gledati svog sina na bokserskom takmičenju u Olimpiji, otkrivena je nakon njegove pobjede. Za razliku od takmičenja na stadionu prisustvo ženama na olimpijskim takmičenjima bilo je dozvoljeno na hipodromu gdje su se održavale trke konja i kočija.

¹ University of Pennsylvania (2003). www.usopen.org (accessed 25 may 2003)

² Tohey, K. and Veal, A. (2000) – The Olympic Games: A social Science perspective, Oxon, CABI, Chapters 2 and 3.

³ The olympic image (1996), Donnees de catalogage avant publication, Canada, str.19.

Posle V vijeka prije nove ere, opadanje interesovanja za Igre odvijalo se postepeno. Kako se centar svjetske moći pomjerio ka Rimu, olimpijski ideali su nestajali. Sa širenjem hršćanstva, popularnost Igara je opala, da bi 393. godine, rimski car Flavije Teodosije, koji je bio posljednji car koji je vladao jedinstvenim Rimskim carstvom, ukinuo sve paganske praznike uključujući i Olimpijske igre.

3. ORGANIZOVANJE I IZVOĐENJE SPORTSKOG DOGAĐAJA

Organizovanje je u stvari bitna funkcija menadžmenta događaja, koje podrazumijeva stvaranje dobre organizacione strukture i kombinovanje ljudskih i ostalih resursa za dostizanje ciljeva, odnosno pretvaranje planova u akcije.

Ukoliko postoje optimalni uslovi sportski događaj ne bi trebalo da isporučuje osrednje iskustvo, već da učenicima događa, bilo da se radi o aktivnim učesnicima ili posjetiocima, priredi iznenađenja, radost i uzbuđenje, kao i da doprinese opštem zadovoljstvu. Za organizovanje sportskog događaja moraju postojati valjani razlozi i pretpostavljena korist, kako za organizatore tako za učesnike i potencijalne posjetioce.

Bez sveobuhvatnog istraživanja i planiranja, kao i analize klimatskih uslova, ukoliko se događaj organizuje na otvorenom prostoru, organizacija događaja osuđena je na neuspjeh. Izbor lokacije, odnosno grada domaćina, mora da ispunjava zahtjevne uslove kada su u pitanju prestižni sportski događaji. Mjesto treba da dražava usklađenost organizacionih uslova događaja, od komfora za učesnike i posetioce, saobraćajne pristupačnosti, pa sve do finansijskih mogućnosti organizatora događaja. Sadržaj događaja unaprijed je poznat, pogotovo ako se radi o sportskim manifestacijama, on mora da bude usklađen sa zahtjevima, kako aktivnih učesnika, tako i posjetilaca.

U teoriji menadžmenta događaja navodi se šest osnovnih interesnih grupa *stakeholder*¹ događaja: organizator događaja, sponzori, učesnici i posjetioци događaja, saradnici angažovani u postavljanju i izvršenju događaja, mediji i uže okruženje događaja.²

Kao organizatori događaja mogu da se pojave privatne profitne organizacije, neprofitne organizacije i u određenim slučajevima pojedine vladine agencije. Organizatori sportskih događaja u većini slučajeva su uslužno orijentisane organizacije, kojima je satisfakcija učesnika i posjetilaca glavni zadatak. U sferi interesovanja organizatora su stručnost i

¹ Bilo koja grupa ili pojedinac koja može imati uticaja ili je pod uticajem ostvarenja organizacionih ciljeva.”, R. E. Friman;

² Bowdin G. AJ (2006)- . Events management, Special event

kompetencije zaposlenih, odnosno izvršioca događaja, budući da njihov rad direktno utiče na kvalitet usluge događaja.

U postavljanju i izvršenju (naročito mega) događaja, pored zaposlenih saradnika, veoma značajna interesna grupa su i volonteri koji su znatno više zastupljeni kod sportskih i kulturnih događaja, nego kod poslovnih događaja.¹

Uspjeh događaja u mnogome zavisi od motivisanosti izvršilaca. Zbog toga je od ključne važnosti da menadžment događaja pronađe optimalan način kako da motiviše zaposlene. U zavisnosti od materijalne strane događaja, najplodotvorniji način motivisanja angažovanih ljudi bila bi kombinacija novčanog i materijalnog stimulansa. Uloga sponzora u organizaciji događaja ima značajnu ulogu. Odnosi organizatora događaja i sponzora su najčešće kratkoročnog karaktera, mada organizatori velikih i mega događaja sve češće teže uspostavljanju dugoročnih odnosa sa sponzorima. Menadžeri događaja treba da poznaju specifične ciljeve sponzora, kako bi izgradili dugoročno održive i obostrano korisne odnose između organizatora i sponzora događaja.²

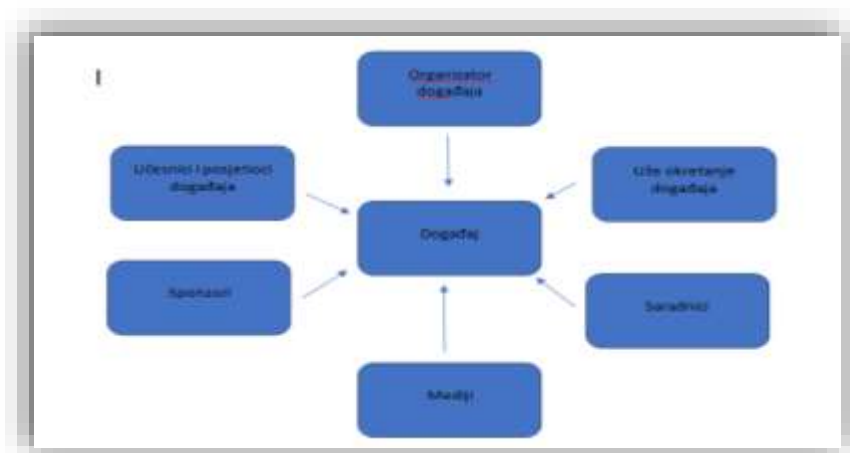
Tokom čitavog trajanja događaja u fokusu interesovanja menadžera događaja moraju biti aktivni učesnici i posjetoci, kao interesne grupe, jer će od njihovog zadovoljstva i ocjene kvaliteta usluga zavisiti uspjeh samog događaja, njegov imidž i posjeta sljedećeg događaja, ukoliko se organizuje u redovnim intervalima.

Šema 1: Izgrađivanje odnosa sa stejkholderima u organizovanju događaja

¹ [Tum](#), J, and [Norton](#), P. (2006) - Management of Event Operations, Copyright Yea

² Bowdin et al., 2006; Andrejević, Grubor, 2007):Events Management, Second edition, Elsevier,

Menadžment događaja, Novi Sad



Izvor: Projekcija autora

Značaj medijskog prisustva u organizaciji bilo kog sportskog događaja je od neprocjenjive važnosti. Mediji se najčešće javljaju u ulozi glavnog sponzora ili partnera događaja. Zbog toga mnogi autori smatraju da je medijska pokrivenost događaja značajna koliko i njihovo fizičko izvršenje. Organizacija i održavanje sportskog događaja je izuzetno zahtjevan i kompleksan posao koji podrazumijeva i odgovarajuću podjelu rada. Dobra postavljena organizaciona struktura, postavljanje kompetentnih rukovodilaca na čelne pozicije radnih jedinica omogućiće lakšu kontrolu, povećanje produktivnosti i na kraju planirani uspjeh događaja. S obzirom da se za svaku aktivnost predviđa vremenski interval izvršenja, da bi lakše pratili i kontrolisali proces organizovanja događaja, menadžeri događaja koriste Gant šemu (Gantt chart), na kojoj se predstavljaju zadaci i odgovornosti, rokovi za izvršenje zadataka, prioriteti i prekretnice, odnosno aktivnosti koje su od posebne važnosti za događaj i izvršenje ostalih aktivnost.

4. BUDŽETIRANJE SPORTSKOG DOGAĐAJA

Za uspješnu organizaciju bilo kog sportskog događaja od krucijalnog značaja je njegovo budžetiranje ili održivo finansiranje. Odobrena sredstva za pripremu, prezentaciju i organizaciju događaja su po pravilu ograničena i nedostajuća. Ukoliko nisu obezbijedena potrebna sredstva, organizator događaja blagovremeno treba da odustane od organizacije istih. Zato je od neprocjenjive važnosti utvrditi realan budžet sportskog događaja. To je u stvari preduslov za planiranje, organizovanje i realizaciju planiranog događaja. Bez potpunog poznavanja karaktera i prirode manifestacije nemoguće je donijeti valjan budžet.

U slučaju da plan prihoda nije realno projektovan i utvrđen na realnim i ostvarljivim prihodima organizatori događaja neće moći da u potpunosti realizuju zacrtan plan, čak se može desiti da se manifestacija i otkaže. Zato je neophodno utvrditi granice ili mete prihoda i rashoda. O ovim metama treba da budu obaviješteni svi učesnici u organizaciji manifestacije. U ovom sektoru organizacije posebnu važnost, ali i odgovornost, pripada menadžeru i timu koji je odgovoran za realizaciju i planiranje bužeta događaja.

Aktivnosti finansiranja sportskog događaja:

- finansijski plan – izrada plana prihoda i rashoda;
- definisanje stabilnih izvora finansiranja sportske manifestacije;
- utvrđivanje odgovarajuće strukture budžetiranja sportske manifestacije;
- rukovođenje procesom realizacije sportske manifestacije.¹

Na menadžmentu sportskog događaja je da realno procjeni visunu troškova sportskog događaja, jer od toga zavisi krajnji uspjeh manifestacije.

Rizik je sastavni dio svake manifestacije, pogotovo ako direktno zavise od vremenskih prilika, nedolaska predviđenog broja takmičara ili gledaoca, lošim odzivom masmedija...

Struktura troškova odnosno rashoda sportskog događaja između ostalog čine: zakup objekta sa ukupnim tekućim troškovima, troškovi smještaja i ishrane stranih gostiju (takmičari, zvanice, sudije), troškovi transporta i transfera za rukovodioce i zvaničnike međunarodne federacije, troškovi zakupa i transfera rekvizita i opreme, troškovi promocije manifestacije štampe (plakate, bilbordi, flajeri, diplome, zastavice, ulaznice, bilteni...), troškovi svečanog otvaranja i zatvaranja događaja, troškovi marketinga i propagande, troškovi obezbjeđenja; izrada pehara, medalja, statua; takse za sudije, nepredviđeni troškovi...

Kada je riječ o prihodima njih možemo razvrstati na direktne i indirekte prihode. U direktne prihode ubrajamo: prodaju ulaznica, ugostiteljske usluge, prodaju suvenira i ostalih propagandnih proizvoda, garderoba sa logom događaja ili pojedinih vrhunskih takmičara, kao i ostali prihodi.

U indirektnu prihode ubrajamo: sredstva iz budžeta nadležnih institucija, sredstva od sponzorstava i fandrejzinga, sredstva od donacija, iznajmljivanje prostora za reklame u

¹ Novaković, S., Radović, I. (2019) Menadžment u sportu – prvo izdanje, Univerzitet Singidunum, str. 191-194.

gradu i sportskim objektima, plaćena propaganda u masmedijima, kao i organizovanje igara na sreću – tombole, kladionice...

Naravno bez pomoći državnih institucija, od lokalnih zajednica, preko Vlada država, pa sve do Međunarodnih institucija, prestižnih sponzora, donacija, nemoguće je organizovati mega sportske događaje. Način i dinamika uplate dogovorenih sredstava jasno se definišu potpisanim ugovorima. Osim prihoda od prodaje ulaznica, ostali direktni prihodi ne učestvuju bitno u budžetu događaja.

5. ULOGA TENISA U TURISTIČKOJ PONUDI

Uloga tenisa u turizmu nije samo faktor unaprijeđivanja turističke ponude, već je i generator dodatnih ekonomskih efekata. Uključivanjem tenisa u turističku ponudu Crne Gore stvara se pretpostavka za dugoročno uspješan nastup destinacije na sve zahtjevnijem turističkom tržištu.

Većina današnjih razvijenih turističkih destinacija upravo nudi, kroz sportsko-rekreativne centre, tenis kao najatraktivniji dio svoje turističke ponude.

Tenis (zajedno za golfom, jahanjem...) s pravom, svrstavaju u sportove, koji doprinose razvoju elitnog turizma, i samim tim privlači turiste većih platežnih mogućnosti, što u svakom slučaju treba imati na umu prilikom izrade sportsko-turističkih programa. Zašto mnogi tenis nazivaju i "aristokratskim sportom", svjedoče i istorijska dešavanja nakon Berlinskog kongresa 1878. godine, kada je Crna Gora i formalno dobila - međunarodno priznanje. U narednim godinama, na Cetinju je funkcionisalo 12 inostranih poslanstava. Sa stalnim prebivalištem diplomatske svite, u grad su došle i njihove navike. Između ostaloga, i sportovi koji do tada nijesu bili prepoznati u Prijestonom gradu, u prvom redu tenis.

Zaljubljenici u tenisku igru, koji posjećuju određenu turističku destinaciju, bez obzira da li se radi o sportsko-rekreativnim aktivnostima, pogotovo, profesionalnim, spadaju u kategoriju nadprosječno edukovanih turista. I jedni i drugi traže potpunu sportsko-turističku uslugu.

Prilikom pravljenja sportsko turističkog proizvoda koji se nudi ljubiteljima tenisa, neophodno je imati u vidu da je riječ o turistima, odnosno sportistima, koji boraveći u više teniskih centara, imaju sasvim jasne zahtjeve, poput; besprekorno uređenih teniskih terena, kvalifikovanih i stručno obučanih trenera, spremišta za opremu, servisiranje opreme, adekvatne medicinske usluge sa odgovarajućim terapijama i masažama, Wellness i fitness centri, dvorane za sastanke, mogućnost posebnog jelovnika za učesnik

Ustvari, teniska turistička “publika” koju nastojimo da duže zadržimo na prostorima Crne Gore dolazi iz zapadnih dijelova Evrope, pripadajući uglavnom onom dijelu populacije koja je navikla na visoke kriterije usluga pojedinih sadržaja – u našem slučaju vezanih za tenis.

6. TENISKI TURNIRI U CRNOJ GORI

Studioznim radom teniski entuzijasti u Crnoj Gori na godišnjem nivou organizuju preko 80 turnira. Ono što je izuzetno važno je da je riječ o turnirima koji su se već čvrsto etablirali u Kalendar takmičenja Teniskog saveza Crne Gore, kao i u Kalendar Međunarodnih teniskih federacija ITF, odnosno ETA.

Svi turniri funkcionišu na održivom principu, što je najbolja preporuka za višegodišnje, odnosno tradicionalno održavanje. Loša strana organizacije ovih turnira je ta što su se oni u 2021. godinu, za koje smo u Tabeli br. 1 dali podatke, odigrali u samo šest gradova: Ulcinj, Podgorica, Danilovgrad, Bijelo Polje, Herceg Novi i Nikšić.

Tabela 1: Odigrani teniski turniri u 2021. godini

NAZIV	DATUM ODRŽAVA NJA	ORGANIZATO R	KATEG ORIJA	KON KUREN CIJA
DRŽAVNO SENIORSKO PRVENSTVO M	28.Nov. 2021 29.Nov. 2021	TK EMINEENT	A Kategori ja	Seniori
MASTERS DO 10 GODINA	12.Nov. 2021 13.Nov. 2021	TK DADEX	A Kategori ja	Do 10 godina
MASTERS DO 12 GODINA TK EMINEENT	06.Nov. 2021 07.Nov.2021	TK EMINEENT	A Kategori ja	Do 12 godina
MASTERS 14	30.Oct.2021 31.Oct.2021	TK BELLEVUE	A Kategori ja	Do 14 godina
MASTERS DO 18 GODINA M	30.Oct.2021 31.Oct.2021	TK EMINEENT	A Kategori ja	Do 18 godina
Bellevu Open – 12 M/Ž	23.Oct.2021 24.Oct.2021	TK BELLEVUE	3. Kategori ja	Do 12 godina

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Bellevu Open – 10	16.Oct.2021 17.Oct.2021	TK BELLEVUE	3. Kategori ja	Do godina	10
Nikšić Open – 12 Ž	09.Oct.2021 10.Oct.2021	TK NIKŠIĆ	4. Kategori ja	Do godina	12
Nikšić Open – 12 M	09.Oct.2021 10.Oct.2021	TK NIKŠIĆ	3. Kategori ja	Do godina	12
Challeenge Open – 14 M	02.Oct.2021 03.Oct.2021	TK CHALLEENGE	4. Kategori ja	Do godina	14
Glava Zete Open – 14 Ž	02.Oct.2021 03.Oct.2021	TK GLAVA ZETE	4. Kategori ja	Do godina	14
TK EMINEENT	02.Oct.2021 03.Oct.2021	TK EMINEENT	3. Kategori ja	Do godina	10
Vio Verde kup – 10 Ž	02.Oct.2021 03.Oct.2021	TK EMINEENT	2. Kategori ja	Do godina	10
Nikšić Open – 12 M	25.Sep.2021 26.Sep.2021	TK NIKŠIĆ	3. Kategori ja	Do godina	14
Nikšić Open – 12 Ž	25.Sep.2021 26.Sep.2021	TK NIKŠIĆ	3. Kategori ja	Do godina	14
Vio Verde kup – 10 M/Ž	25.Sep.2021 25.Sep.2021	TK EMINEENT	2. Kategori ja	Do godina	10
Memorijal “Ivan Huić” - 12	18.Sep.2021 19.Sep.2021	TK IGALO	2. Kategori ja	Do godina	12
Vio Verde kup – 10 M	11.Sep.2021 12.Sep.2021	TK EMINEENT	3. Kategori ja	Do godina	10
Vio Verde kup – 10 Ž	11.Sep.2021 12.Sep.2021	TK EMINEENT	2. Kategori ja	Do godina	10
Kup Oslobođenja – 14 M	12.Sep.2021 12.Sep.2021	TK NIKŠIĆ	3. Kategori ja	Do godina	14

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NEC Open	04.Sep.2021 05.Sep.2021	TK NEC	4. Kategori ja	Do godina	16
Vio Verde kup – 10 Ž	21.Avg. 2021 22.Avg. 2021	TK EMINEENT	2. Kategori ja	Do godina	12
ELITTE kup	14.Avg. 2021 15.Avg. 2021	TK ELITTE	4. .Kategor ija	Do godina	14
EMINENT kup – 10 M	14.Avg. 2021 15.Avg. 2021	TK EMINENT	4. .Kategor ija	Do godina	10
EMINENT kup – 10 Ž	14.Avg. 2021 15.Avg. 2021	TK EMINENT	3. .Kategor ija	Do godina	10
EMINENT kup - 12	07.Avg. 2021 08.Avg. 2021	TK EMINENT	2. .Kategor ija	Do godina	12
Nikšić Open - 12 Ž	01.Jul. 2021 31.Avg.2021	TK NIKŠIĆ	4. .Kategor ija	Do godina	10
KUP Nikšića – 10 M	01.Jul. 2021 31.Avg. 2021	TK NIKŠIĆ	3. .Kategor ija	Do godina	10
CHALLENGE Open – 12 M	24.jul. 2021 25.jul 2021	TK CHALLENGE	2. .Kategor ija	Do godina	12
Glava Zete – 12 Ž	24.jul. 2021 25.jul 2021	TK GLAVA ZETE	3. .Kategor ija	Do godina	12
Vio Verde Open – 12 Ž	21.jul 2021 22.jul 2021	TK EMINEENT	3. .Kategor ija	Do godina	12
ELITTE kup	17.jul 2021 18.jul 2021	TK ELITTE	4. .Kategor ija	Do godina	12
Vio Verde kup	10.jul 2021 11.jul 2021	TK EMINEENT	4. .Kategor ija	Do godina	14
CHALLENGE Open – 10 ž	10.jul 2021 11.jul 2021	TK CHALLENGE	4. .Kategor ija	Do godina	14

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Vio Verde kup – 10 M/Ž	03.jul 2021 04.jul 2021	TK EMINEENT	2. .Kategor ija	Do godina	14
Nikšić Open – 14 M	02.jul 2021 03.jul 2021	TK NIKŠIĆ	3. .Kategor ija	Do godina	14
Nikšić Open 12 – M/Ž	29.jun 2021 30.jun 2021	TK NIKŠIĆ	2. .Kategor ija	Do godina	12
Bellevu Open – 12 M	26.jun 2021 27.jun 2021	TK BELLEVUE	2. .Kategor ija	Do godina	12
Bellevu Open – 12 Ž	26.jun 2021 27.jun 2021	TK BELLEVUE	3. .Kategor ija	Do godina	12
DRŽAVNO PRVENSTVO – 16 M	26.jun 2021 27.jun 2021	TK ELITTE	A. .Kategor ija	Do godina	16
AS Open – 10 M/Ž	12.jun 2021 13.jun 2021	TK AS	2. Kategori ja	Do godina	10
DRŽAVNO PRVENSTVO – 18 M	12.jun 2021 13.jun 2021	TK EMINENT	A. Kategori ja	Do godina	18
DRŽAVNO PRVENSTVO – 14 Ž	05.jun 2021 06.jun 2021	TK EMINENT	A. Kategori ja	Do godina	14
DRŽAVNO PRVENSTVO – 10 M/Ž	05.jun 2021 06.jun 2021	TK AS	A. Kategori ja	Do godina	10
DRŽAVNO PRVENSTVO – 14 M	05.jun 2021 06.jun 2021	TK EMINENT	A. Kategori ja	Do godina	14
.DRŽAVNO PRVENSTVO – 12 M/Ž	29.maj 2021 30.maj 2021	TK BELLEVUE	A. Kategori ja	Do godina	12
Glava Zete Open - 14 Ž	22.maj 2021 23.maj 2021	TK GLAVA ZETE	4. Kategori ja	Do godina	14
Ulcinj Open - 10 M/Ž	22.maj 2021 23.maj 2021	TK BELLEVUE	2. Kategori ja	Do godina	10

CHALLENGE Open – 14 M	22.maj 2021 23.maj 2021	TK CHALLENGE	4. Kategori ja	Do godina	14
EMINENT kup – 10 M	15.maj 2021 16.maj 2021	TK EMINENT	3. Kategori ja	Do godina	10
EMINENT kup – 10 Ž	15.maj 2021 16.maj 2021	TK EMINENT	2. Kategori ja	Do godina	10
EMINENT kup – 12 M/Ž	08.maj 2021 09.maj 2021	TK EMINENT	2. Kategori ja	Do godina	12
Igalo Open – 10 M/Ž	31.maj 2021 01.apr. 2021	TK IGALO	2. Kategori ja	Do godina	10
DADEX – 12 M	17. apr. 2021 18.apr. 2021	TK DADEX	2. Kategori ja	Do godina	12
Glava Zete Open – 12 Ž	17. apr. 2021 18.apr. 2021	TK GLAVA ZETE	3. Kategori ja	Do godina	12

Izvor: Arhiova Teniskog saveza Crne Gore

7. EKONOMSKI EFEKTI MEĐUNARODNIH TURNIRA U ORGANIZACIJI TENISKOG SAVEZA CRNE GORE

Teniski savez Crne Gore u 2021 godini organizovao je 12 međunarodnih juniorskih turnira. Godinu dana kasnije, kao pouzdan višedecenijski partner ITF I ETA, Teniski savez Crne Gore dobio je povjerenje da poveća broj turnira, tako da je u 2022. godini organizovano, čak, 17 međunarodnih juniorskih turnira, od toga 10 profesionalnih turnira nagradnog fonda od 15 do 25.000 dolara, kao i reprezentativna takmičenja BJKC (Fed kup) i Dejvis kup.

Tabela 2: Teniski turnir ETA kategorije održani 2021. godine

NAZIV	DATUM ODRŽAVA NJA	ORGANIZARO R	KATEG ODIJA	KONKURE NCIJA
Bellevue Cup 2021	24/04/2021 02/05/2021	TS CRNE GORE	2. Kategorij a	Junior i juniorke do 14 godina
Cungu Open 2021	01/05/2021 09/05/2021	TS CRNE GORE	3. Kategorij a	Junior i juniorke do 14 godina
Montenegro Kup 2021	14/06/2021 20/06/2021	TS CRNE GORE	3. Kategorij a	Junior i juniorke do 14 godina
Rio verde open	12/06/2021 17/06/2021	TS CRNE GORE	3. Kategorij a	Junior i juniorke do 16 godina
Nikšić open	17/07/2021 25/07/2021	TS CRNE GORE	3. Kategorij a	Junior i juniorke do 16 godina
Eminent Podgorica open 2021	31/07/2021 08/08/2021	TS CRNE GORE	3. Kategorij a	Junior i juniorke do 16 godina
Eminent open 2021	24/04/2021 02/05/2021	TS CRNE GORE	3. Kategorij a	Junior i juniorke do 12 godina
Rio verde cup	09/08/2021 15/08/2021	TS CRNE GORE	2. Kategorij a	Junior i juniorke do 14 godina

Izvor: [www. Tenniseurope.org](http://www.Tenniseurope.org)

Tabela 3: Teniski turniri ITF kategorije održani 2021

NAZIV	DATUM ODRŽAVAN JA	ORGANIZAT OR	KATEGORI JA	KONKURENCI JA
Montenegro Open 2021	17/05/2021 22/05/2021	TS CRNE GORE Ulcinj	3. Kategorija	Junior i juniorke do 18 godina
Podgorica Open 2021	24/05/2021 29/05/2021	TS CRNE GORE	3. Kategorija	Junior i juniorke do 18 godina

		Podgorica		
Trebjesa Open 2021	07/06/2021 12/06/2021	TS CRNE GORE Nikšić	3. Kategorija	Junior i juniorke do 18 godina
Aurora Kup 2021	04/10/2021 10/10/2021	TS CRNE GORE Ulcinj	3. Kategorija	Junior i juniorke do 18 godina

Izvor: www. Tenniseurope.org

U 20222 godini ostvareno je oko 1.800 noćenja po turniru

$$1.800 \text{ noćenja} \times 17 \text{ turnira} = 30.600 \text{ noćenja.}$$

Ako uzmemo podatak da je prosječna cijena noćenja iznosila 60e po osobi, lako ćemo izračunati koliko su hotelijeri ostvarili prihoda

$$30.600 \text{ noćenja} \times 60e \text{ cijena noćenja} = 1.836.000e.$$

Ne smijemo zaboraviti ni ostalu vanpansionsku potrošnju. Uz pretpostavku da su učesnici turnira po danu trošili prosječno 30e za “doći ćemo” do **918.000** e dodatne potrošnje. Sa sigurnošću možemo tvrditi je je turistička privreda Crne Gore od učesnika 17 međunarodnih turnira prihodovala oko 2.750.000e.

$$1.836.000e + 918.000e = 2.750.000e$$

Pored pomenutih turnira, Teniski savez Crne Gore u 2022. godini uspješno je organizovao Devis i Fed Cup. Takmičenja su se, zbog dotadašnje uspješne organizacije, održavala u Ulcinju. Od ova dva takmičenja ostvareno je preko 3.000 noćenja u hotelima visoke kategorije sa cijenom od 160e po noćenju.

$$3.000 \text{ noćenja} \times 160e = 480.000e$$

Ukoliko ovom iznosu od 480.000e za smještaj dodamo i 60e potrošnje po danu, obzirom da se radi o već afirmisanim teniserima, dolazimo i do 180.000e dodatne, vanpansionske potrošnje, što ukupno iznosi oko **660.000e**.

Međutim, treba istaći da je ovdje riječ o pred i post sezoni.

Kroz povraćaj PDV-a država Crna Gora ima i dodatne, direktne, prihode.

Tabela 4: Povraćaj PDV-a na osnovu troškova odigravanja ITF I WTA turnira u takmičarskoj sezoni

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	SVRHA	KOLIČINA	IZNOS PDV-a (e) 21%
1.	Naplata PDV-a od nagrade	15.000\$	3.150\$ - 2.550,00
2.	Naplata PDV-a od kotizacije	900x1e	900,00
3.	Naplata od boravišne takse	900x0,50e	450,00e
4.	Osiguranje	7% od 900 noćenja - 45e po noćenju	2.835,00
5.	Naplata PDV-a od ostvarenog broja noćenja	13.500,00 (15e po danu)	2.835,00
6.	Naplata PDV-a od utroška za hranarinu	27.000,00	5.067,00
7.	Naplata PDV-a od vanpansionske potrošnje	256 taksi	537,00
8.	Naplata PDV-a od aerodromskih taksi	42 avionske karte	2.025,00
9.	Naplata PDV-a od kupovine avionskih karata	32 osobe sa sopstvenim prevozom	336,00
10.	Naplata PDV-a od potrošnje gostiju sa sopstvenim prevoznim sredstvom: putarina, gorivo, troškovi na putu, voda, hrana...	32 osobe sa sopstvenim prevozom	336,00
11.	Naplata PDV-a od ostalih prihoda: jedna masaža dnevno po takmičaru, stringovanja žica na reketima, taksi prevoz ,pranje i peglanje veša, liječenje i medikament, suplementacija itd.		2.352,00
	UKUPNO:		20.560,00

Izvor: Analiza stručne služba TSCG

8. ZAKLJUČAK

U skladu sa zahtjevima suvremenih turista javljaju se razni selektivni oblici turizma među kojima je i manifestacijski turizam ili turizam događanja. Sportske manifestacije na više načina, donose korist organizatoru, pogotovo domaćem stanovništvu, kao i učesnicima

događaja. Socijalni i kulturni uticaji događaja na okruženje određeni su i fizičkom veličinom događaja. Događaji malog i lokalnog obima ne mogu proizvesti identične socijalne i kulturne uticaje na okruženje, kao što to čine veliki i mega događaji. Za mnoge sportske manifestacije, koje će pronaći svoje mjesto u turističkoj ponudi bilo koje turističke destinacije, nijesu potrebna znatna finansijska sredstva, već jasna vizija, odabrana ideja, interesovanje za istraživački rad i na kraju vrijeme za realizaciju ideje. Krajnji rezultat mora biti uspješna organizacija, čiji efekti treba da budu lako mjerljivi.

Važno je organizovati sportke – turističke događaje i prilagoditi ih onim sa čim raspolazemo. Istovremeno neophodno je tražiti nove mogućnosti, istraživati nova tržišta, tražiti prilike za buduće manifestacije, sa ili bez novih objekata.

Studioznim radom teniski entuzijasti u Crnoj Gori na godišnjem nivou organizuju preko 80 turnira. Ono što je izuzetno važno je da je riječ o turnirima koji su se već čvrsto etablirali u Kalendar takmičenja Teniskog saveza Crne Gore, kao i u Kalendar Međunarodnih teniskih federacija ITF, odnosno ETA. Teniski savez Crne Gore u 2021. godini organizovao je 12 međunarodnih juniorskih turnira. Godinu dana kasnije kao pouzdan višedecenijski partner ITF i ETA, Teniski savez Crne Gore dobio je povjerenje da poveća broj turnira, tako da je u 2022. godini organizovano, čak, 17 međunarodnih juniorskih turnira, od toga 10 profesionalnih turnira nagradnog fonda od 15 do 25.000 dolara, kao i reprezentativna takmičenja BJKC (Fed kup) i Dejvis kup. Uloga tenisa u turizmu nije samo faktor unaprijeđivanja turističke ponude, već je i generator dodatnih ekonomskih efekata. Uključivanjem tenisa u turističku ponudu Crne Gore stvara se pretpostavka za dugoročno uspješan nastup destinacije na sve zahtjevnijem turističkom tržištu.

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IMPORTANCE OF EVENT TOURISM WITH THE EXAMPLE OF TENNIS ASSOCIATION OF MONTENEGRO

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ABSTRACT:

Pursuant to the requests of modern tourists, different selective forms of tourism occur, among which there is event tourism. Event tourism unequivocally contributes to increase in volume of tourist demand. Tourist destinations tend to develop event tourism with the aim in achieving multiple effects, such are: extension of tourist season, improvement of necessary tourist and sport infrastructure, creation of positive image of destination, etc. By studying history of sport, as well as sport events, we can determine that sport events played an important role in development of society, tourist destinations in particular. Tourist and sport workers recognizing the importance of sport events managed to establish great industry of sport events from seemingly small sport event.

Role of tennis in tourism does not represent merely factor for improvement of tourist offer but also generator of additional economic effects. By including tennis into the tourist offer of Montenegro, an assumption is made for the long-term successful appearance of destination at the demanding tourist market. By their studious work, tennis enthusiasts in Montenegro, at the annual level, organize over 80 tournaments. It is important to highlight that these tournaments are already firmly established within Calendar of competition of Tennis Association of Montenegro, as well as Calendar of International Tennis Federation ITF, that is ETA. All tournaments are sustainable, which represents best recommendation for multiannual, that is traditional organization.

Keywords: *sport tourism, sport event, tennis, economic effects, calendar of tournament*

NEUROMARKETING RESEARCH AND THEIR APPLICATION IN EFFECTIVE ADVERTISING STRATEGY

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ABSTRACT:

Neuromarketing research has emerged as a promising field for developing effective advertising strategies. This approach involves the use of different techniques and methods such as recording of brain waves and the potential related to different stimuli, eye movement tracking, facial expression analysis, in order to understand consumer behavior and preferences. By analyzing the impact of different marketing stimuli in advertisements, one can gain insight into how consumers make purchasing decisions. This paper presents an overview of neuromarketing research, the latest technologies and their applicability in the development of effective advertising strategies. We analyzed several studies that used neuromarketing techniques to develop successful advertising campaigns and applied artificial intelligence-based technologies (MojoAI) to address the challenges of creating and testing a campaign for a higher education institution. In this study, the correlation of sentiments of different age groups and genders in two different campaigns dedicated to the enrollment of a certain study program was tested. Also, the paper considers how neuromarketing techniques, such as sentiment analysis (facial expressions), as well as other artificial intelligence techniques can be applied in creating a marketing strategy and testing advertising campaigns, making them more attractive, memorable and convincing. The paper highlights the potential of neuromarketing research in advertising as revolutionary, when it comes to insight into consumer behavior and preferences that were previously unattainable by traditional research methods.

Keywords: neuromarketing, artificial intelligence (AI), marketing campaigns, management

1. INTRODUCTION

Modern consumers are becoming more and more demanding, have complex needs and are exposed to the influence of a large amount of information every day. During the 20th century, the prevailing view was that consumers, in most cases, make more conscious and rational decisions about purchasing products, that is, opting for certain services. The development of modern information technologies, the emergence of a digital environment, intense competition in all segments and the desire for instant solutions contributed to the fact that at the end of the 20th and the beginning of the 21st century, a greater number of purchasing decisions have been made on a subconscious level, mostly under the influence of emotions. (Lukić, 2019)

Scientific achievements in the field of neuromarketing have found their application not only in the academic but also in the commercial field, where they effectively recognize the "hidden" responses and reactions of consumers or service users. The application of neuromarketing initiated an increasing number of studies dealing with the analysis of the impact of advertising campaigns (its elements), various marketing stimuli on the behavior of the target group; how they perceive, feel, process the messages they are exposed to, how they make a purchase decision, etc. (Alsharif, 2023; Jain, 2022; Zaferiou, 2019; Kumar, 2015; Sebastian 2014)

The impact of advertising on the emotional and cognitive processes of the target group, on their behavior (eg decision-making, choices, preferences, perception, attitudes) requires a sophisticated approach of scanning and measuring their reactions. In order to understand the emotional response to the content, stimulus, neuromarketing uses modern technologies (electroencephalogram (EEG), functional magnetic resonance imaging (fMRI), electrodermal skin activity (EDA or GSR), infrared spectroscopy (fNIRS), eye movement features and others) and the latest decade, modern software is being developed that is used to identify consumer emotions based on facial expressions. (Pratama et al 2021; Moung et al, 2020; Jia et al, 2020) New versions of the software can recognize facial movements that last only 50ms and cannot be seen by the human eye, but with the further development of artificial intelligence, increasingly accurate software program. (Lukić, D., 2019)

The aim of the paper is to analyze various studies to look at modern research techniques, for (re)defining the creative concept of the advertising campaign (arrangement and content of visual, textual elements, etc.) in order to improve the communication strategy with the target group.

2. APPLICATION OF MODERN NEURORESEARCH

Traditional research techniques and testing of advertising campaigns mainly indicated the subjective attitude of the target group towards the campaign, i.e. the degree of liking, i.e. dislike for the same. However, neuromarketing made it possible to take a closer look at creative work, that is, to understand the emotional and cognitive impact of each element of a creative concept. (Joshi et al, 2023; Herhausen et al, 2019)

Understanding the "emotional journey" of the consumer through the creative concept of the advertising campaign provides valuable data, i.e. insight into the combination of elements that would most effectively connect the consumer and the brand on the emotional level.

Depending on the goal of the research and the depth of understanding the problem, the best neuromarketing technology is determined:

Electroencephalography (EEG) - measures electrical activity in the brain and can provide insights into attention, emotional involvement and cognitive processes.

Functional magnetic resonance imaging (fMRI) - measures changes in blood flow in the brain and can provide insights into emotional reactions, memory encoding and decision-making processes.

Eye tracking - measures where and how long people look at certain stimuli, and can provide insights into attention and visual engagement.

Galvanic skin response (GSR) or electrodermal activity (EDA) – measures changes in skin conductance caused by sweating, which can indicate emotional arousal.

Heart rate variability (HRV) - measures changes in heart rate, which can indicate emotional reactions and levels of engagement.

Facial Expression Analysis - uses computer vision algorithms to detect and interpret facial expressions, which can provide insights into emotional reactions.

These technologies can be used in conjunction with other research methods, such as surveys, focus groups, and observational studies, to provide comprehensive insights into consumer behavior and decision-making processes.

The choice of technology will depend on the specific research question and the level of detail required to address it. (Zaferiou, 2019; Jain&Sharma, 2018; Falk&Bassett, 2017; Bradley&Lang 2015; Poels&Dewitte, 2006; Russell&Pratt 1980) Face recognition of respondents is supported by artificial intelligence (AI) and enables the application of Sentiment Analysis to improve marketing strategy and increase conversion rate (Srivastava, G. & Bag, S. 2023., Suman, S., Urolagin, S. 2022.,)

The success of an advertising campaign is measured by how respondents evaluate and react to various elements, whether it is the first impression ("halo effect"), whether the message is clear, whether it has attracted attention, whether they trust the advertisement and whether it communicates the image and value of the brand, whether it is original, and in this manner the arrangement of elements, colors, text, images or video format is tested.

Advanced technologies, development of artificial intelligence, progress in the field of machine learning gives the possibility of creating, redirecting and modifying the message, personalizing the content of the message, as well as Sentiment analysis through personal information (gender, age) and character expression to recognize and interpret basic emotions (anger, fear, happiness, sadness, disgust, surprise and neutral state) as a result of reaction to the campaign (Suman, S., Urolagin, S., 2022; Hartmann, et al 2021). As virtual reality has become a common meeting place for people and brands and as new forms of communication appear (live streaming, digital advertising, video games, etc.) with the increase of interactions, there is a need for a better understanding of the experience, especially through the facial expressions of the target group (McDonnell, et al. 2020; Yolcu, G et al. 2019)

One of the methods used is sentiment analysis, which is a contextual analysis of advertising campaign elements (shape, color, text, etc.) that identifies and separates subjective information and the emotional tone of the message; positive, negative or neutral. This type of measurement is used for both traditional and digital advertising and allows to improve customer service and increase brand reputation through these metrics scanned advertising elements and corresponding emotions. (Pang&Lee, 2008; Chatterjee&Hoffman, 2012; Yang, Chen&Huang, 2016; Kim&Park, 2013; Li, Liu&Li, 2019) The technique of sentiment analysis is used by researchers to detect and evaluate consumer feelings and apply the results in real time for faster and more accurate recognition of information. (Ghose&Ipeirotis 2011; Zhang, Liu&Wu, 2018; Lu et al, 2020; Al-Hawari et al 2021; Dua net al 2021)

3. RESEARCH METHODOLOGY AND RESULTS

The application of modern neuromarketing techniques was tested with the help of an innovative solution, i.e. hardware and software system MojoAI during two days of the education fair in Novi Sad 2023.

The MojoAI application broadcasts animated content (text, graphics, images) and anonymously records the visitor's reaction, determining the viewer's age cohort, sentiment (positive, neutral, negative), as well as gender. The MojoAI platform (the company Mojo AI media technologies DOO) is fully compliant with the law on the protection of personal data and the GDPR, where the entire analysis takes place on the device itself using localized analytics containing artificial intelligence and where the application anonymizes the data immediately after the analysis, while also deleting these videos.

The accuracy of the analytics is achieved by the fact that each device in the network has the ability to learn on the spot and recognize if a person returns multiple times in a certain period of time, without recording the person's personal data. In order to achieve this, a sophisticated anonymization system is used, where the anatomy of the face is stored in the form of a mathematical record from which the face cannot be constructed, and thus anonymized data is used for further statistical analysis of the visitors' reactions.

The methodology of data collection included the activation of the hardware part of the platform (a tablet with content displayed at the Singidunum University stand at the fair), display of stimuli (21 enrollment campaigns, 23 enrollment campaigns for selected study programs), registration of visitors to the stand at a distance of up to 2.5 m from tablets, real-time sentiment analysis, creating statistics by age and gender cohorts. During the two days of the fair, the application recorded 1281 targeted views and 600 visitors to the stand, 60% of whom were male.

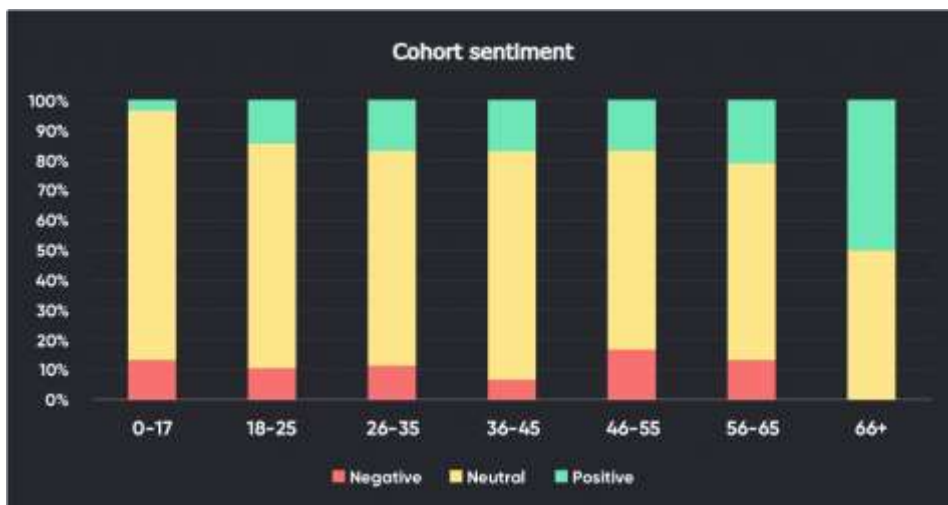


Figure 1. Enrollment campaign 21 vs 23 by age groups for both sexes according to sentiment

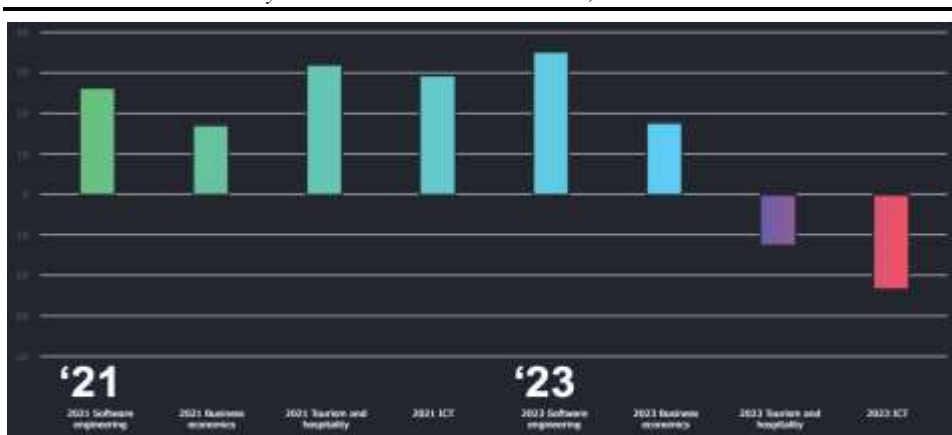


Figure 2. Change in sentiment expressed as a share of the difference between positive and negative sentiment in total sentiment

The biggest difference in visitor reaction was observed for the content of the ICT 21 and ICT 23 campaigns, as well as hospitality 21 and 23, which enabled the authors to do an additional analysis of the content as well as a comparison of elements (graphics, text, colors, images) in the respective campaigns.

3. CONCLUSION

The use of AI solutions such as MojoAI allows for a better understanding of the preferences, interests, and attention of the target group. It enables decision-making based on data, as well as the preparation of campaigns that can be previously tested with the target group. Also at trade fairs and various events, it allows to increase the interest of visitors, as well as conversions that can lead to a specific campaign goal.

Neuromarketing studies make it possible to gain an objective insight into the factors and elements of an advertising campaign that are of strategic importance for the positioning of brands, and thus for making decisions about purchasing them. As a response to the challenges of modern consumer society, there is a need for a sophisticated way of discovering the subconscious and measuring the cognitive, emotional reactions of consumers in order to gain insight into motivations, preferences and purchasing decisions.

In conclusion, the use of neuromarketing technologies, sentiment analysis and AI solutions is revolutionary for the advertising industry. These technologies provide invaluable insights into the emotions, preferences and behavior of target groups, enabling advertisers to create more effective campaigns and improve the user experience. By

harnessing the power of neuroscience, data analytics and machine learning, advertisers can make informed decisions and tailor their message to connect emotionally with their target audience. As technology continues to evolve, we expect even more innovative solutions to emerge, leading to higher levels of engagement, loyalty and growth for brands that adopt them.

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НЕУРОМАРКЕТИНГ ИСТРАЖИВАЊЕ И ЊЕГОВА ПРИМЕНЉИВОСТ У ЕФИКАСНОЈ СТРАТЕГИЈИ ОГЛАШАВАЊА

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АПСТРАКТ

Неуромаркетинг истраживања су се појавила као обећавајуће поље за развој ефикасних стратегија оглашавања. Овај приступ подразумева коришћење различитих техника и метода као што су снимање мозга, праћење очију, кодирање лица како би се разумело понашање и преференције потрошача. Анализом утицаја различитих стимуланса у рекламама, може се стећи увид у то како потрошачи доносе одлуке о куповини. Овај сажетак представља преглед истраживања неуромаркетинга, најновијих технологија и њихове применљивости у развоју ефикасних стратегија оглашавања. Прегледали смо неколико студија које су користиле технике неуромаркетинга за развој успешних рекламних кампања и примениле технологије засноване на вештачкој интелигенцији (МоЈоАИ) да би одговориле на изазове у креирању и тестирању једне универзитетске кампање. У овој студији смо тестирали корелацију између осећања у оквиру различитих старосних група у поређењу са две различите кампање посвећене упису у студентске програме. Штавише, расправљамо о томе како се технике неуромаркетинга као што су анализа осећања, кодирање лица и друге технике вештачке интелигенције могу применити у креирању маркетиншке стратегије и тестирању кампања, чинећи рекламе привлачнијим, памтљивијим и убедљивијим. Потенцијал истраживања неуромаркетинга за оглашавање наглашен је као поље револуционарања пружањем увида у понашање и преференције потрошача који су раније били недостижни традиционалним методама истраживања.

Кључне речи: неуромаркетинг, вештачка интелигенција (АИ), маркетиншке кампање, менаџмент

HOFSTEDE'S DIMENSIONS OF NATIONAL CULTURE IN THE FUNCTION OF IMPROVING ENTREPRENEURIAL ACTIVITIES

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ABSTRACT:

In the modern business environment, entrepreneurial activities are gaining more and more importance. Entrepreneurship and entrepreneurial activities strongly affects the economy of every country. They should be adapted to the modern business environment. Entrepreneurs are the bearers of entrepreneurial activities. Although practice shows that entrepreneurs have universal characteristics, certain variations can also be observed in individual entrepreneurs. Variations, for the most part, appear due to the different national cultures from which the entrepreneurs originate. The connection between entrepreneurial behaviour and national cultures is determined by the framework of the dimensions of national cultures established by the scientist Geert Hofstede. This work aims to provide, through Hofstede's dimensions of national culture, a theoretical presentation of the most significant characteristics that influence the development and improvement of entrepreneurship. In this context, the influence of national culture on entrepreneurial activity is analysed.

Keywords: national culture, organizational culture, entrepreneurship, management, enterprise

1. INTRODUCTION

Entrepreneurship is the main carrier of business activities. Therefore, it is necessary to analyze the elements that affect its growth and development. Most authors, who deal with this topic, agree that these are the following factors: demographics, finance, socialization, national culture, human resources, etc. These factors vary from country to country. The factor that has the most influence on entrepreneurial activities is national culture. The dominant values that make up one national culture differ from country to country, therefore the concepts of entrepreneurship are different. Therefore, cultural differences must be considered in all segments of business functions, from marketing, management, and entrepreneurship to finances. Depending on the cultural environment, i.e. the national culture to which they belong, entrepreneurs will create their own business and their own behavior. The aim of this paper is to define the concepts of national culture and entrepreneurship, as well as to determine their interrelationship. The measurement of

national culture is carried out using measurement models, of which Hofstede's model of cultural dimensions was used for the purposes of this paper. At the end of the paper, a conclusion and recommendations were given in the direction of strengthening entrepreneurial activities in companies.

2. DIFFERENT DIMENSIONS OF NATIONAL CULTURE

National culture is a system of assumptions, values, and norms, shared by members of one national community. National culture is contained of language, tradition, religion, education, way of dressing, behavior in certain situations, etc. However, this does not mean that all members of one national culture will behave identically. Namely, national culture is an important element for achieving success or failure in business. However, cultural differences are very important characteristics that determine why one company has one way of doing business or another. That represents that the same way of doing business can be positive in one cultural environment, while in another it can lead to unwanted consequences. Certainly, deeper analysis and understanding of these cultural differences lead to more precise decision-making, a better understanding of consumers' desires and needs, and improved communication, and managerial skills.

National culture has a strong influence on the company's business, primarily through employees. They are the bearers of certain value systems (attitudes, assumptions, norms) and moral principles that originate from their national culture, which are inborn in them through childhood, schooling, and education. Employees bring these value systems into their companies. In that way, employees shape the way of doing business.

The most important research on the influence of national culture on the way of doing business was done by Gert Hofstede. According to Hofstede's research, the dimensions of the national culture of a society are:

(Hofstede, 2001).

1. Distance of power - represents the "level" of uneven distribution of power that members of national culture accept as normal. The distance of power will influence the attitudes of employees, primarily managers, about decision-making processes. Namely, in companies with a high distance of power, power is concentrated in managers. They make their own decisions, not involving employees in decision-making processes. In companies with a low distance of power, power is more evenly distributed, not only to managers but to employees, so they are involved in decision-making processes in the company.
- 30.
2. Individualism - represents the extent to which employees have developed a sense of belonging to the company. In individualistic cultures, there is no sense of belonging to the company. It is believed that each individual is responsible for

their own destiny and individuals are mostly focused on themselves and their needs. There is a strong sense of belonging in collectivist cultures. In these cultures, the individual feels emotionally attached to the organization, is loyal to his organization, and is responsible for his own destiny.

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3. "Male-female" values - in cultures dominated by male values, results, money, aggression are valued, and in cultures dominated by female values, moderation, social status of the relationship are valued.

4. Avoiding uncertainty represents a tendency to take risks. Given the aversion of people to risk and risk situations, this is about the level of risk avoidance. Namely, in cultures with a high level of uncertainty avoidance, employees do not tend to change, risk acceptance, and responsibility. In cultures with a lower level of uncertainty, there is a greater willingness to accept change, risk, and risk situations.

5. Long-term-short-term orientation is an attitude that speaks of how far from the present moment an individual sees the future within the framework of setting a certain plan .

Having in mind these dimensions, we can say that differences in business can be noticed in different companies, and thus in the concepts of entrepreneurship. These differences are attributed to the stated dimensions of national culture. As far as these dimensions are concerned, Hofstede believes that out of all these dimensions, the hierarchical distance of power and the avoidance of uncertainty have the strongest influence. These dimensions of national culture will be used to explain the impact of national culture on entrepreneurship.

3. ENTREPRENEURSHIP AND ENTREPRENEURIAL ACTIVITIES

Entrepreneurship is defined as the ability to initiate certain actions, i.e. taking action with the aim of achieving a certain goal. This includes readiness to fight obstacles, readiness to uncertainty of outcome and risk (Buble & Kružić, 2006).

Also, entrepreneurship is a set of knowledge, skills, ideas and initiatives possessed by an individual, but also by a group, collective or business entity. "Courage, impulse, foreboding and alertness are the building blocks of entrepreneurial success" (Kirzner, 1997).

Entrepreneurship in a company depends on the economics, social and political conditions in a country, as well as on a good (bad) business climate, both locally and globally. In weak and underdeveloped economies, entrepreneurship is usually weak, while in strong

and developed economies, entrepreneurship is very strong. However, there is one specificity from entrepreneurship, it can start a weak economy of the country. According to Kirchhoff, whenever there was an economic crisis, i.e. a decline in economic activity, entrepreneurship started the economy with its ideas and creations and led to new growth and an increase in employment. This refers to the entrepreneurship of small companies, but also entrepreneurial experiences, innovations, and changes in large companies (corporations) (Kirchhoff, 1994, Khan, 2018).

In order for entrepreneurship to be stimulating for the development of an economy, two factors are important: quality entrepreneurial education and motivation of employees. Therefore, when it comes to education, there should be reference institutions that will be able to provide knowledge to all interested parties, on the one hand, and on the other hand it is necessary to empower employees and everyone else to want to be educated (Kent, 1990, Landström, et.al., 2012).

Quality entrepreneurship education should have the following characteristics: broad programs that will include as many young people as possible, because it is difficult to assess in advance who has the talent for entrepreneurship; any economic education should include entrepreneurship education; the development of entrepreneurial talent is not only possible through economic education and school approach, so it is necessary to develop entrepreneurial talent through various forms of practical entrepreneurial skills (Kirchhoff, 1994).

Entrepreneurial education should be innovative and creative. Through good education, entrepreneurs can be formed who will carry new ideas in a very uncertain competitive environment. It should encourage entrepreneurial culture and nurture an entrepreneurial mindset, attitudes and skills that allow individuals to identify new opportunities in solving entrepreneurial and other business problems (Bakar et. al., 2015, Malerba & McKelvey, 2019).

In addition to education, motivation is another important factor for the development of entrepreneurship. Motivation means the willingness of an individual to make a certain effort in order to achieve a given goal. An individual will be motivated to create, if it will bring him results (Hsu, et. al., 2014). In the context of entrepreneurship, motivation means that “an individual will be “motivated to make an effort to start a business if he expects the job to bring him more money and a reputation in his environment” (Marvel, 2007, Mota, et.al., 2019).

4. ENTREPRENEURIAL CULTURE - DETERMINANT OF ENTREPRENEURIAL ACTIVITIES

In the context of business, entrepreneurial culture can be described as the attitudes, values, skills and power of a group or individual working in an organization characterized by risk (Danish, et. al., 2019). According to Hofstede (Hofstede, 2001), culture can be described as a collective indoctrination of consciousness that has the power to distinguish members of one group or group of people in relation to another group of people. Cultural characteristics of entrepreneurs, such as education, language, religion, represent an important role in the development of entrepreneurial abilities and contribute to the survival of the entrepreneur's business (Altinay, 2008). In this sense, the culture that entrepreneurs create plays a vital role, because organizational culture is strongly linked to innovation and creativity (Nystrom, 1990, Kao, 1989, Burns, 2001, Pohlmann, et. al., 2005). The claim that differences in economic growth may be related to differences in entrepreneurial culture was emphasized very early (Baumol, 1968). Therefore, it is necessary to encourage entrepreneurial culture at the microeconomic and macroeconomic level, at the level of the organization, but also at the level of the entire country.

Entrepreneurial culture is the main driver of entrepreneurial activities and social progress in general. Today, entrepreneurship is a global phenomenon. This is evidenced by well-known global studies of entrepreneurship, such as the Global Entrepreneurship Monitor - GEM (Global Entrepreneurship Monitor) and the Global Entrepreneurship and Development Institute - GEDI (The Global Entrepreneurship and Development Institute), which use various indices to measure entrepreneurial activities by country and regions. GEM has developed the Composite Entrepreneurial Ecosystem Quality Index (ESI), a diagnostic tool that provides frameworks and data for analyzing almost any sub-national ecosystem, while GEDI uses the Global Entrepreneurship Index (GEI) which measures the level of entrepreneurial activities in a number of countries.

Numerous factors of entrepreneurship development can be divided into two basic groups: (Zacharakis , et. al., 2020). The first group consists of economic factors. The second group consists of non-economic factors, namely cultural values and economic policy measures that affirm entrepreneurship. Many people contributed to the growth of the importance of entrepreneurship and entrepreneurial culture factors. The very beginning of the development of entrepreneurial culture can, however, be linked to the failure in that era of dominant concept of economic management.

This concept is variously called: corporatism, tripartism or collectivism (Sathe, 2003). All approaches have some common characteristics. The first relates on the necessity of direct and active involvement of the state in administration economic life. According to this understanding, the state should immediately it intervenes not only at the macro level, but also at the micro level, that is, its role not only creates a stimulating business environment for economic entities, it should be directly involved in the processes of economic regulation

life. To a large extent, this approach was inspired by the experience of the Scandinavian countries in regulating the economy, and to a lesser extent the Japanese tradition of state interventionism. It is clear that in such an understanding of the role of the state in economic management, entrepreneurship and small businesses are practically absent had no role. Another characteristic common to these concepts is the understanding that economic development and increasing national competitiveness could be achieved only on the basis of economies of scale. In other words, big companies, i.e. "big business" are carriers of economic growth as such they should enjoy support from the state. According to the third characteristic of the concept of tripartism, governments, "big business" and trade unions must closely cooperate on macro and micro level. Cooperation between the government and "big business" in the development of the national economy cannot give expected results without full cooperation with organized labour by force, as a third party. (Paunović, 2017)

Entrepreneurship is the essence of free entrepreneurship, because the birth of new pre-longer life gives vitality to the market economy. New businesses create a very large proportion of innovative products and services that transform the way of who work and live.

4.1. An organizational culture that supports entrepreneurship

The creation of a positive organizational culture implies the creation of an environment in which the emphasis is on: opportunities and strength (comparative advantages) of employees, rewarding and less on punishing and the overall development of employees, and not only on organizational effectiveness. (Robbins, 2013)

In this sense, the basic values of entrepreneurial culture exposed are in the continuation of the text (McCrimmon, 1995):

A positive attitude and openness to change no matter where it comes from. The most successful organizations build a culture that welcomes change and the opportunities it brings. Changes are not a threat to the organization, but an opportunity and a chance. Over time, orientation to change becomes part of the organization's culture. Market conditions demand that organizations not only adapt to changes in the environment, but also work on their creation. Instead of being reactive, organizations increasingly need to be proactive. (Lockhead, 2008)

Bearing in mind the acceleration of technological changes, it is essential that organizations invest in the development of human resources. The development of human resources is a long-term investment (not an expense), an investment that returns the fastest. Related to the previously mentioned is the organization's orientation towards valuing and respecting individuals and their real potential. Entrepreneurial culture implies such an atmosphere in which different ideas and approaches to solving some problems are welcome, as well as strengthening the awareness of each individual that he is an "important link" in the whole story and that someone respects his competence. In order

for the organization to learn, it must first make mistakes, admit them, but also learn from them so as not to repeat them. In this context, the acceptance of risks and the fact that through risk-taking sometimes a mistake is made, and that there is no cruel punishment for possible failures in business, is a significant value of entrepreneurial culture.

Independence in making business decisions implies responsibility for making decisions at lower levels as well, while minimizing bureaucratic decision-making procedures.

A positive culture implies equal treatment of employees, regardless of their position in the hierarchy, which means that employees should be viewed more as partners and not as employed workers. The systemic perspective in this context means that everyone in the organization, regardless of their position, with their constructive approach can contribute to concrete solutions to possible problems from the aspect of the organization as a whole.

Open communication and quality teamwork imply that information must be shared. Without open communication, there are no reliable inputs in solving existing problems. Openness to the environment and the influences of the environment is of particular importance because it contributes to the creation of an organization that, through interaction with other business entities, solves its essential development issues much faster.

Organizations with an entrepreneurial culture highly value the action orientation of employees and their willingness, but also their ability, to bring a business idea that has been developed and prepared for a certain time to fruition.

Commitment to work as well as the feeling of belonging to a certain organization are perhaps the key determinants of organizational culture, which is defined as entrepreneurial. Namely, the awareness that employees can realize their own goals through the realization of the organization's goals strengthens their commitment and their willingness to engage in it as if they were in their own business. In order to establish and incorporate the mentioned values in the corporate environment, it is necessary to develop appropriate systems of motivational factors, both material and non-material. Material motivators are an essential element of the support system and represent a starting component in organizations. There are numerous non-material factors that can have a very stimulating effect on employees: interesting work, the possibility of advancement and further professional development, greater rights and responsibilities, new challenges, a fair relationship between employers, a pleasant working atmosphere, flexible working hours, the possibility of doing work at home, etc. Of essential importance is the readiness of the top management to enable independence for employees, to encourage their creativity and the process of their development. In this way, a direct signal is sent to employees that the organization cares about their opinion and position on an issue. An important motivating factor is trust in employees and readiness top managers to allow their associates to bring a certain idea to market realization in practice. The award for exceptional dedication and loyalty of associates at all levels of decision-making through a

higher salary, bonuses and even participation in the distribution of profits is currently the most common form of motivation and reward. In recent times, the readiness of top management to enter into ownership and partnership relations with key employees in the implementation of specific projects of interest to the organization, which creates an additional feeling of belonging and commitment to the organization. (Paunović, 2003)

However, there are also factors that demotivate corporate entrepreneurship. Many organizations talk about entrepreneurship, ask employees to behave entrepreneurially, to take risks. When they succeed in their ventures, they usually get very little, and when they fail in their ventures, they are punished (dismissed). In other words, there is inadequate or no reward for success and punishment for mistakes.

The question that inevitably arises in the conditions of turbulent changes in the business environment is related to the possible impact of modern information technologies and the internet on the functioning of the organization, but also adaptation, i.e. the change of culture. Organizational changes are not only changes in the organizational structure, but perhaps also changes in the organizational culture. What we can certainly expect, when it comes to the development of new products and services, are constant and significant changes. One of the biggest changes faced by managers in large organizations, which is already visible, refers to the increasingly significant possibilities of flexible work and its engagement. As a result of the development of modern information and communication technologies, especially the Internet and social networks, the working environment and the environment for performing work are changing significantly. People can increasingly do their jobs at any time and any place. Working at home or in a virtual office, the organization reduces its costs, increases profitability, but at the same time poses some challenges. Work flexibility brings to the fore the need for more flexible organizational models. More flexible, short-term forms of organization are needed that will be built and dismantled daily. In this context, the model of a virtual organization as a temporary network of independent entities connected by appropriate information and communication systems is interesting. In this way, organizations share knowledge, excel in what they do best. Their organizational culture is based on supporting innovation and continuous development of human resources. However, what will be a big challenge for many refers to the fact that in models based on virtual organizations, it will be necessary to build partnership and cooperation relationships, in some situations, even with those who were competitors. In this context, it is particularly important to develop an organizational culture of trust and a sense of common commitment and connection in business. (Mullins, 2010)

5. THE RELATIONSHIP BETWEEN NATIONAL CULTURE AND ENTREPRENEURSHIP

When we talk about the relationship between national culture and entrepreneurship, we can say that there is no single opinion that entrepreneurship is a universal category.

Although entrepreneurs in different countries have universal characteristics, they may have other characteristics that are specific to the culture from which they come (Eroglu & Piçak, 2011).

Entrepreneurship in the context of different national cultures refers to the initiation of entrepreneurial activities in the economies of the countries from which entrepreneurs (companies) come. Namely, in different economies, due to different beliefs and attitudes of entrepreneurs, there are also different entrepreneurial activities, i.e. entrepreneurial behavior (Radziszewska, 2014, Eroglu & Piçak, 2011). Thus, cultural differences directly affect entrepreneurial behavior. This connection is best explained by Hofstede's dimensions of national culture (which have already been discussed), viewed in the context of entrepreneurship, namely: individualism, avoidance of uncertainty and distance of power.

In cultures with a high level of individualism, an entrepreneurial culture is nurtured, which results in a larger number of entrepreneurs and entrepreneurial activities. In these cultures, the initiative and independence of employees is rewarded. In contrast, low individualism results in fewer individual entrepreneurs and fewer entrepreneurial ventures (Hofstede, 2001).

When it comes to avoiding uncertainty, countries with a high degree of uncertainty avoidance are not ready for independent entrepreneurial activities and investments, unlike countries with a low degree of uncertainty avoidance where there is a willingness to invest and entrepreneurial activity (Makino & Nuepert, 2000). As already mentioned, avoiding uncertainty is associated with taking risks. A high degree of uncertainty avoidance leads to risk avoidance, while a low degree of uncertainty avoidance leads to increased risk appetite (Hofstede, 2001).

As far as power distance is concerned, low power distance results in greater access to resources and greater entrepreneurial opportunities, meaning more entrepreneurial initiatives. High distance of power conditions limited access to resources and entrepreneurial opportunities, so a smaller number of entrepreneurs appear in such societies (Hofstede, 2001).

Therefore, high individualism, low avoidance and distance of power are dimensions that favor the development of a better cultural environment and entrepreneurship. Therefore, those national cultures that have developed these dimensions have a conditions for the development of entrepreneurship. National culture in such economies is a stimulus for the development of entrepreneurship. This is due to the fact that national culture is not the only factor influencing the development of entrepreneurship, but certainly its influence is very strong and very significant.

6. CONCLUSION

The general conclusion of this paper is that every company has its own culture, which is predominantly influenced by the national culture of the society in which it's originated.

National culture determines the values of the organizational culture of the company that operates within its framework and significantly affects the organizational culture and behavior in the company. The extent to which culture in a company will be entrepreneurial depends on the extent to which the national environment is conducive to the development of such a culture. In this regard, the recommendations would be the following :

- Educate employees and everyone else in the direction of developing entrepreneurship. This means developing creativity and entrepreneurial spirit in employees, meaning readiness to accept changes, risks, new ideas;
- Companies should apply new technologies, encourage and support new ideas and innovative solutions with their employees;
- It is necessary that the company's financial resources are available. It often happens that the company's financial resources are directed to solving current problems, instead of creating something new that will bring greater value to the company;
- Develop teamwork, which means innovative teams with people with different skills and knowledge;
- Establish an adequate reward system. An entrepreneur needs to be rewarded according to the invested energy, effort and risk in order to be motivated for entrepreneurial activities;
- Make the organization of work with the longest possible system of rules and procedures. A strict system of rules and procedures stifles the entrepreneurial spirit and initiative of employees, which discourages the development of entrepreneurship;
- Managers should fully accept and support entrepreneurial activity, without fear of mistakes and failures, because successful entrepreneurship today cannot be imagined without the support of managers.

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RAZVOJ FINANSIJSKOG IZVEŠTAVANJA U FUNKCIJI MENADZMENTA JAVNOG SEKTORA

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SAŽETAK:

Savremeni trend promene na globalnom nivou u političkoj, socijalnoj, ekonomskoj i institucionalnoj sferi nisu mogle ostati bez uticaja na nacionalne države a samim tim i na javni sektor. Sva ta novonastala stanja, pojave i događaji definišu novo okruženje u kojem država odnosno javni sektor funkcioniše. Ne postoji mogućnost da javni setor izbegne trendove i ne reaguje na promene okruženja. Svaka promena u okruženju, u većoj ili manjoj meri, zahteva od menadzmenta javnog sektora da pronađe socijalno, ekonomski i politički adekvatan i održiv način prilagođavanja. sektora okruženju ključnu ulogu ima računovodstvo javnog sektora kao izvor potrebnih menadžerskih informacija.

Ključne riječi: javni sektor, okruženje, računovodstvo, izveštavanje.

1.UVOD

Osnovnu aktivnost koju u različitim državama sveta obavljaju subjekti javnog sektora koja omogućuje njegovu adaptibilnos funkcijama savremene države predstavlja finansiranje iz različitih oblika javnih prihoda i funkcionisanje u javnom interesu. Savremena državna zajednica se u uslovima globalizacije mora pravovremeno prilagođavati trendovima, sačuvati postojeće kao i formirati nove izvore finansiranja budžeta. Država od svog nastanka kroz svoju regulatornu, ekonomsku i redistributivnu funkciju transferiše finansijska sredstva, od privatnog ka javnom sektoru sa ciljem unapredjenja socijalnih i ekonomskih funkcija u javnom interesu.. Državi je posredstvom javnog sektoru poverena imovina koju su sticale predhodne generacije od njenog nastanka i od koje se očekuju pozitivni efekti na blagostanje i dobrobit sadašnjih i niza budućih generacija. Zbog poverenja koje svaki građanin pojedinačno ima u državni aparat kao i veličine i vrednosti poverene imovine kao i činjenice da neefikasnost, neefektivnost ili loše upravljačke odluke u javnom sektoru imaju dalekosežne posledice na stanje države i nacije u celini, poreski obveznici, imaju nedvosmisleno ustavno pravo na dostupnost informacija o prikupljanju i trošenju budžetskih sredstava. Odgovorni ljudi celog javnog sektora kao i pojedinih njegovih delova na svim nivoima moraju iskazati javnu odgovornost za ostvarene rezultate koji moraju biti u skladu sa unapred definisanim ciljevima kao i jasno i transparentno

prikazati načine upotrebe javnih resursa. Ovaj zadatak subjekti javnog sektora ostvaruju kroz adekvatan računovodstveni sistem koji mora biti u službi jasnoće, preciznosti i informativne bogatosti eksternih finansijskih izveštaja čija su forma, oblik i sadržaj strogo definisana određenim normativnim aktima.

2. NUŽNOST DEFINISANJA JAVNOG SEKTORA

Problem jasnog definisanja javnog sektora već duže vreme egzistira u stručnoj literaturi. Polazeći od različitih koncepata, kao što su vlasništvo, kontrola, oporezivanje, način polaganja računa ili nadležnosti, dolazimo do različitih tumačenja pojma javni sektor. Preciznom definisanju javnog sektora može sr pristupiti po osnovu više različitih kriterijuma. Najčešće korišteni kriterijumi su: vlasništvo, upravljanje, način finansiranja kao i oblik odgovornosti za poverene nadležnosti. Ni jedan od ovih kriterijuma pojedinačno, nije sveobuhvatan da bi nedvosmislene samostalno mogao definisati pojam javnog sektora koji se danas koristi u praksi. Pojam javnog sektora različito se tumači u različitim državama a često različito i u okviru iste države tokom različitog vremenskog perioda. Jasno postavljanje granica između javnog i privatnog sektora predstavlja dinamički proces koji nije potpuno jasno i nedvosmisleno definisan. Najčešći problem u praksi predstavlja varijabilan karakter vlasništva odnosno imovine koja često prolazi kroz proces transferisana iz javnog u privatni sektor ili obrnuto. Često se u savremenom neoliberalnom kapitalizmu dešava da se državni aparat uključi u funkcionisanje privatizovanih subjekata bilo direktno putem različitih subvencija ili indirektno putem regulative koja se odnosi na njihove aktivnosti. Ukoliko privatne kompanija finansiraju izgradnju i održavanje zgrada koje potom iznajme državi za različite namene, može se slobodno reći da pitanje vlasništva nad ovom imovinom ni jasno definisano takodje kao primer možemo uzeti i funkciju odbrane gde se za snabdevanje vojske primenjuju različiti aranžmani koji uključuju angažovanje privatnih kompanija. U literaturi se najčešće mogu sresti tri aspekta definisanju javnog sektora: pravni, finansijski i funkcionalni. Prema pravnom aspektu, javni sektor obuhvata državne institucionalne jedinice i organizacije kojima se upravlja putem javnog prava. Finansijski aspekt proširuje granice pravne definicije tako što u javni sektor, pored institucija i organizacija uključuje još i privatne organizacije koje su dominantno finansirane iz javnih izvora kao i neprofitne organizacije koje svoje aktivnosti obavljaju u okviru delatnosti obrazovanje i zdravstvena zaštita. Funkcionalni aspekt definisanju javnog sektora kao o kriterijum primenjuje područje delovanja u kojem se obavljaju aktivnosti subjekta. Po ovom aspektu javni sektor obuhvata sve organizacije koje svoje aktivnosti obavljaju u oblastima javne administracije, socijalne zaštite, reda i zakona, obrazovanja, zdravstvene zaštite, socijalnih usluga i usluga kulture bez obzira na izvore finansiranja i pravnu formu finansijera.¹ Stiglitz u svojoj knjizi Ekonomija javnog sektora primenjuje

¹ EU Commission, Public Sector Information: A Key Resource for Europe, Green Paper on Public Sector

funkcionalni pristup, odnosno on ne definiše javni sektor u principu, ali navodi da on u Sjedinjenim Američkim Državama obuhvata¹:

- federalnu vladu u čijem su resoru nacionalna odbrana, poštanska služba, štampanje novca i regulisanje trgovine između saveznih država i sa inostranstvom i
- savezne države i lokalne vlasti koje su zadužene za obrazovanje, policijsku i vatrogasnu službu, komunalne usluge i biblioteke.
- Problemom definisanja javnog sektora bavile su se i OECD-a koji ima specifičan pristup jer se njime ne određuje koji subjekt pripada javnom, a koji privatnom sektoru već se definišu kriterijumi koje treba primenjivati svrstavanja pojedinih subjekata u javnom sektor. Ove kriterijume čine:
- ciljna funkcija subjekta, odnosno da li je subjekt profitno ili neprofitno orijentisan,
- funkcionisanje subjekta u javnom ili privatnom interesu i
- način finansiranja.

Najčešće korišćena definicija javnog sektora objašnjava da je to onaj segment socijalne i ekonomske aktivnosti koji se nalazi u vlasništvu i pod kontrolom države. Primena i ovog kriterijuma u određenim situacijama ne dovodi do određivanja precizne granice gde počinje, a gde se završava javni sektor Konceptualnom oviru za finansijsko izveštavanje opšte namene entiteta javnog sektora² definiše da javni sektor obuhvata: nacionalnu, regionalne i lokalne vlade i sa njima povezane vladine entitete. Povezani vladini entiteti obuhvataju širok spektar entiteta kao što su na primer: različita ministarstva i njihovi departmani programi, odbori, komisije ili agencije i državni fondovi socijalnog osiguranja. Prema istim izvorima javni sektor ne obuhvata javna privredna preduzeća.

3. KARAKTERISTIKE JAVNOG SEKTORA I FINANSIJSKO IZVEŠTAVANJE

Profesionalne računovođe su potpuna saglasnost da se subjekti javnog i privatnog sektora razlikuju u značajnom broju karakteristika. IPSASB je 2011. godine objavio nacrt ključnih karakteristike javnog sektora sa potencijalnim implikacijama na

Information in the Information Society, 1999str. 11. <ftp://ftp.cordis.europa.eu>

¹ Stiglitz, J.E. Ekonomija javnog sektora, Ekonomski fakultet Beograd, 2004, str. 12.

² IPSASB®, Handbook of International Public Sector Accounting Pronouncements, Volume I, The Conceptual Framework for General Purpose Financial Reporting by Public Sector Entities, 2005, str. 27.

finansijsko izveštavanje¹. U ovom nacrtu se kao precizne karakteristike subjekata javnog sektora prikazuju:

- obim i finansijski značaj nerazmenskih transakcija,
- značaj budžeta,
- priroda nekretnina, postrojenja i opreme,
- nadležnost za imovinu koja predstavlja nacionalno i lokalno nasleđe,
- "dugovečnost" javnog sektora,
- regulatorna uloga države,
- vlasništvo ili kontrola prava u odnosu na prirodne resurse i fenomene i
- statističke osnove računovodstva.

32.

Razmenske transakcije obuhvataju sve transakcije u kojima jedan subjekt stiče imovinu ili usluge ili izmiruje obaveze i po tom osnovu u zamenu direktno daje približno istu vrednost. Nerazmenske transakcije su one u kojima jedan subjekt prima neku vrednost od drugog subjekta bez direktnog davanja približno iste vrednosti u zamenu za primljenu vrednost i transakcije u kojima jedan subjekt daje neku vrednost drugom subjektu bez direktnog primanja jednake vrednosti u zamenu za primljenu vrednost. Za razliku od subjekta privatnog sektora, za koje su nerazmenske transakcije predstavljaju retku pojavu, u subjektima javnog sektora ove transakcije čine osnovu na kojoj nastaje najveći deo priliva i odliva ekonomskih koristi, . Značajan deo poslovanja subjekata javnog sektora finansira se iz resursa prikupljenih oporezivanjem koje za poreske obveznike predstavlja zakonom nametnutu transakciju. U slušaju kada se neki subjekt javnog sektora finansira isključivo iz transfera od nekog drugog subjekta koji se nalazi na višem hijerarhijskom nivou i tada se radi o resursima koji su inicijalno prikupljeni kroz različite vidove oporezivanja posredstvom nerazmenskih transakcija. Druga značajna karakteristika subjekata javnog sektora je značaj koji za njih ima budžet. Budžetiranje predstavlja važnu aktivnost i finansijskog upravljanja u subjektima sektora jer se njime određuju i finansijski kvantifikuju buduće aktivnosti subjekta. Budžetima se u mnogim subjektima javnog sektora pridaje mnogo veći značaj nego finansijskim izveštajima. Državni budžet kao i budžeti nižih administrativnih nivoa se najčešće javno publikuju što predstavlja zakonsku obavezu a informacije koje su u njima prezentovane omogućuju korisnicima da uporede stvarno nastala trošenja budžetskih sredstava sa planiranim i tako odrede da li su sredstva trošena u skladu sa javno publikovanim finansijskim planom. Bitna razlika postoji između subjekata privatnog i javnog sektora i u osnovnoj nameni nekretnine, postojenja i oprema. Primarni cilj entiteta privatnog sektora je ostvarenje dobiti, pa se u skladu sa tim i nekretnine, postrojenja i oprema poseduju sa ciljem da direktno ili indirektno generišu

¹ IPSASB, ED, Key Characteristics of the Public Sector with Potential Implications for Financial Reporting,
IFAC, Toronto, 2011, str. 24.

prilive ekonomskih koristi u subjekt. Osnovni cilj subjekata javnog sektora je da širokom broju korisnika pruži dobra i usluge pa prema tome posjedovanje i korišćenje nekretnina, postrojenja i opreme usmereno je ka tom cilju. Razlika između subjekata privatnog i javnog sektora je i u činjenici da je staranje o imovini koja predstavlja nacionalno istorijsko, kulturno i prirodno nasleđe uvek u nadležnosti javnog sektora. Primarni cilj aktivnosti na očuvanju ovih vrsta nasleđa je da se one sačuvaju za buduće generacije kao deo nacionalnog identiteta. Kontinuirana egzistencija ili dugovečnost velikog broja subjekata javnog sektora i dugotrajnost njihovih programa i projekata u velikoj meri razlikuju ove subjekte od subjekata privatnog sektora. Kontinuirana egzistencija subjekata javnog sektora posledica je njihove prirode kao i zakonske zasnovanosti njihovog postojanja.. Političke promene i njima izazvane promene u strukturi javnog sektora ne mogu da utiču na kontinuitet obavljanja aktivnosti javnih subjekata jer i država sa promenjenim odnosima političkih snaga ima obavezu da svojim stanovnicima obezbedi određeni nivo i kvalitet javnih dobra i usluga. Iz navedenih razloga se polazi od pretpostavke na kojoj se zasniva pripremanje i prezentovanje finansijskih izveštaja principu stalnosti poslovanja kao i na principu dugoročne finansijske održivosti aktivnosti, programa i projekata subjekata javnog sektora. Finansijske aspekti dugoročnih projekata i programa subjekata javnog sektora najčešće se mogu precizno sagledati tek nakon niza godišnjih obračunskih perioda, što ima značajne implikacije na obuhvat finansijskog izveštavanja u kojem planske finansijske informacije dobijaju primarni značaj. Regulatorna uloga uloga javnog sektora odnosi se na zaštite interesa građana ne samo kada se oni javljaju u ulozi potrošača već i kada je reč o njihovoj zaštiti od određenih rizika koja se ne može ostvariti posredstvom tržišnih mehanizam. Regulatornu ulogu subjekti javnog sekora mogu sprovoditi direktno ili posredstvom specijalizovanih agencija. Prirodni resurs i prirodni fenomeni se po pravilu nalaze u vlasništvu ili pod kontrolom subjekata javnog sektora. Pravo korišćenja ovih resursa i fenomena nije besplatno, po tom osnovu subjekti javnog sektora ostvaruju značajan deo svojih prihoda. Računovodstvo i finansijsko izveštavanje ima ključnu ulogu u vrednovanju i priznavanju ove vrste imovine.

4. RAZVOJ FINANSIJSKOG IZVEŠTAVANJA JAVNOG SEKTORA

Istorijski gledano naučna istraživanja u oblasti razvoja finansijskog izveštavanja i računovodstvene prakse i profesije u javnom sektoru su, svojim većim delom, bila zasnovana na tradicionalističkom pristupu koji polazi sa aspekta da je uloga države, ograničena na pravnu regulative kao stvaranje privrednog ambijenta i da zbog toga država ne može biti, niti uzrok poremećaja već neutralni faktor u funkcionisanju državne zajednice. Iz tih razloga se veoma mali broj naučnika i analitičara bavio proučavanjem uloge i uticaja države na razvoj računovodstvene prakse i finansijskog izveštavanja. U savremenom obliku funkcionisanja državne zajednice odgovarajuće institucije se moraju baviti razvojem organizacije računovodstvene profesije kao i računovodstvene prakse u službi razvoja finansijskog izveštavanja. Na osnovu sprovedenih istraživanja

u nekoliko država razvijenih tržišnih privreda Goddard¹ je definisao tri istorijska perioda u razvoju računovodstva javnog sektora:

- period liberalno-buržoaske hegemonije,
- period korporatizacije ili korporatističke hegemonije i
- period neoliberalne hegemonije.

Za prvi period specifična je dominacija koalicije zemljoposjednika, manufakturne buržoazije i zanatlija i snažna industrijalizacija, nastanak i organizacija radničke klase kao i razvoj institucija javnog sektora. Dominira uverenje da se maksimiziranjem interesa slobodnih pojedinaca istovremeno postiže i društveni optimum koji se primenjuje i na državu od koje se očekuje da interveniše što je manje moguće. Shodno tome i računovodstvena praksa je vrlo skromna i svodi se na kontrolu novčanih tokova. Nikitin² smatra da je do ustanovljavanja računovodstva javnog sektora kao sistema došlo upravo na kraju ovog perioda i to činom uvođenja dvojnog knjigovodstva u javni sektor Francuske 1815. i Velike Britanije 1829. godine.

U drugom istorijskom period se razlikuje tri etape: prelazna, korporatističko-intervencionistička i etapa države blagostanja.

Za prvu etapu koja je trajala od kraja devetnestog do početka dvadesetog veka karakteristične su radikalne promene u civilnom sektoru i razvoj demokratije, ali i uspostavljanje temelja intervencionizma kao posledice promenjene uloge države i njenog jačanja tokom. Računovodstvo javnog sektora u ovom periodu usmereno je na pronalaženje najboljeg načina za primenu zakonskog i regulatornog okvira definisanog i kontrolisanog od strane centralnih državnih institucija čija je osnovna svrha kontrola rada državnih službenika. Druga etapa traje do kraja drugog svetskog rata u kojoj dolazi do jačanja plutokratskog, finansijsko-imperijalističkog kapitalizma i daljeg jačanja socijalnih i ekonomskih aktivnosti države. Podsticaji za promenu stava u odnosu na ekonomsku ulogu države bili su Ekonomska kriza iz 1929. godine i drugi svetski rat. U ovom periodu nastaje državni intervencionalizam pa su osnovna pitanja kojima se bavi računovodstvo javnog sektora pitanja interne finansijske kontrole, finansijskog izveštavanja i jednoobraznosti računa. Treću etapu koja traje do sedamdesetih godina dvadesetog veka karakteriše ekstenzivna intervencionistička ulogom države i uspostavljanjem države blagostanja. Javni sektor postaje značajan ekonomski faktor, a država kroz aktivnu budžetsku i monetarnu politiku nastoji da neutralizuje negativna ekonomska kretanja. Računovodstvu javnog sektora prebacuje fokus interesovanja sa finansijskog računovodstva na upravljačko računovodstvo i

¹ Približno period od 1830. do 1880. godine.

² Približno period od 1880. do 1970. godine

kontrolu I razvoj odgovarajućih upravljačkih tehnika usmerenih pre svega na preraspodelu resursa.

Treći period, period ekonomske neoliberalne hegemonije traje i danas. On je započeo u drugoj polovinu sedamdesetih i početak osamdesetih godina prošlog veka kada je energetska kriza pospešila i ekonomsku krizu koja se manifestovala stagflacijom, odnosno kombinacijom inflacije i ekonomske stagnacije. Što je dovelo do sve većih zahteva za ekonomskom podrškom države privatnom sektoru, s jedne strane i jačanjem njene uloge u održavanju dostignutog nivoa socijalnog blagostanja s druge strane. Veliki broj svetski poznatih ekonomista ovakvu aktivnu ulogu države smatrali su primarnim uzrokom stagflacije i zalagali su se da se njene aktivnosti ograniče isključivo na obezbeđivanje stabilne ponude novca.

5. ZAKLJUČAK

Javne diskusije poznatih svetskih ekonomista o tome kakva treba da bude uloga države u životu intezivno su započele sedamdesetih godina prošlog veka, pored monetarizma, iznedrile su i koncept racionalnih očekivanja, teoriju realnih poslovnih ciklusa, ali i neokenzijanizam. Energetska kriza je inicirala nastanak novih trendova i razmišljanja o ulozi države u funkcionisanju svake nacionalne ekonomije pojedinačno. Od tog momenta makroekonomija dobija nove dimenzije i u njoj nastaje nova ekonomska uloga države. Nastanak krize sedamdesetih godina dvadesetog veka je snažno uticao i na javni sektor što je dovelo do privremenog pada javnih izdataka i sve glasnijih zahteva za njegovim reformisanjem i prilagođavanjem budžetskim prihodima. Redefinisanje javnog sektora je sa sobom pokrenulo i značajne inovacije u računovodstvu i finansijskom izveštavanju javnog sektora. Dolazi se do zaključaka da je i u javnom sektoru potrebno implementirati, prilagoditi i dalje razvijati primenu upravljačkih tehnika karakterističnih za privatni sektor, prilagođavati javne rashode javnim prihodima a ne obrnuto, preciznije i u kraćim periodima definisati poslovne parametre kao i ponovo se fokusirati na finansijsko izveštavanje. Potrebno je tako redefinisati osnove javnog sektora kako bi on funkcionisao na približnim ekonomskim principima na kojima funkcioniše privatni sektor u tome ključnu ulogu pripreme, razvoja, kontrole i analize ima računovodstvo a u okviru njega finansijsko izveštavanje.

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DEVELOPMENT OF FINANCIAL REPORTING IN THE FUNCTION OF PUBLIC SECTOR MANAGEMENT

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ABSTRACT: *The current trend of change at the global level in the political, social, economic and institutional spheres could not remain without influence on nation states and thus on the public sector. All these new conditions, phenomena and events define the new environment in which the state or the public sector operates. There is no possibility for the public sector to avoid trends and not react to changes in the environment. Any change in the environment, to a greater or lesser extent, requires public sector management to find a socially, economically and politically adequate and sustainable way to adapt.*

Key words: *public sector, environment, accounting, reporting*

UTICAJ MARKETINŠKIH AKTIVNOSTI NA BRENDIRANJE SPORTA

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SAŽETAK:

Predmet istraživanje je po pravilu neka, određena veza između pojava. S tim utvrđivanje predmeta obuhvata određivanje tj definisanje samih pojava između kojih se veza utvrđuje, kao i određivanje prirode same veze. Predmet istraživanja predstavlja brendiranje kao važan faktor uspešnog razvoja u sportu, sa posebnim osvrtom na brendiranje Fudbalskog kluba Crvena zvezda.. Teorijsko definisanje problema i predmeta istraživanja je logička operacija kojom se pomoću apstraktnih pojmova određuje suština pojave koja se istražuje. Operacionalno, radno definisanje problema sastoji se u određivanju indikatora odnosno pokazatelja koji se mogu iskustveno ispitati i proveriti. Step en istraženosti brendiranja u sportu , s obzirom da je marketing sve uticajnija i zastupljenija oblast ekonomije, iz dana u dan postaje sve značajniji i sveobuhvatniji. Pošto se izvrši operacionalno definisanje pojava postavljaju se pretpostavke ili hipoteze istraživanja. Njihova funkcija je u tome da se pretpostavi veza između pojave koju istražujemo i drugih činilaca koji bi po pretpostavci mogli biti sa njom u nekoj vrsti veze. Cilj istraživanja je proveravanje opravdanosti postavljene hipoteze.

Ključne reči: internet marketing, marketing, kampanja, SD Crvena Zvezda

1.UVOD

Ljudi imaju potrebu za fizičkom aktivnošću i to je osnovni društveni značaj sporta. S druge strane, sport je profesija mnogim ljudima, te je i izvor egzistencije. Sport je deo kulture ali i naučno-obrazovnog deo da se s pravom kaže da je sport ogledalo stanja u državi. Sportisti su predstavnici nacije, svojevrsni vitezovi savremenog društva, oni poseduju hrabrost, dostojanstvo, odvažnost, plemenitost – jednom rečju, sportski duh.

Profesionalni sport sve više gubi neka osnovna svojstva igre. Sport postaje posao, često mukotrpan, izvršilački, bez užitka igre. Tako, na primjer, danas u svijetu najpopularniji sport - fudbal, ujedno ekonomski i najunosniji, gubi obilježje prave igre i razonode za one koji se njime aktivno bave, postaje za sportiste i naporan posao i životno zanimanje, pa zauzima sve više njihovog vremena i života, što se ne može označiti kao slobodno vrijeme, nego prije kao puno radno obavezujuće vrijeme i nerijetko kao prekovremeni rad.¹

¹ Vrcan, S. (1971): Socijologija pred fenomenom nogometa, Socijologija, br. 1. Beograd

U ovom istraživanju pokušaću da utvrdimo da li se na adekvatan način prezentira brend fudbalskog kluba Crvena Zvezda. Pokušaćemo da utvrdimo uticaj sponzora na klub, navijača, legendi kluba, medija, kao i način na koji funkcioniše celokupna politika fudbalskog kluba. Trudićemo se da dokažemo da je ključ uspeha omladinska škola fudbala, koja je oduvek regrutovala mlade i talentovane igrače.

Cilj istraživanja je da se opiše i predstavi brend FK Crvena zvezda, kao i da se objasni uticaj različitih faktora, poput medija, sponzora i slično, na brendiranje kluba. Cilj ovog istraživanja je takođe i predviđanje budućnosti brenda FK Crvena zvezda, kao i predlog mera za njegovo unapređenje. Prilikom rada upotrebiće se sledeće metode: metod posmatranja, merenja, statistički metod, uporedni metod.

2.MARKETING U SPORTU

Marketing u sportu možemo posmatrati kao jedan od glavnih, a sad i kao stratejski pravac sportskih organizacija, u realizaciji sportskih ciljeva, programa i zadataka. Marketing u sportu predstavlja poslovnu funkciju sportske organizacije, odnosno ekonomski proces koji povezuje proizvodnju sportskih proizvoda, usluga i kapitala i potrošnju u oblasti sporta na najefikasniji način. Svaka socijalno-kulturna pojava, a u tom smislu i sportska delatnost, ima stalnu potrebu za moralnom, organizacionom i finansijskom podrškom društva. Jedan od fenomena sporta početkom XXI veka nalazi se u pojavljivanju ozbiljnog biznisa. U tom biznisu centralno mesto zauzimaju sportski protagonisti: sportisti, treneri, menadžeri, sportske organizacije, organizatori sportskih događaja, kao jedinstveni promotori korporativnog biznisa, odnosno sponzora i to pre svega preko sportskog auditorijuma, kojim oni vladaju [1]. U isto vreme sportski protagonisti razvijaju sopstveni biznis, u kome identifikuju svoje proizvode i ciljno tržište. Razvoj sporta i uočavanje potencijalnog tržišta u sportskom auditorijumu uticali su na stratejska opredeljenja mnogih kompanija koje proizvode sportsku opremu i rekvizite. Oni razvijaju svoju proizvodnju dvojako: na osnovu potreba savremenog sporta u dostizanju optimalnih sportskih rezultata, razvijajući savremene tehnologije i usavršavajući svoje proizvode; i na osnovu potreba širokog tržišta, koje se nalazi u sportskom auditorijumu. Pod tim se podrazumeva zadovoljenje potreba svih onih koji na bilo koji način učestvuju u sportskim aktivnostima (sportista profesionalaca i amatera, rekreativaca i onih koji se identifikuju sa sportskim zvezdama). Društveni značaj sporta proizilazi iz prirodne potrebe ljudi za sportskim aktivnostima, u kojima se oni usmeravaju ka savršenstvu duha i tela. Sportski interesi igraju veoma važnu komunikacijsku ulogu u društvu, političkoj i što je važno za marketing u sportu ekonomskoj sferi čovekovih delatnosti. Drugi, ne manje važni interesi sporta, leže u sferi radne delatnosti, jer za mnoge, sport je profesija. U značajnoj meri savremeni sport predstavlja uspešan i zadovoljavajući biznis za mnoge[2]. On je uvek predmet interesa najšire javnosti, i izložen je neprestanom fokusiranju sredstava masovnog informisanja. U praksi savremeni sport susretao se sa dva ortodoksna načina rešavanja finansijskih problema sportskih organizacija. Jedan od njih

odnosio se na zemlje u kojima je država neposredno, centralizovano subvencionisala i dodeljivala sredstva sportu. Drugi način odnosio se na zemlje slobodne ekonomije i slobodnog tržišta, gde se problem finansiranja sporta rešavao uglavnom uvođenjem marketing funkcije u menadžment sportskih organizacija, bez obzira u kom su statusu, profesionalnom ili amaterskom, profitnom ili neprofitnom. Marketing u sportu možemo posmatrati kao jedan od glavnih, a sada već i krajnje neophodan, opredeljujući strategijski pravac sportskih organizacija, u realizaciji sportskih ciljeva, programa i zadataka. U sadašnjim okolnostima sport, da bi se ostvario kao kreacija, traži puteve izlaska iz začaranog kruga, u kome nedostajuća sredstva, odlučujuće opredeljuju kvantitet i kvalitet sportskog stvaralaštva. Misija marketinga u sportu nalazi se u kontinuiranom pribavljanju fondova i traženju finansijske podrške za realizaciju sopstvenih sportskih programa. Sa jedne strane profit i njegovo umnožavanje, radi ostvarivanja sportskog razvoja, je jedan od važnih momenata uvođenja marketing strategije u sport, na putu ostvarivanja glavnog sportskog cilja: dostizanja optimalnih sportskih rezultata a samim tim i usavršavanja odgovarajućih čovekovih kvaliteta. Sport, s obzirom na svoju društvenu i privrednu ulogu i svoj veliki publicitet, izuzetno je pogodan za privredne aktivnosti. Stoga, preduzetništvo u sportu ima široke primene zbog mogućnosti animacije, na različite načine, širokih masa ljudi. Razvoj niz delatnosti, koje su na bilo koji način vezane uz sport ili su u sportu, kao i poboljšanje uslova i načina života ljudi, pogodovalo je aktivnom sudelovanju sve većeg broja ljudi u sportskim aktivnostima kao aktivni ili pasivni učesnici[3].

Tako je stvoreno tržište kao prvi preduvet bilo kakvog poduzetništva. Razvoj poduzetništva je pridonela i rastuća potražnja za sportom i sportskim proizvodima. Sportski programi su povezani sa komplementarnim delatnostima, kao što su proizvodnja i prodaja sportske opreme, odeće, obuće i prehrambenih artikala, turizam i razne druge uslužne delatnosti koje konzumira velika masa ljudi. A to pruža veliku mogućnost zarade.

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U savremenom svetu određena područja sporta su privredne delatnosti koje ne samo da pružaju mogućnost zarade, već se mogu ostvariti veliki poslovni poduhvati uz visoku zaradu. Dolazimo do toga da što je profit veći, to je isplativije ulaganje. Što je logično. Profitabilnost je dakle pokretač i motiv poduzetništva u sportu, čiji se proizvodi i programi, kao i svaki drugi, vrednuju putem tržišta. Sportski marketing je posebno područje primene koncepta marketinga na području sporta. Postoje neke dileme pojmovnog i terminološkog određenja posebnog područja primene marketinga. Većina autora knjiga o opštem marketingu obrađuju posebna ili izbrana područja primene marketinga. Iz ovoga je vidljivo da postoje određene razlike primene marketinga unutar

¹ Klarić, D (2016)- Sportski turizam u Crnoj Gori, DAT Budva

određenih područja, ali ne odgovara na pitanje da li je to primena uvek istog opšteg marketinga ili je to primena specifičnog marketinga. To su, dakle dva stava primene marketinga. Ono što je zajedničko je da marketing daje osnovu, način razmišljanja i postupke kojima se to čini[4].

Sportski marketing kao poslovna funkcija odnosi se na koncept potražnje za sportskim proizvodima i uslugama, koncept zadovoljenja te potražnje, sportskog proizvoda, koncept razmene, sportskog tržišta i koncept marketara. Sportski marketing kao poslovna funkcija sadrži sistemski pristup u funkciji postavljenog cilja, uz identifikaciju i anticipaciju potražnje, definiranja i zadovoljenje potražnje za sportskim proizvodima i uslugama. Sportski marketing kao naučna disciplina izučava postupke i aktivnosti koji omogućavaju najviši mogući stupanj efikasnosti primene marketinga u datim okolnostima, uz primenu naučno poznatih i razrađenih metoda i načela, a u svrhu napretka i razvoja dotične delatnosti. Marketing u sportu predstavlja noviju naučnu oblast koja u sferu svog interesovanja stavlja sportski proizvod ili sportski rezultat, sportsko takmičenje ili sportski događaj, plasman sportske opreme i rekvizita, širok spektar raznovrsnih sportskih usluga, kao i promotivnu i propagandnu ulogu sporta.

Činjenica da je savremeni sport postao sastavni i neodvojivi deo života velikog broja ljudi na planeti, implicira neverovatne mogućnosti i potencijale u smislu povezivanja sporta i biznisa na globalnom svetskom tržištu sportskih proizvoda, usluga i kapitala. Treba naglasiti da i sportski marketing kao naučna disciplina ima svoj istorijski razvoj i svoju teorijsku osnovu[5].

2.1. Sportski marketing kao naučna disciplina

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Razni autori su dali razne definicije marketinga.

Lewis i Appenzeller (a istu koristi i Shillbury) identifikuju dve primene kako bi definisali koncept sportskog marketinga: [7]

- Marketing sporta – upotreba varijabli marketing miksa da bi komunicirali koristi od učešća u sportu i gledanja sporta, do potencijalnih korisnika;
- Marketing kroz sport koristeći sponzorstvo kao alat promocije i oglašavanja proizvoda.

Mullin definiše sportski marketing kao sve aktivnosti dizajnirane da se saznaju potrebe i želje sportskih potrošača kroz proces razmene. I kaže da je sportski marketing razvio dve ključne tačke:[8]

- Marketing sportskih proizvoda i usluga ide direktno do sportskih potrošača;
- Marketing drugih potrošača i industrijskih proizvoda i usluga kroz sportsku promociju.

Postoje još mnoge druge definicije od različitih autora. Uz sve te definicije, može se reći da je sportski marketing društveni proces kojim pojedinci i društvo primenom koncepta marketinga u svim područjima sporta dobijaju ono što im je potrebno i što žele, uz pomoć skupa aktivnosti kojima se putem tržišta razmenjuju sportski proizvodi i usluge.

Mullin je 1980 godine prepoznao, po prvi put, seriju karakteristika sportskih proizvoda koje utiču na marketinški proces. Mullin tvrdi da je sport napredovao iz forme institucije koja je jednostavno administrativna do forme organizacije koja zahteva vođenje. Praveći tu razliku, Mullin je naglasio da je sport dostigao nivo u svom razvoju gde je zadatak sportskog menadžera aktivno traženje načina proširivanja osnove prihoda organizacije. S jedne strane, menadžer je zadužen za zadržavanje statusa quo u sportskoj organizaciji, a s druge strane, menadžer je odgovoran za procenjivanje i vrednovanje trendova kako bi uticao na preživljavanje organizacije i njen uspeh.

Danas, skoro da ne postoji ozbiljna sportska organizacija koja u okviru svoje organizacione strukture ne poseduje posebno marketinško odeljenje ili sektor. Funkcija marketing menadžera u sportu je od neprocenivog značaja i u savremenom sportu predstavlja veoma traženo i dobro plaćeno zanimanje.

U svakom slučaju povezivanje ljudi sa sportom, sportskim idolima ili timovima je fascinantna. Mnogi zaljubljenici u sport doživljavaju duboku emocionalnu povezanost i čak ličnu identifikaciju sa timovima za koje navijaju i sa sportistima koje obožavaju. Uticaj sporta na ljude je toliko očigledan da je potpuno jasno zašto sport zauzima centralno mesto u idnustriji sponzorstva i zašto sve velike kompanije promovišu svoje proizvode preko sporta.

Tržište sportskih proizvoda, usluga i kapitala se, pre svega, odnosi na profesionalne i visoko komercijalne sportove, najuspešnije klubove i najprofitabilnije lige. Klubovi su najčešće subjekti koji projektuju sportske proizvode i usluge, dok su potrošači, odnosno konzumenti proizvoda i usluga navijači, odnosno ljubitelji sporta koji prisustvuju sportskim priredbama na stadionima i drugim sportskim objektima ili prate sportske događaje preko TV ili drugih medija. Publika koja dolazi na sportske objekte kupuje ulaznice, dok se praćenje preko TV stanica naplaćuje preko pretplate, ako je reč o

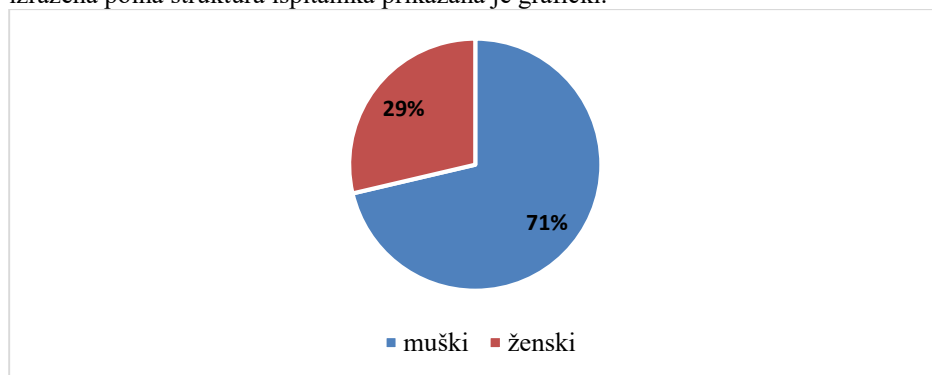
državnim medijskim kućama ili specijalizovanim sportskim stanicama, odnosno besplatno kada je reč o komercijalnim televizijama ili internet sajtovima. Privatne medijske kuće od prodaje sekundi za reklame tokom sportskih prenosa ili primaju posebne uplate za praćenje prenosa udivo. Najznačajniji prihodi u sportu su prihodi od prodaje TV prava, prihodi od prodaje komercijalnih prava i prihodi od prodaje ulaznica[9].

Za vreme komunizma sport je finansirala država. U to vreme sport je bio pod kontrolom države i nije bilo prostora a ni preterane potrebe za osamostaljivanjem, odnosno preduzimanjem marketinških strategija u cilju pribavljanja finansija za sportske programe. U kapitalističkim zemljama, marketing je uveden kao deo menadžmenta sportskih organizacija a iz budžeta države finansirani su samo sportski događaji sa nacionalnim interesom. U zemljama bivšeg socijalizma, sport se okreće ka tržištu. Okretanje sporta ka tržištu predstavlja opasnost za samu misiju sporta jer današnje tržište, zbog velike konkurencije i razvijene svesti potrošača, nemilosrdno prodaje ideje, robu i ljude, srljajući u komercijalizaciju i gubeći elementarnu originalnost, koja je u domenu sportskog duha, prioritet.

Profitne sportske organizacije odgovaraju za profit i njime raspolažu, dok se neprofitne trude da kroz poreske olakšice profit vežu za njihove organizacije. Razlika između profitnih i neprofitnih organizacija je pre svega u pravnom statusu organizacija. Neprofitne organizacije stvaraju profit da bi isti u celosti uložili u sopstveni razvoj, od prihoda neprofitnih organizacija ne smeju se finansirati vlasnici organizacije, jer se prihod stiče isključivo kroz državne subvencije. Vlasnik neprofitne organizacije može biti država ali i privatno lice. Većina sportskih organizacija ima status neprofitnih organizacija. Neprofitne organizacije, za razliku od profitnih kojima je cilj profit, teže ostvarenju sportske misije-a to je ostvarivanje odličnih sportskih rezultata[10].

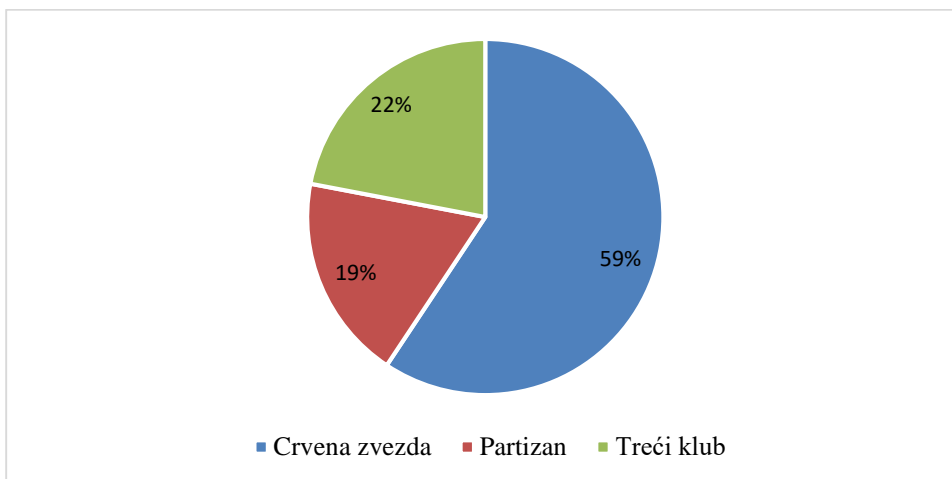
3.REZULTATI ISTRAŽIVANJA

Za potrebe istraživanja sprovedena je anketa na uzorku od 150 ispitanika. Od ukupnog broja ispitanika, 107 ispitanika je muškog pola, dok je 43 ženskog pola. Procentualno izražena polna struktura ispitanika prikazana je grafički.



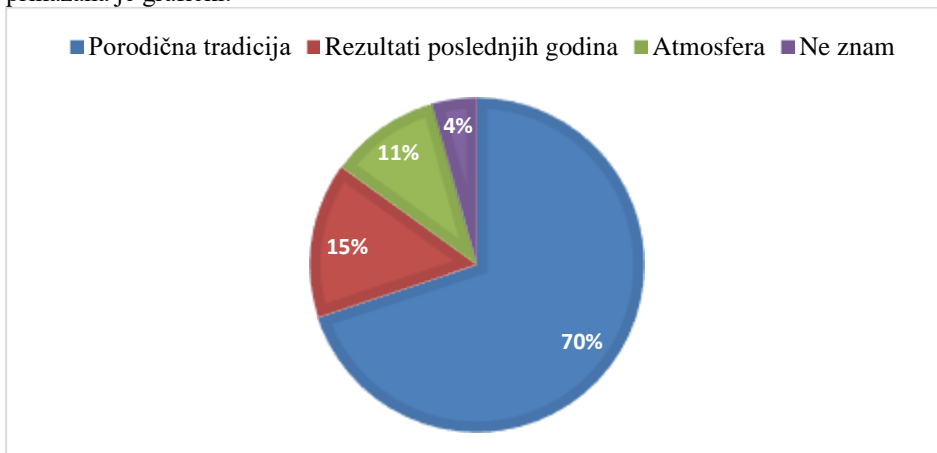
Grafikon 1. Struktura pola ispitanika

Na pitanje za koga navijaju od fudbalskih klubova, 89 ispitanika je reklo da navija za Crvenu zvezdu, 28 za Partizan, a preostali deo ispitanika je reklo da navija za treći klub. Procentualno izražena struktura ispitanika prikazana je grafički.



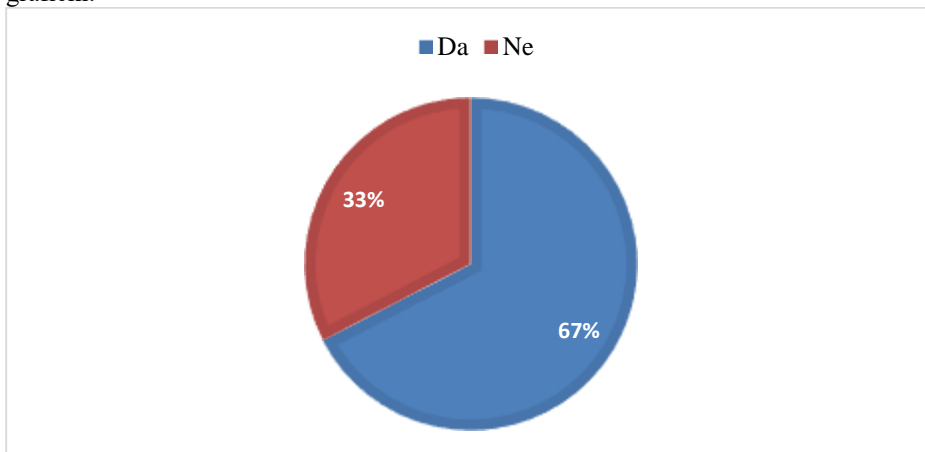
Grafikon 2. Prikaz navijanja ispitanika

Od ukupnog broja ispitanika koji navijaju za Crvenu zvezdu, na pitanje zašto navijaju za Crvenu zvezdu 65 ispitanika je reklo zbog porodične tradicije, 14 ispitanika zbog rezultata u poslednjih par godina, 10 ispitanika je reklo zbog atmosfere koja se stvara, dok preostalih 4 nisu imali konkretan odgovor. Procentualno izražena struktura ispitanika prikazana je grafički.



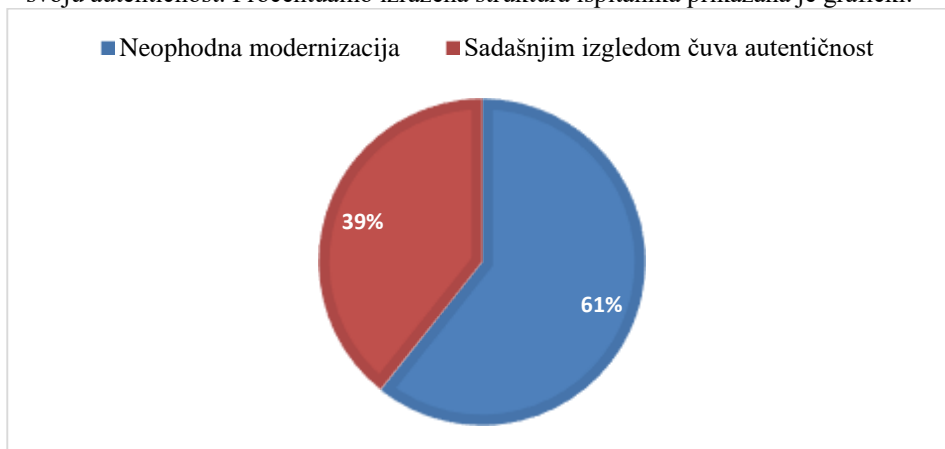
Grafikon 3. Prikaz razloga navijanja za Crvenu zvezdu

Od ukupnog broja ispitanika koji navijaju za Crvenu zvezdu, na pitanje da li su zadovoljni radom marketniške strukture FK Crvena zvezda, 60 ispitanika je bilo zadovoljno, a 29 ispitanika nisu bili zadovoljni. Procentualno izražena struktura ispitanika prikazana je grafički.



Grafikon 4. Prikaz zadovoljstva primenom marketinških aktivnosti

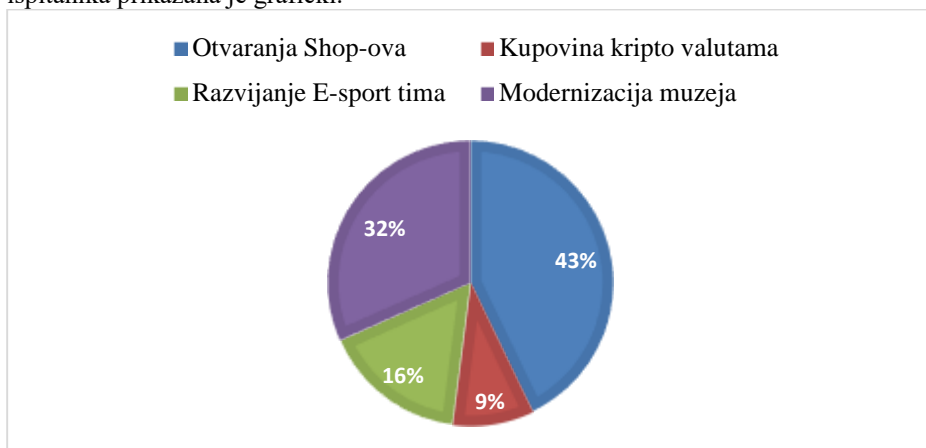
Od ukupnog broja ispitanika koji navijaju za Crvenu zvezdu, na pitanje da li su zadovoljni izgledom Muzeja FK Crvena zvezda, odnosno da li smatraju da ga je neophodno modernizovati ili takav kakav jeste ima svoju kulturološku vrednost, 54 ispitanika je reklo da ga je neophodno modernizovati, dok je 35 ispitanika reklo da sadašnjim izgledom čuva svoju autentičnost. Procentualno izražena struktura ispitanika prikazana je grafički.



Grafikon 5. Prikaz neophodnosti promena

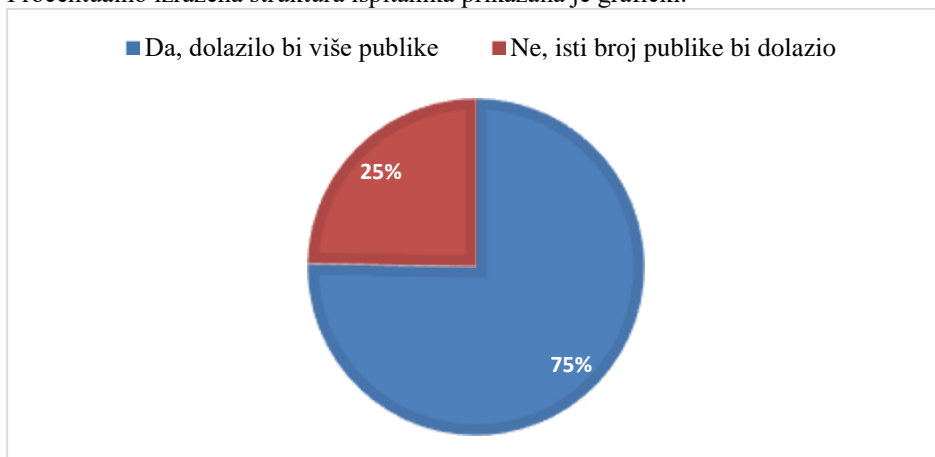
Od ukupnog broja ispitanika koji navijaju za Crvenu zvezdu, na pitanje šta bi unapredili od ponuđenih odgovora (Otvaranje Shop-ova u više gradova, mogućnost kupovine u

kripto valutama, razvijanje E-sport tima, modernizacija muzeja)kao mogućnost za uvećanje brenda FK Crvena zvezda, 42 ispitanika je reklo Otvaranje Shop-ova, 9 ispitanika je reklo mogućnost kupovine kripto valutama, 16 ispitanika je reklo razvija E-sport tima i 31 ispitanika je reklo modernizacija Muzeja. Procentualno izražena struktura ispitanika prikazana je grafički.



Grafikon 6.Šta biste unapredili od ponuđenih odgovora

Od ukupnog broja ispitanika koji navijaju za Crvenu zvezdu, na pitanje da li smatrate da bi veći broj ljudi dolazio na stadione unapređenjem marketinga, 67 ispitanika je odgovorila sa da, dok preostali deo ispitanika smatra da bi svakako dolazili isti ljudi kao i pre. Procentualno izražena struktura ispitanika prikazana je grafički.



Grafikon 7. Da li bi dolazio veći broj publike na stadion unapređenjem marketinga
 Preporuke uspešnije brendiranje i adekvatnu promociju fudbalskog kluba Crvena zvezda

Danas, Crvena zvezda predstavlja svojevrsan mit, kao najbrojniji, najpopularniji i najtrofejniji fudbalski klub na ovim prostorima. Uostalom, od samog početka Zvezdu je pratio kult velike sportske porodice koja se prepoznatljivom harizmom i uspešnim rezultatima iz dana u dan širila, sticala popularnost i povećala armiju pristalica i navijača. Prevazišla je sportske okvire, odavno postavši jedan od simbola srpskog identiteta.

Kako je rođena Crvena zvezda? Ideja o osnivanju krenula je na inicijativu Gradskog odbora USAOS-a Beograda. Tokom februara 1945. Godine omladinci, članovi Ujedinjenog saveza antifašističke omladine Srbije, počeli su pripreme za osnivačku skupštinu jednog omladinskog fiskalnog društva, sa ciljem da bude sastavljeno od raznih sportskih sekcija. Jednu od tih sekcija je činio i fudbalski klub. Posmatrajući Zvezdin životni vek, od lagang izrastanja u sportskog giganta, tokom kojeg je prolazila kroz razne periode teškoća i uspeha, poraza i pobeda, sa ponosom se može reći da se ime Crvena zvezda i danas izgovara sa poštovanjem i uvažavanjem u celom svetu. Crvena zvezda je najveći fudbalski klub na Balkanu. Ne samo zbog titule prvaka Evrope i sveta, 25 titula šampiona države, 24 kupa, već i zbog višemilionske armije navijača, od „Tokija do Milvokija“. Ključ uspeha je omladinska škola fudbala. Veliko zadovoljstvo je videti preko 300 klinaca kako se bore za dres Crvene zvezde. Menadžment kluba stalno pravi različite akcije kojima bi privukao što više talentovane omladine da se okuša u Crvenoj zvezdi. Jedna od tih akcija je i „Tražimo talente, budi naš skaut“. Akcija „Tražimo talente, budi naš skaut“ trajala je 20 dana, pregledano je 550 video prijava, od kojih je nakon pažljivog pregledanja od strane trenera i skauta Omladinske škole Crvene zvezde izabrano 140 najdarovitijih dečaka. Svi oni dobili su poziv da dođu na test utakmice koje su održane na pomoćnim terenima ispod južne tribine.

U beležnicama stručnjaka koji brinu o Zvezdinoj budućnosti već su se našli najtalentovaniji igrači. Jedan broj njih će odmah biti registrovan za mlađe kategorije našeg najtrofejnijeg kluba, dok će ostali biti intenzivno praćeni i vodiće se računa o njihovom napretku. Takođe, biće novih pozivnica za dolazak na Marakanu narednog leta, dok će najmlađi dečaci ubuduće biti pozivani na prijateljske utakmice. Sva deca su nakon odigranih test utakmica obišla i muzej Crvene zvezde i dobila poklon. Među pozvanom decom bili su i dečaci koji su proglašeni za najtalentovanije na kampovima fudbalskog kluba Crvena zvezda koji su održavani tokom 2012. godine u Baru, Jahorini i na Zlatiboru. Ističemo još da dugujemo veliku zahvalnost sbim roditeljima koji su doveli svoju decu u Beograd na test utakmice, čime su pokazali veliku privrženost i ljubav prema Crvenoj zvezdi. Bitan faktor uspeha fudbalskog kluba Crvena zvezda su i njeni navijači, Delije, simpatizeri i prijatelji kluba. Svako od njih od malih nogu je zavoleo Crvenu zvezdu i redovan je posetilac Zvezdinih utakmica. Među navijačima Zvezde su ljudi različitih slojeva društva, različitog obrazovanja, različitog uzrasta...i svi su tu da podrže naš najveći klub. Marketing fudbalskog kluba Crvena zvezda sprovodi akcije za održavanje već dobrih odnosa sa publikom i pristupanju novih članova. Jedna od akcija je i „Moja prva utakmica“.

Poenta ove akcije je da se od malih nogu deca nauče da uživaju u fudbalu i lepršavoj igri Crvene zvezde. Program akcije obuhvata dolazak na stadion 30tak minuta pre početka utakmice na zapadnu tribinu u VIP galeriju, posetu muzeju, kao i dodelu poklon paketića,

zatim gledanje utakmice uz prisustvo jednog roditelja, spuštanje na teren na kraju utakmice i slikanje sa prvotimcima po završetku meča. Bitan uticaj u brendiranju fudbalskog kluba Crvena zvezda imao je muzej kluba. Jedan od mojih predloga jeste upravo modernizacija muzeja na stadionu. Naime, muzej koga krasi najprestižniji trofeji u svetskom klupskom fudbalu, lošije su eksponirani. U najmodernijim svetskim muzejima, eksponati idu hijerarhijskim putem, odnosno, ko najznačajnijem trofeju, dok je slučaj u našem muzeju drugačiji i vrhunac vidite odmah na ulasku u muzej. Crvena zvezda treba imati saradnju i sa Turističkom organizacijom Beograda, kao najznačajniji sportski brend u Srbiji, a samim time i u Beogradu. Treba slediti primer fudbalskog kluba Barselone. Poseta gradu Barseloni, u većini slučajeva, turisti običu i istoimeni Fudbalski klub i njihov stadion “Camp Nou”. Njihov model “Tour de Camp Nou” je odličan model koji može primeniti i FK Crvena Zvezda, kojom bi pokrili obilazak stadiona i poseta Muzeju. Smatram da, pored Članstva, FK Crvena zvezda nema pravi pristup prema navijačima, odnosno da ne daje na značaju koliko oni to zaslužuju. Igrači, koji su idoli mladima, na koga treba da se ugledaju mlađe generacije, dosta su izolovani, teško je doći u kontakt sa njima, gde, ja verujem, možda bi nekom detetu i život promenilo. Smatram da bi druženje sa igračima dosta promenilo sliku o fudbalerima, kao i da bi se mlađe generacije okrenule sportu i Crvenoj zvezdi još više. Jedan od predlog jeste i da kupljenom članskom kratom, u grbu Crvene zvezde budu uvezeni ili odštampana imena članova, tako bi se svaki član još više osećao kao dete Kluba. Sa navijačkom bazom koja je rasprostranjena širom teritorije Srbije, Crvena zvezda ima samo dva oficijalna shop-a, i oba su u glavnom gradu Srbije. Na kapacitet koji poseduje Crvena zvezda, smatram da u svakom regionu treba imati oficijalni shop, time bi povećala popularnost, a i ekonomski benefiti bi svakako bili uvećani. Uvećanjem brenda, privlačimo i dodatne sponzore, koji su neophodni za normalno funkcionisanje Kluba. Na novijim stadionima do mnogo većeg nivoa do izražaja dolaze sponzori klubova. Najupečatljiviji deo jesu novi i moderni paneli koji stoje na stadionima iznad terena kao reklame, na našu konstrukciju stadiona, mislim da ne bi bilo problema napraviti tako nešto, a svakako bi privuklo dodatne sponzore, pogotovo u poslednje vreme kako Crvena zvezda igra sa velikim uspehom i u evropskim takmičenjima. U ovom dobu kada je sve digitalizovano, i gde sve više dolazi do izražaja internet, smatram da bi uvođenje mogućnosti plaćanja kripto valutama zaista donelo nešto novo na ovim prostorima. Crvena zvezda bi tako postala prvi klub koja je pružila tu mogućnost i jasno stavila do znanja da u stopu prati najnovije trendove u svetu. Takođe postoji rizik, ali postoji i šansa gde se može uvećati taj iznos na znatno višim nivoima, što smo imali prilike da vidimo na Bitcoin-u. Mlađe generacije, odnosno deca do deset godina, u poslednje vreme, sve više su okrenuta E-sportu, Crvena zvezda ima svoj E-sport tim, ali mislim da nije toliko eksponiran kao FK. Dosta dece ne zna da Crvena zvezda ima svoj E-sport tim, tako da bi saznanjem da ima, sigurno privuklo još veću pažnju kod njih i privolelo ih crveno-belom taboru. Sportsko društvo Crvena zvezda u okviru svog društva ima impozantan broj klubova, pored fudbalskog, tu su još i košarkaški, teniski, vaterpolo, odbojka itd. KK Crvena zvezda već godinama unazad važi za jednu od najboljih marketinških organizacija, a to potvrđuju i nagrade koje su stizale od Evrolige gde pet godina stoji na pobjedničkom postolju. FK i KK Crvena zvezda, nemaju razvijenu

saradnju, što je po meni, besmisleno, zato što je to jedna porodica. Smatram da bi košarkaška sekcija u marketing mogla da pomogne fudbalskom, što novitetima i idejama, što i npr. razmenom karata, raznim gestovima igrača oba tima, postavljanjem štanova fudbalskog kluba na košarkaškim utakmicama i obrnuto itd.

4. ZAKLJUČAK

Brend fudbalskog kluba Crvena zvezda se gradi godinama. Najupečatljiviji deo brenda kluba je njegova bogata istorija, koja je stvaran generacijama fudbalera, koji su dolazili do velikih uspeha.

Budućnost Crvene zvezde treba da bude sopstvena škola fudbala koja će izbaciti neke nove mlade nade koje će, nadamo se, opet ponoviti uspehe zvezdinih zvezda. Mislim da se omladinska škola razvija na adekvatan način što će se vremenom i pokazati, kada ti klinci budu ostvarivali svoje snove i zaigraju za prvi tim Crvene zvezde. FK Crvena zvezda ima bogatu prošlost, a kroz sadašnji naporan rad imaće još bogatiju budućnost. Razvojem sporta generalno, a posebno fudbala, razvija se i potreba kompanija, koje ne moraju da budu deo ove branše, da sve više učestvuju i budu deo sportskih manifestacija, posredno ili neposredno. Samim tim dolazi do velikih ulaganja u uspešne sportske klubove putem sponzorstva, ili drugih načina investiranja, a jedan od tih klubova je i fudbalski klub Crvena zvezda, koja ima odlično razvijen marketing odnosa sa svojim potrošačima.

Marketing odnos predstavlja poslednju fazu u razvoju programa lojalnosti između Fudbalskog kluba Crvena zvezda i njegovih profitabilnih potrošača. To je najviši vid saradnje između kluba i svih njegovih partnera. Ostvaruje se obostranom razmenom i isporukom obećanja i korisnih informacija, a posledica toga je obostrana korist, kako FK Crvena zvezda, tako i svih potrošača.

Što se tiče budućnosti poslovnog tržišta na kome privređuje i fudbalski klub Crvena zvezda, mislim da će se u narednom periodu polako doći do zaokreta sa domaćeg na globalne izvore snabdevanja, sponzorstva, kao i drugih vidova poslovne saradnje. U osnovi ovih promena koje će uslediti nalaze se pojačana svetska konkurencija, sve više interesovanja među velikim svetskim kompanijama za investiranje u fudbal, kao i sve većivrazvoj informacionih tehnologija i globalizacije svetske privrede. Svi ovi odnosi dovešće do promene u odnosima između poslovnih potrošača koji sarađuju sa klubom. Svi poslovni potrošači su partneri koji će postati jedna od osnova za stabilno funkcionisanje fudbalskog kluba Crvena zvezda, što je preduslov za postizanje velikih sportskih uspeha i vraćanje zrvne Zvezde na put stare slave.

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THE INFLUENCE OF MARKETING ACTIVITIES ON THE BRANDING OF SPORTS

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ABSTRACT:

As a rule, the subject of research is some, specific connection between phenomena. With that, the determination of the subject includes the determination, that is, the definition of the very phenomena between which the connection is established, as well as the determination of the nature of the connection itself. The subject of the research is branding as an important factor of successful development in sports. Special attention was paid to FC Crvena zvezda and its brand. Theoretical definition of the problem and the subject of research is a logical operation by which the essence of the phenomenon to be investigated is determined using abstract terms. Operationally, the working definition of the problem consists in the determination of indicators, that is, indicators that can be empirically tested and verified. The degree of research into branding in sports is high, and given that marketing is an increasingly influential and prevalent area of the economy, that degree of research into branding in sports will grow to an even higher level over time. After the operational definition of phenomena is carried out, assumptions or research hypotheses are set. Their function is to assume a connection between the phenomenon we are investigating and other factors that could be assumed to be in some kind of relationship with it. The aim of the research is to check the validity of the hypothesis.

Keywords: internet marketing, marketing, campaign, SD Crvena zvezda

POSLOVNI I VIRTUELNI INKUBATORI KAO POKRETAČI RAZVOJA PREDUZETNIŠTVA

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APSTRAKT:

Osnovni cilj pokretanja poslovnih i virtuelnih inkubatora je odgovarajuća infrastrukturna podrška u procesu osnivanja i razvoju novih malih i srednjih preduzeća, na temelju inovacijskih ili preduzetničkih ideja i start up projekata, podjednako na lokalnom i nacionalnom nivou. Poslovni inkubatori su se u razvijenim državama, ali i onim koje su u tranziciji nametnuli kao pouzdano sredstvo podrške razvoja i rasta malih i srednjih preduzeća, a zatim, ravnomjernog regionalnog razvoja na nacionalnom nivou. Razvojem informaciono komunikacionih tehnologija dolazi do pokretanja sve većeg broja virtuelnih inkubatora kao novog načina ugovaranja poslovne saradnje i širenja mreže poslovnih klijenata. Predmet istraživanja u ovom radu je analiza opravdanosti organizovanja preduzetničkih i virtuelnih inkubatora u Crnoj Gori sa aspekta tehničkih, komercijalnih, ekonomskih i drugih parametara koji su potrebni da bi se provjerila održivost projekta na dugi rok, u kome je jedino moguće potpuno efektiviranje angažovanih resursa. Cilj istraživanja je da se na istraživačkoj osnovi ispita opravdanost izvodljivosti predložene razvojne varijante budućih preduzetničkih inkubatora koji treba da predstavljaju važnu infrastrukturnu podršku razvoju novih, i preduzetničkih poduhvata u početnim fazama njihovog razvoja.

Ključne riječi : poslovni inkubatori, start up, virtuelni inkubatori, preduzetništvo, inovacije.

1. UVOD

Osnovni cilj pokretanja poslovnih inkubatora je podrška u procesu osnivanja i razvoju novih malih i srednjih preduzeća, na temelju inovacijskih ili preduzetničkih ideja i projekata pojedinaca. Poslovni i virtuelni inkubatori su se u posljednjoj dekadi prošlog vijeka i u državama u tranziciji nametnuli kao pouzdano sredstvo podrške razvoja i rasta malih i srednjih preduzeća, a zatim, ravnomjernog regionalnog razvoja na nacionalnom nivou, te uključivanja njihovih privreda u evropske integracione procese. Preduzetnicima početnicima sa inovativnim idejama pomoć je najpotrebnija zbog nedostatka iskustva,

finansijskih sredstava, mentorstva i drugih oblika pomoći i usmjeravanja. Podržavanjem start-up projekata povećava se broj uspješnih poslovnih poduhvata, što u većini slučajeva utiče na otvaranje novih poslova i direktno vodi ka mjerljivosti konkretnih rezultata rada pojedinog inkubatora, iako na duži period (Lee Tupek, Ćorić, 2018).

2. POSLOVNI INKUBATORI

Evropska komisija definiše poslovne inkubatore kao mjesto gde su novoosnovane firme skoncentrisane na ograničenom prostoru. Cilj poslovnog inkubatora je da tako što će im pružiti podršku time povećá šanse za rast ovih firmi, kao i da povećá broj firmi koje opstaju tako što će im obezbijediti jedan model-objekat, sa potrebnom opremom i uobičajenim pomagalicama (kancelarijski namještaj, priključak na Internet, računari, fotokoporni aparate i dr.), zatim menadžerske usluge i razni druge vidove podrške . Pri tome, kada je u pitanju svrha organizovanja poslovnih inkubatora, fokus je prvenstveno na lokalnom razvoju i otvaranju novih radnih mjesta, s tim da isključiva orijentacija na tehnologiju nije uvijek u prvom planu, posebno u početnoj fazi njihovog razvoja (Ilić, 2006).

Uticaj inkubatora na ekonomski razvoj lokalne zajednice, odnosno osnivanje podsticanje start-up preduzeća ima značajne društvene i nematerijalne koristi koje se ne mogu mjeriti jedino i uobičajenim koristima od prihoda. U konačnom, opravdanost osnivanja poslovnih inkubatora se u najkraćem sastoji u sljedećem:

- Podsticanje i razvoj novih preduzeća (start-up i slično);
- Promocija rasta i opstanka MSP;
- Podsticanje rasta zaposlenosti;
- Podsticanje većeg ulaganja kapitala u MPS;
- Promocija tehnoloških zahtjevnih MSP;
- Omogućava efikasno iskorišćavanje i korišćenje napuštenih prostorija;
- Stvaranje povoljnog ambijenta za razvoj “preduzetničkih mreža”;
- Podsticanje izdvajanja jedinica iz većih preduzeća (spin-off) i drugo.

3. VIRTUELNI INKUBATORI

Virtuelni inkubator je organizovan slično kao i preduzetnički inkubator za start up preduzeća i za poslovne subjekte koji već posluju, samo je razlika u tome što zakupci dobijaju mogućnost da imaju adresu u centru grada, reklamu na totemu i uslugu primanja pošte i slanja iste od strane zaposlenih u poslovnom inkubatoru. Na sledećoj slici je prikazana proces virtuelne biznis inkubacije u poslovnom svijetu poznatija kao inkubacija „bez zidova“ koja podrazumjeva prije svega niže troškove poslovanja, podršku preduzetnicima u ranoj fazi, razvoj sirovih ideja i pretvaranje istih u održive poslovne modele, nezavisnost od geografske i infrastrukturne lokacije i niz prednosti koje omogućavaju bolji pristup globalnom tržištu.

Slika 1. Virtuelna poslovna inkubacija



Izvor : prilagođeno prema (<https://worldbusinessincubation.wordpress.com/>)

Korisnici virtuelnog inkubatora nisu fizički prisutni u prostoru već imaju adresu i ovaj model je posebno pogodan za kompanije koje posluju u drugim gradovima uspješno, a žele da otvore posebnu poslovnu jedinicu u nekom novom gradu ili drugoj državi.

Virtuelni start up inkubator nudi početnicima u poslu usluge :

- zakupa adrese firme sa reklamom na video totemu ispred inkubatora,
- prijema pošte i slanja iste klijentu u roku od jednog dana od prijema skenirano uz pohranjivanje u posebnim sandučetu za tog klijenta,
- knjigovodstva koje su besplatne prvih par mjeseci,
- pravnog savjetovanja prvih par mjeseci,
- besplatne edukacije online i uživo koje će povremeno biti organizovane i za stanare inkubatora.

Virtuelni biznis inkubator za kompanije koje već posluju nudi klijentima usluge:

- zakupa adrese firme sa reklamom na video totemu ispred inkubatora,
- prijema pošte i slanja iste klijentu u roku od jednog dana od prijema skenirano uz pohranjivanje u posebnim sandučetu za tog klijenta,

- besplatne edukacije online i uživo koje će povremeno biti organizovane i za stanare inkubatora.

Cijena mjesečnog zakupa za korisnike virtuelnog biznis inkubatora treba da iznosi znatno manje na mjesečnom nivou nego zakup koji plaćaju korisnici koji borave u poslovnim inkubatoru.

Virtuelnom inkubacijom moguće je kreirati sinergiju kompanija koje mogu da ostvaruju saradnju bez obzira na ograničenja u veličini poslovnog prostora za preduzetnički inkubator, i omogućavaju se dodatni prihodi koji mogu da nadomjeste rashode koji će biti opravdani za finansiranje inkubacije budućih preduzetnika koji su korisnici prostora (Lojpur, Grgurević, Radević, 2022).

Struktura poslovnih subjekata u Crnoj Gori, jasno ukazuje na dominantnu ulogu malih preduzeća u ukupnom broju preduzeća. Poslovni i virtuelni inkubatori kreiraju nova radna mjesta i doprinose povećanju zaposlenosti, utiču na diversifikaciju i poboljšanje privredne strukture, izvor su inovacija i podstiču tehnološki progres. Shodno platformi ekonomskog oporavka Crne Gore budućni rast naše države treba da se zasniva na mikro, malim i srednjim preduzećima u kojima se moraju indukovati produktivne investicije koje će povećati njihovu konkurentnost (Platforma ekonomskog oporavka 2022 - 2026. godine, 2022). Na ovaj način, crnogorskim kompanijama će se omogućiti zadovoljavanje domaće tražnje, ali i jačanje izvoza, što znači prisutnost na velikim tržištima kako bi se mogao koristiti efekat ekonomije obima.

4. ZAKLJUČAK

Razvoj preduzetništva i malog i srednjeg biznisa je prepoznat kao jedan od prioriteta u svim strateškim dokumentima naše države. Potrebno je kreirati stimulativan institucionalni okvir za razvoj preduzetništva posebno među mladima, čime se može uticati na samozapošljavanje i otvaranje novih radnih mjesta, što će biti generator za razvoj novih privrednih subjekata i uticati na povećanje konkurentnosti ukupne privrede. Poslovni i virtuelni inkubatori imaju potencijal za stvaranje novih radnih mjesta, kao i jačanje lokalne i nacionalne ekonomije.

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BUSINESS AND VIRTUAL INCUBATORS AS INITIATORS OF ENTREPRENEURSHIP DEVELOPMENT

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ABSTRACT:

The main goal of starting business and virtual incubators is appropriate infrastructural support in the process of establishing and developing new small and medium-sized enterprises, based on innovative or entrepreneurial ideas and start-up projects, both at the local and national level. Business incubators have established themselves in developed countries, but also in those in transition, as a reliable means of supporting the development and growth of small and medium-sized enterprises, and then, even regional development at the national level. The development of information and communication technologies leads to the launch of an increasing number of virtual incubators as a new way of contracting business cooperation and expanding the network of business clients. The subject of research in this paper is the analysis of the justification of organizing entrepreneurial and virtual incubators in Montenegro from the aspect of technical, commercial, economic and other parameters that are needed to check the sustainability of the project in the long term, in which the only possible full effectuation of the engaged resources. The goal of the research is to investigate the feasibility of the proposed development variant of future entrepreneurial incubators, which should represent important infrastructural support for the development of new and entrepreneurial ventures in the initial stages of their development.

Keywords: *business incubators, start up, virtual incubators, entrepreneurship, innovations.*

***PRAVNE I POLITIČKE NAUKE, SOCIOLOGIJA,
PSIHOLOGIJA***

***LEGAL AND POLITICAL SCIENCES, SOCIOLOGY,
PSYCHOLOGY***

PREDAJA DJETETA KAO RADNJA PROVOĐENJA IZVRŠNOGA POSTUPKA

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SAŽETAK

Provođenje izvršenja predajom djeteta u izvršnom postupku predstavlja refleksiju neizvršene obaveze koja proizlazi slijedom sadržaja konkretne pravosnažne sudske presude. U ovome radu autori će analizirati postupak izvršenja predajom djeteta, kao i uslove za takav postupak kao radnju provođenja. Osim toga, kao bitnog aktera toga postupka, analizirat će se i uloga organa starateljstva, odnosno važnost uloge organa starateljstva u odnosu na položaj djeteta u takvim okolnostima. Ukazat će se na važnost određivanja najboljeg djetetova interesa, prava koje treba biti vodilja svim učesnicima jednog takvog postupka. Osim toga, ukazat će se i na problematiku koja se može javiti i dodatno otežavati postupak provođenja predmetne izvršne radnje, dakle radnje predaje djeteta u izvršnom postupku. Shodno mogućim opstrukcijama u vezi s provođenjem izvršenja, analizirat će se i mogućnost inicijative za upotrebu pravne sankcije za stranu koja onemogućuje provođenje postupka predajom djeteta.

Ključne riječi: *dijete, izvršni postupak, organ starateljstva, Konvencija o pravima djeteta*

1. UVOD

Predaja djeteta u izvršnom postupku predstavlja prinudni način izvršenja pravosnažne presude kojom je određeno povjeravanje malodobnog djeteta jednom od roditelja te, s druge strane, kojom je utvrđeno i pravo drugog roditelja na viđanje djeteta. Specifičnost postupka ove vrste, zapravo, ogleda se u činjenici da se radi o živom biću koje se nalazi u ulozi predmeta i sredstva izvršenja, dakle, riječ je o malodobnom djetetu.

Iako se radi o sudskoj odluci kojom je utvrđena obaveza povjeravanja djeteta jednom od roditelja a drugom pravu na viđanje djeteta, i u ovom slučaju je neophodno imati u vidu najbolji djetetov interes.

Naime, u članu 1. Konvencije o pravima djeteta¹ propisano je: „U ovoj Konvenciji dijete znači svako ljudsko biće mlađe od 18 godina, osim ako se po zakonu koji se primjenjuje na dijete punoljetnost ne stječe ranije.“

Nadalje, u stavu 1. člana 9. Konvencije propisano je: „1. Države-potpisnice će se pobrinuti da dijete ne bude protiv svoje volje odvojeno od svojih roditelja, osim kada nadležne vlasti koje podliježu sudskom ispitivanju odluče, u skladu s odgovarajućim zakonima i procedurama, da je takvo odvajanje potrebno u najboljem interesu djeteta. Takva odluka može biti potrebna u određenim slučajevima kao što su zlostavljanje ili zanemarivanje djeteta od roditelja, ili gdje roditelji žive odvojeno i mora se donijeti odluka o djetetovom mjestu stanovanja.“² Ovim radom se ukazuje, prije svega, na važnost provođenja izvršnoga naslova, dakle, pravosnažne i izvršne sudske presude kojom je određeno pravo na povjeravanje djeteta jednom roditelju, a drugom roditelju pravo na viđanje djeteta. S tim u vezi se ukazuje i na važnost zaštite najboljeg djetetova interesa, dakle na primjenu i te imperativne pravne norme u predmetnom kontekstu. Ovo je važno iz razloga što se pred izvršni sud sada postavlja zadatak da provede jedan takav izvršni naslov. Naime, sadržaj izvršnoga naslova se ne preispituje u izvršnom postupku, nego se provodi ono što je pravosnažno presuđeno. Važna činjenica u postupku provođenja izvršenja predaje djeteta jeste da bi se moglo odstupiti od te pravne norme. Navedeno upravo iz razloga što najbolji djetetov interes ovdje ima primat, a što se cijeni u svakom konkretnom slučaju. Upravo iz toga razloga organ starateljstva, u skladu sa svojim kompetencijama, treba imati ključni prijedlog rješenja problema kako bi se zaštitio djetetov najbolji interes, te aktivno sudjelovati u svakom segmentu konkretnog postupka. Predmetna tematika, zapravo, i daje jedan prikaz važnosti ovoga postupka koji, prije svega, štiti sam predmet, odnosno sredstvo izvršenja koje predstavlja malodobno dijete. Ovo je također pokazatelj da predmetna tematika treba biti više zastupljena te da se posebno organ starateljstva predstavlja kao ključna karika koja treba odgovoriti da li izvršenje izvršnoga naslova u predmetnom kontekstu, zapravo, predstavlja zaštitu djetetova najboljeg interesa.

2. NAČIN PROVOĐENJA IZVRŠENJA PREDAJOM DJETETA

Odredbom člana 227. Zakona o izvršnom postupku Federacije Bosne i Hercegovine³ (u daljnjem tekstu: ZIP) propisan je način provođenja izvršenja predajom djeteta. Naime, dijete, kao predmet izvršenja u ovom postupku, ima položaj predmeta i sredstva izvršenja, odnosno radnje kojom se ostvaruje provođenje pravosnažne i izvršne sudske odluke.

¹ Konvencija o pravima djeteta, usvojena na Generalnoj skupštini Ujedinjenih nacija, 20. novembra 1989. godine, dostupno na:

https://www.unicef.org/bih/media/676/file/Konvencija%20o%20pravima%20djeteta.pdf?fbclid=IwAR0CMNHt4iz3GL1pX4OgswiM4xY_n3DBGvt1sBO0jj6Nd5Xv67lSKQdcysc (pristupljeno: 1. 2. 2023. godine).

² <https://www.unicef.org/bih/konvencija-o-pravima-djeteta>

³ Zakon o izvršnom postupku Federacije Bosne i Hercegovine, „Službene novine Federacije Bosne i Hercegovine“, broj: 23/03, 52/03, 33/06, 39/06, 39/09, 35/12 i 46/16; i „Službeni glasnik Bosne i Hercegovine“, broj 42/18 – Odluka Ustavnog suda.

Dakle, imajući u vidu sadržaj obaveza iz izvršne isprave, kao predmet takve obaveze može biti i dijete. Kada govorimo o djetetu u predmetnom kontekstu, onda mislimo na njegov položaj nakon razvoda braka.

Naime, odredbama člana 50. Porodičnog zakona Federacije Bosne i Hercegovine¹ propisano je da će, nakon neuspjelog pokušaja mirenja bračnih partnera, ovlašteno lice nastojati da se partneri sporazumiju o tome s kim će živjeti njihovo malodobno dijete ili dijete nad kojim se nakon punoljetstva ostvaruje roditeljsko staranje. Također, nastojat će se postići sporazum o djetetovim odnosima s roditeljem s kojim neće živjeti, kao i o njegovu izdržavanju te o ostalim sadržajima roditeljskog staranja.

Međutim, ako bračni partneri ne postignu sporazum u vezi s tim s kojim od njih će živjeti njihovo malodobno dijete, ili ako postignuti sporazum ne odgovara djetetovim interesima, organ starateljstva će, na zahtjev ovlaštenog lica ili po službenoj dužnosti, odlučiti o tim pitanjima. Takva odluka će važiti do pravosnažnosti odluke o razvodu braka.

Dakle, organ starateljstva je uključen u brakorazvodne postupke, u kojima se odlučuje i o daljnjem položaju djeteta nakon razvoda braka, i to, opet, u kontekstu zaštite najboljeg djetetova interesa.

Ono što se javlja kroz praksu jeste činjenica da onaj roditelj kojem je dijete povjereno može biti doveden u situaciju da drugi roditelj ne dozvoljava ostvarivanje prava iz izvršne isprave, odnosno presude kojom je brak razveden i malodobno dijete povjereno jednom od roditelja (može biti i više djece). Naime, imajući u vidu tu situaciju, odnosno nemogućnost jednog od roditelja da ostvaruje kontakte sa svojim djetetom, u toj situaciji roditelj svoje pravo može ostvariti prinudnim putem, odnosno primjenom instrumenata izvršnoga postupku. Dakle, kada roditelj kojem je povjereno dijete, odnosno djeca ne pruža drugom roditelju mogućnost viđanja djeteta na način kako to proizlazi iz konkretne presude, on na taj način uzrokuje situaciju u kojoj dijete, odnosno djeca postaje objektom prinudnog izvršenja.

Kako je prethodno navedeno, način provođenja izvršenja regulisan je odredbom člana 227. ZIP-a.

Tom odredbom je propisano da se u postupku predaje djeteta nameće obaveza zaštite najboljeg djetetova interesa. Osim toga, kao institucija koja se uključuje u postupak, tu je i organ starateljstva. Naime, organ starateljstva u tom kontekstu ima ulogu svojim stručnim znanjem pridonijeti provođenju radnje predaje djeteta te, pri tome, svojim djelovanjem utjecati da se prilikom tih aktivnosti ne zanemari najbolji djetetov interes.

Uključivanje organa starateljstva obavezujuća je radnja „[...] obzirom da sud (ni sudija ni sudski izvršilac) ne raspolaže stručnim znanjem za postizanjem tog cilja uz istovremeno izvršenje obaveza iz izvršne isprave, zakonodavac je u ovome stavu odredio obavezu suda

¹ Porodični zakon Federacije Bosne i Hercegovine, „Službene novine Federacije Bosne i Hercegovine, broj: 35/05, 42/05 – ispravka teksta, 31/14 i 32/19 – odluka Ustavnog suda.

da kod ove vrste sudskog izvršenja obavezno zatraži **stručnu pomoć organa starateljstva**¹.

3. NAJBOLJI DJETETOV INTERES

Predmetni položaj djeteta koji dobija nakon što se pokrene izvršni postupak na osnovu pravosnažnog i izvršnog sudskog naslova (presude), rezultat je neizvršenja te presude kao sudske odluke. Podnoseći prijedlog za izvršenje, strana iz pamičnoga prethodnog postupka, odnosno roditelj kojem je povjereno dijete, sada prinudnim zakonskim putem želi ostvariti to svoje pravo. Međutim, ovdje treba imati u vidu činjenice da se radi o malodobnom djetetu koje se sada nalazi u situaciji da postaje predmet predaje, odnosno prisilne predaje drugom roditelju. Ova mogućnost, dakle, svoj osnov pronalazi u zakonskoj regulativi, odnosno primjenom propisa izvršnoga postupka. Iako se radi o zakonskoj regulativi koja kroz instrument izvršnoga postupka daje tu mogućnost, imperativno, kao prioritet, jeste da se ima u vidu zastupanje najboljeg djetetova interesa. Naime, upravo iz tog razloga je neophodno učešće organa starateljstva koji, u skladu sa svojim stručnim ovlaštenjima, treba biti poveznica između, s jedne strane, prilagodbi provođenja zakonske inicijative te, s druge strane, zaštite djeteta, odnosno njegova najboljeg interesa. Iako se radi o presuđenoj stvari koja nije ispunjena dobrovoljnim putem, i predmetna situacija se podvela pod prisilnu, ipak, u pitanju je, kao prioritet, zaštita najboljeg djetetova interesa.

U predmetnom kontekstu misli se na sam položaj djeteta u postupku predaje, dakle način na koji se treba provesti to izvršenje.

Zakonodavac je u kontekst te radnje uključio obavezujuće prisustvo organa starateljstva, a upravo iz razloga što organ starateljstva, u okviru svojih nadležnosti, pridonosi adekvatnom postupanju s ciljem zaštite najboljeg djetetova interesa.

Ustavni sud ukazuje na to da podržava praksu Evropskog suda, a prema kojoj je zauzet stav da u postupcima u kojima se odlučuje o pravima djeteta „najbolji interesi djeteta bit će od prvenstvenog značaja“.²

Usporedbe radi, postupak izvršenja predaje djeteta u Republici Hrvatskoj regulisan je odredbama Obiteljskog zakona³. Taj postupak je definisan u članu 509. Obiteljskog zakona kao „Posebni postupci ovrhe“. Naime, odredbom člana 525. toga zakona je propisano da ako dijete ima navršениh 14 godina života i protivni se da ostvaruje lične

¹ A. Daupović et al., *Komentar Zakona o izvršnom postupku...*, str. 672.–673.

² Ustavni sud, Odluka, broj: AP 3073/09 od 7. aprila 2011. godine; dostupna na: www.ustavnisud.ba (pristupljeno: 3. 2. 2023. godine).

³ Obiteljski zakon Republike Hrvatske, „Narodne novine“, broj: 103/15, 98/9 i 47/20, dostupno na: <https://zakon.hr/z/88/Obiteljski-zakon> (pristupljeno: 27. 3. 2023. godine).

odnose s drugom osobom iz izvršne isprave, sud će odbiti prijedlog za izvršenje. Dakle u tom kontekstu, kroz izražavanje djetetove volje, odstupa se od izvršnoga naslova i odbija prijedlog za izvršenje, iako se radi o provođenju izvršnoga naslova. Dakle, kao mjerodavna činjenica za provođenje izvršenja u tom kontekstu uzima se djetetova volja. Na taj način se, zapravo, prepoznaje najbolji djetetov interes.

4. NOVČANA KAZNA

Kao prethodna radnja koju je moguće primijeniti prije same predaje djeteta, jeste, zapravo, i mogućnost sankcionisanja izvršenika kroz izricanje novčane kazne. Pravni osnov za ovakvo postupanje propisuje zakonodavac u stavu 2. člana 227. ZIP-a, ostavljajući pri tome rok od tri dana za predaju djeteta. Dakle, na ovaj način se izvršenik prethodno upozorava da može snositi posljedice novčanog kažnjavanja ako ne postupi u skladu s izvršnim naslovom, odnosno pravosnažnom presudom na osnovu koje je podnesen prijedlog za izvršenje. Naime, predmetni kontekst ukazuje na činjenicu da prije samog prinudnog oduzimanja i predaje djeteta egzistira mogućnost novčanog kažnjavanja kao mjera kojom bi se doprinijelo izvršenju. Na ovaj način bi se mogao izbjeći sam postupak prinudne predaje djeteta drugom roditelju, a koji sam po sebi može biti traumatičan za dijete, kao i ukazati na važnost postupanja prema izvršnom sudskom naslovu i važnost same pravne prirode toga postupka.

5. ZAKLJUČAK

Kako se i ukazuje sadržajem ovoga rada, i u izvršnom postupku se imperativno štiti najbolji djetetov interes. Naime, u izvršnom postupku dijete ima položaj predmeta i sredstva izvršenja preko kojega se provodi izvršni naslov, odnosno pravosnažna sudska presuda. U postupcima izvršenja predajom djeteta, obavezujuću ulogu ima organ starateljstva koji se uključuje odmah od samog početka takvog jednog izvršnoga postupka. Njegova uloga, zapravo, treba doprinijeti, svojim stručnim kvalifikacijama, samom postupku predaje djeteta na način da inicira postupanje koje štiti djetetov interes. Dakle, organ starateljstva u predmetnom kontekstu ima ulogu nadzora u smislu zaštite malodobnog djeteta. Sam postupak predaje djeteta je specifičan upravo iz razloga što predstavlja predmet i sredstvo izvršenja kojim se provodi izvršni naslov koji je osnov za izvršenje. U vezi s tim se ističe i činjenica mogućnosti novčanog kažnjavanja kao vida sankcije za izvršenika, odnosno za stranku u postupku koja treba omogućiti predaju djeteta a koja pasivna legitimacija proizlazi iz izvršnoga naslova. Dakle, u okviru ovoga postupka akcent je na zašiti najboljeg djetetova interesa, a što, zapravo, i zakonodavac zakonskim okvirom i iniciranjem učešća i organa starateljstva, na taj način, ukazuje i na tu imperativnu odredbu.

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HANDING OVER THE CHILD AS AN ACTION FOR IMPLEMENTATION OF EXECUTIVE PROCEDURE

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ABSTRACT

Enforcement by handing over the child in the enforcement procedure represents a reflection of the unfulfilled obligation that results from the content of a specific final court verdict. In this paper, the authors will analyze the execution procedure by handing over the child, as well as the conditions for such a procedure as an enforcement action. In addition, as an important actor of that procedure, the role of the guardianship body will be analyzed, that is, the importance of the role of the guardianship body in relation to the position of the child in such circumstances. The importance of determining the best interest of the child will be pointed out, which is a right that should be the guiding principle for all participants in such a procedure. In addition, the problems that can arise and further complicate the procedure of implementing the enforcement action in question, i.e. the action of handing over the child in the enforcement procedure will be pointed out as well. According to the possible obstructions related to the implementation of the execution, the possibility of an initiative to use a legal sanction for the party that prevents the implementation of the procedure by handing over the child will be analyzed.

Key words: child, enforcement procedure, guardianship body, Convention on the Rights of the Child

RADNOPRAVNI I DRUŠTVENI ASPEKTI DISKRIMINACIJE ŽENA PRI ZAPOSŁJAVANJU I NA RADU

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SAŽETAK:

Radom se analizira diskriminacija uopće, s obzirom na izraženost i kvantitet, posebno s aspekta diskriminacije žena prilikom zapošljavanja i na radu, za vrijeme trajanja radnog odnosa. Kroz prizmu međunarodnih i domaćih dokumenta, zakonskih i podzakonskih akata koji tretiraju oblast diskriminacije, predmet rada bit će pravna i društvena praksa, koja upućuje na izraženost problema diskriminacije, posebno u postupku prijema na rad i ostvarivanja prava iz rada. Pretpostavlja se da na diskriminatorni položaj žene pri zapošljavanju i na radu utiču brojni pravni, ali i drugi društveni faktori. Također se pretpostavlja da je diskriminacija žena na tržištu rada rezultat društvenog položaja žene i negativnih percepcija o njihovoj društvenoj ulozi, za koju još uvijek postoje izgrađeni diskriminatorni stavovi i uvriježena mišljenja, da žena prije svega treba biti dobra domaćica i majka. Iz tog razloga postoji potreba da se mijenja slika žene, koja ima pravo na afirmaciju kroz rad, što je još uvijek određenom dijelu populacije nezamislivo.

Ključne riječi: rodna diskriminacija, položaj žena, rad i zapošljavanje

1. UVOD

Najstariji oblici diskriminacije su rodnog obilježja. Borba za ostvarivanjem prava na ljudsku slobodu i jednakost je dugotrajan i nedovršen proces. Jednakost pred zakonom i u primjeni zakona glavna je odlika pravne države i temeljeno pravno načelo. Unatoč tome status i položaj žena i muškaraca različito se određuje, tako da je ženin položaj nedjeljiv od obiteljskog, a muškarca od njegove profesije. Time se zacrtala i podjela poslova, gdje je ukorijenjen stav da je ženama primarna uloga majčinstva, kojom se pridodaju kućanski poslovi, a muškarcima hraniteljska funkcija obitelji. Niti izlazak žena na tržište rada nije promijenio percepciju žene kao kućanice, niti muškarcima pridodao zajedništvo u obavljanju kućnih poslova. Politikom jednakih mogućnosti ženama je omogućen izlazak na tržište rada, ali nisu uklonjeni brojni stereotipi koji su podloga diskriminacije žena u društvu. Brojne barijere su eksplisitne, dok su implicitne opće prihvaćene i podržavane,

najčešće u oblasti ostvarivanja prava na rad i diskriminacija koje nastaju na radu. Unatoč ustavnim, zakonskim i podzakonskim pretpostavkama za jednakost žena i muškaraca, neupitna je neravnopravnost žena, posebno u oblasti zapošljavanja i rada. Narativ ravnopravnosti uveliko se razlikuje u normativnoj regulaciji i postupanjima prema općeprihvaćenim politikama, gdje je i sama normativna regulacija upitna. Pojam roda društveno je konstruiran, dok je pojam spola biološki određen, te stoga pojmovi rodne jednakosti, ravnopravnosti spolova kao i jednakosti muškaraca i žena ipak nemaju isto značenje [1]. Radom se tretiraju međunarodni i domaći dokumenti, zakoni i podzakonski akti koji tretiraju oblast diskriminacije, ali i pravna praksa i sociološki fenomen rodne neravnopravnosti, osobito u postupku provođenja natječajnih procedura iz oblasti zapošljavanja te kasnijih prava, koja proizlaze iz ugovora o radu. Primjenom dogmatskog metoda analizirat će se značenje i pravna suština normi kojima su definirani radna diskriminacija i mehanizmi zaštite diskriminacije, ponajprije zaštite žena od diskriminacije pri zapošljavanju i na radu, dok će se komparativnom metodom analizirati i usporediti određene pravne i društvene norme, prisutne kod normativnog određivanja pojma diskriminacije i mjera za njeno suzbijanje. Kvalitativnom analizom sadržaja analizirat će se pojedini elementi u aspektu od opće cjeline prema konkretnijim strukturama, dok će se kvantitativna analiza sadržaja koristiti radi analiziranja odnosa pojedinačnih elementa u kontekstu stvaranja cjeline koja obuhvaća pojedinačne elemente i nadograđuje se kao nova cjelina, da bi se potom, u kontekstu danog istraživanja koristila sinteza deduktivne i induktivne analize, radi percepcije elemenata međuutjecaja i određenja pojave, koji utječu na borbu protiv diskriminacije i to u dvosmjernom aspektu odnosa pojedinačnog i općeg. Radom se pretpostavlja potvrda hipotetičke dileme o tome da na ukupni položaj žene, pa samim tim i na diskriminaciju uopće, a posebno na diskriminaciju pri zapošljavanju i na radu utiču brojni pravni, ali i drugi društveni faktori. Pretpostavlja se i to da je diskriminacija žena na tržištu rada rezultat društvenog položaja žene i negativne percepcije o društvenoj ulozi žena koja za većinu nije vezana za rad, te da je afirmacija žene kroz rad nezamisliva za stvorenu sliku žene koja prije svega treba biti dobra domaćica i majka.

2. POJMOVNO TEORIJSKI KONTEKST DISKRIMINACIJE PRI ZAPOŠLJAVANJU I NA RADU

Diskriminacija je složen i višeznačan pojam, kod kojeg treba razlikovati diskriminaciju kao društvenu pojavu od diskriminacije kao fenomena znanstveno teorijskog smisla. Diskriminacija ima svoju etimološku, ontološku i sadržajnu dimenziju, pod kojom podrazumijevamo odvajanje i pravljenje razlika, koje se u konačnici manifestira ograničenim stjecanjem pojedinih ljudskih prava. Posljedice u ponašanju pod utjecajem stereotipa i predrasuda predstavljaju faktičku stranu diskriminacije, i ona je povezana s individualnim psihološkim osjećajem i duševnom boli. Osjećaj stigmatiziranosti izaziva nelagodu ili osjećaje poput bijesa, tuge, osamljenosti, dok još veću nepravdu predstavljaju gubitak posla ili nemogućnost zapošljavanja, loši stambeni uvjeti ili niski prihodi koji su rezultat diskriminacije [2]. Diskriminacija za posljedicu ima nejednakost u prilikama da

se ostvare pravnom regulativom zajamčena prava. Može se manifestirati kao nejednako tretiranje, isključivanje, te dovođenje u podređen položaj osoba koje se nalaze u istoj, sličnoj ili usporedivoj situaciji. Kao pojam označava obespravljenost, neravnopravnost, podređenost, gdje se nekoga dovodi u podređen položaj, osporava ili mu se oduzimaju određena prava, odnosno čini razlika na štetu jedne strane. Sociološki promatrano diskriminacija označava različito postupanje prema osobama ili društvenim grupama, nepravedno i nedosljedno, vodeći se pri tome pisanim ili nepisanim normama ponašanja, koja im u tom postupanju potpomažu i omogućavaju. U nekim se zakonodavstvima marginaliziranim kategorijama, s ciljem sprječavanja diskriminacije, usvajaju zakonska rješenja kojima ostvaruju određene privilegije, što označava takozvanu pozitivnu diskriminaciju. Premda je sve veći udio žena na tržištu rada, njihov je položaj i dalje lošiji od položaja muškaraca. Najčešće svoje mjesto nalaze u potplaćenim djelatnostima i radnim mjestima, te se susreću s diskriminacijama u prilikama za zaposlenje, pri napredovanju i drugim, iz čega proizlaze glavni problemi položaja žena na tržištu rada. Kako se prirodno pravna teorija temelji na prihvatanju objektivno važećih vrijednosnih sistema pravednosti prava, u tom kontekstu prirodno pravo postavlja hijerarhiju odnosa s pozitivnim pravom, gdje prirodno pravo i pravednost imaju apsolutnu prednost, tako da se prednost daje pravednosti ispred bilo kakvih oblika diskriminacije i neprirodnog razlikovanja različitih osoba. Samo pravedno pravo je pravo, što je bitnija osobina prava od njegove efikasnosti, u kojem kontekstu zahtjev za pravednost prava prema teoriji prirodnog prava čini idejni temelj borbe protiv diskriminacije. Nasuprot prirodnom pravu, teorija pravnog pozitivizma negira pravednost prirodnog prava i mogućnost te teorije da osigura sistem pravednosti prava, te po pravnom pozitivizmu ima suštinski dualizam između pravednog i pravno utemeljenog [3]. Prema tome, prirodno pravo nije efikasno jer ima dualizam i stvara stalnu društvenu napetost postojanja nepravde koja mora biti pravno eliminirana. Pravni pozitivizam podrazumijeva dosljednu primjenu prava i njegovu efikasnost, i zapostavlja sadržaj prava, odnosno njegovu pravednost. Efikasnost u primjeni prava pravnog pozitivizma čini ga neutemeljenim u borbi protiv diskriminacije uopće, a samim tim ni rodne diskriminacije. Pravo propisuje ono što treba biti, a ne ono što jeste, iz čega se može zaključiti da pravo pripada idealnom svijetu, iz čega se izvodi razdvajanje dvije sfere, normativne, kao idealne sfere utvrđene pravnim normama i sfere realnih društvenih odnosa, koji ne odgovaraju tom normativnom svijetu.

3. DISKRIMINACIJA KAO OBLIK POVREDE NAČELA RODNE RAVNOPRAVNOSTI

Kako je diskriminacija društvena pojava, fenomen koji postoji i pripada realnom svijetu, koji nije utvrđen pravnim normama već se stvorio kao rezultat nepravdičnosti političke sfere koja snagom jačega i vlasti dovodi pojedince i društvene grupe u neravnopravan položaj, pravni karakter ima samo borba protiv diskriminacije, koju obuhvaća pravo. Na diskriminaciju žena na tržištu rada utječu brojni faktori. Sociološki promatrano, uzrok diskriminacije žena je u okolnostima njihovog društvenog položaja i uloge. Unatoč tome što žene imaju brojnije društvene uloge, posebno u organizaciji obiteljskog života, uloga

kućanice i majke izrodila se u smetnju za učešće na tržištu rada i donijela im hendikep pri zapošljavanju. Brojni poslodavci nevoljko zapošljavaju žene, smatrajući da će ju ostvarivanjem prava na porodiljni dopust morati zamijeniti drugom radnicom, da nemaju snage raditi teže fizičke poslove, pa sve do toga da žene neće zadovoljiti radom na rukovodećim ili na radnim mjestima gdje se zahtijeva kreativnost. Ovakve predrasude počivaju iz vremena patrijarhalnog obiteljskog karaktera, gdje su ženama bile isključivo namijenjene uloge dobrih domaćica i kućanica. Ekonomske perspektive žena na tržištu rada gotovo da su uvjetovane rodnom segregacijom, koja je određena različitim vrstama i nivoima aktivnosti i zaposlenja, bilo da je riječ o sektorskoj, horizontalnoj segregaciji, koja se odnosi na određene vrste zanimanja, ili vertikalnoj, prema hijerarhiji u organizaciji. Kroz horizontalnu segregaciju vidljiva je podjela zanimanja koja je problematična ne samo zbog takozvane podjele poslova na muške i ženske, nego i zbog različite cijene rada, koja je redovito u korist muškaraca. Vertikalna segregacija ukazuje na podzastupljenost žena na pozicijama moći, poznatiju pod nazivom „efekt staklenog stropa“. Zakonom o radu zabranjena je izravna diskriminacija pri kriterijima za zapošljavanje i napredovanje. Zakonom je propisana jednakost plaća za isti rad, bez obzira na rodne razlike, kako bi se izbjegla socioekonomska diskriminacija. Osim odredbi Zakona o radu, suzbijanje diskriminacije definirano je i Zakonom o suzbijanju diskriminacije i Zakonom o ravnopravnosti spolova, kojima je uređeno postupanje prema ženama u odnosu na trudnoću, porod i roditeljstvo, kako bi se onemogućila diskriminacija. Unatoč tome, poslodavci u intervjuima ne izbjegavaju diskriminatorna pitanja koja zadiru u osobnost, poput pitanja o planiranju obitelji i porodičnim obvezama. Zakon o radu omogućava uskraćivanje odgovora na takva nedopuštena pitanja, premda praksa ukazuje na to da su veće šanse za zasnivanje radnog odnosa ženama koje prilikom intervjua ne odgovaraju iskreno na navedena pitanja, nego da se pozivaju na zakonske odredbe o uskraćivanju odgovora. Također, prema Zakonu o radu, trudnoća ne smije biti prečica do otkaza ugovora o radu, te jamči zadržavanje radnih mjesta po prestanku porodiljnog dopusta. Tržište rada treba biti otvoreno jednako za žene i muškarce, i to kroz jednakost u plaćama, vrednovanja vještina, sposobnosti i znanja, kako bi doprinijele tržištu rada. Međutim, u suvremenom svijetu gotovo se uobičajilo prihvaćanje stanja u kojem postoji diskriminacija žena pri zapošljavanju i radu, što se može potkrijepiti različitim statističkim podacima koji su zabrinjavajući i bez djelovanja na javne vlasti i društvenu zajednicu. Nedvojben je značajan doprinos žena ekonomiji kroz plaćeni rad koji obavljaju. Povijesno gledajući genezu ekonomske neravnopravnosti žena u odnosu na muškarce, može se pretpostaviti da je njihov ulazak na tržište rada bio promatran tek kao dodatni prihod obitelji iz koje dolaze i nastavak njihovog rada bez naknade kod kuće. Iz tog razloga im je pripisana manja novčana vrijednost nego u odnosu na muškarce. Ujedno su zadržavale obvezu obavljanja gotovo svih dosadašnjih kućanskih poslova. Na žene se također oslanja cjelokupni, kako ekonomski tako i socijalni sustav, obavljanja poslova koje plaćena ekonomija ignorira, kao što su briga o starijim i nemoćnim osobama, obavljanja različitih kućanskih poslova, volonterski rad i sl. Zbog navedenog mnoge aktivnosti žena nisu uzimane u obzir pri razvijanju zakona i politika, čime je stanje neravnopravnosti dodatno pogoršano [4]. Koliko je to značajan problem govori i činjenica da je mjerenje neplaćenog

rada bio glavni izazov vladama na Svjetskim konferencijama Ujedinjenih nacija o ženama u Nairobiju i Pekingu, iz kojih je proizašao Akcijski plan, koji poziva nacionalne i međunarodne statističke organizacije da izmjere neplaćeni rad i njegovu vrijednost prikažu u bruto društvenom proizvodu. Postoji više oblika diskriminacije koji su inkorporirani u pravni sustav i koji sami po sebi značajnije utječu na diskriminaciju žena uopće, a posebno diskriminaciju žena pri zapošljavanju i na diskriminaciju na radu. U manjoj ili većoj mjeri oni se isprepliću međusobno i po tome kako se manifestiraju teško ih je ponekada gledati izolirane i pojmovno ih svrstati [5]. Bez obzira na pojavne oblike, treba se zauzimati za svako onemogućavanje pravljenja razlike, isključenja ili davanja prvenstva na temelju rase, boje kože, spola, vjere, političkog uvjerenja, nacionalnog ili socijalnog porijekla, koje ima za posljedicu ukidanje ili narušavanje jednakosti mogućnosti ili tretmana u zaposlenju ili zanimanju [6]. Ponekad se javlja više oblika diskriminacije istovremeno, pa se njihova djelovanja isprepliću [7]. Kako je rodna ravnopravnost prepoznata kao jedan od ključnih ciljeva Europske unije, oslanjajući se na iskustva u borbi protiv rodne diskriminacije, konsenzus je postignut oko reguliranja ostalih oblika diskriminacije na razini Europske unije, uključujući europsko primarno i sekundarno zakonodavstvo [8].

4. ZAKLJUČAK

Premda su u brojne rodne razlike i danas prisutne, koje onemogućavaju potpunu afirmaciju žena, vidan je napredak u zaštiti prava žena u Europi, u brojnim područjima, pa tko i uključivanja na tržištu rada. U svrhu ostvarivanja ravnopravnosti primjena učinkovite rodno osviještene politike je ključna i od nje se očekuje obuhvaćanje i eliminiranje svih rodni stereotipa, kako bi se utjecalo i na buduće generacije. Osim napretka u području zdravlja i obrazovanja, potrebno je dati snažnu podršku afirmaciji žena na tržištu rada, posebno zato što što preuzimaju i brojne druge društvene uloge, kao majki, supruge i kćeri. U tu svrhu potrebno je osigurati dodatne kapacitete za zbrinjavanje djece u vrtićima i školskim produženim boravcima, te odgovarajućim preraspodjelama kućanskih poslova unutar obitelji. Institucije ulažu sve više napora u razvijanje svijesti o rodnoj ravnopravnosti, te pravnim aktima propisuju jamstvo jednakosti ženama iz oblasti radnog prava, te je izgledno poboljšanje položaja žena i iskorjenjivanje diskriminacija u svim područjima radnih odnosa. Državne institucije, nevladine organizacije i mediji zajedno nose odgovornost za suzbijanje rodne neravnopravnosti, koja je ključni element razvoja društva. Prilagodbama svojih politika rodnoj ravnopravnosti društva potrebno je rješavati sve slučajeve diskriminacije preventivnim djelovanjem, koje će utjecati na sprječavanje takvih pojava ubuduće.

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LABOR LAW AND SOCIAL ASPECTS OF DISCRIMINATION OF WOMEN IN EMPLOYMENT AND WORK

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ABSTRACT:

The paper analyzes discrimination in general, with regard to the severity and quantity, especially from the aspect of discrimination against women in employment and at work, during the employment relationship. Through the prism of international and domestic documents, laws and bylaws that deal with discrimination, the subject of work will be legal and social practice, which indicates the severity of discrimination, especially in the process of hiring and exercising rights from work. It is assumed that the discriminatory position of women in employment and work is influenced by numerous legal and other social factors. It is also assumed that discrimination against women in the labor market is the result of women's social position and negative perceptions of their social role, for which there are still established discriminatory attitudes and prevailing opinions that a woman should be a good housewife and mother. For this reason, there is a need to change the image of women, who have the right to affirmation through work, which is still unthinkable for a certain part of the population.

Keywords: *gender discrimination, the position of women, work and employment*

PERSPEKTIVE HUMANISTIČKOG VASPITANJA U KONTRASTIMA SAVREMENOG DRUŠTVA

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APSTRAKT: Osnovna teza rada očitava se u kritici karakteristika potrošačkog društva odnosno negativnih posljedica masovne kulture koje direktno i indirektno remete vaspitnu dimenziju škole a očigledno pospješuju ambijent u kojem se apostrofira obrazovni model po kojem postaju presudno važne isključivo kompeticije koje projektuje tržište rada i kapitala. Kao centar interesovanja prepoznata je i tretirana dominantno materijalistička vizija svijeta u kojoj, autor, vidi brojne razloge za pesimizam povodom prognoze humanističkih orijentacija i perspektiva vaspitno-obrazovnog procesa. U jednom od 6 poglavlja to osnovno stanovište potkrepljuje brojnim primjerima uvećanog nasilja u školama, pada autoriteta, pada motivacije, neuvažavanja preostalih tradicionalnih obrazaca i sveukupnim poremećajem sistema vrijednosti.

Ključne riječi: humanističko vaspitanje, masovna kultura, destrukcija

1. UVOD

U opštem smislu, izbor naslovljene teme na izvjestan način leži u podužem interesovanju za što jasnijim uvidom u uzročno-posljedični odnos dominantnih izbora savremenog društva. Parcijalno gledano, motiv za konstrukciju rada nalazi se u refleksiji očigledno neuspješnih reformskih zahvata u regionalnim obrazovnim sistemima ponajviše zbog pogrešnog institucionalnog odgovora na navedene izbore.

Analizom sprege raznih tehničko-tehnoloških uticaja i slabofunkcionalne obrazovne politike i sterilne apologetike humanističkog vaspitanja u sveopštoj dehumanizaciji društva, rad uvezuje sistem kritičkih osvrta prema ključnim determinantama savremenog društva a sa osnovnim ciljem procjene štetnih uticaja na mlade ljude. Naročito, u domenu preširoko liberalizovanog vaspitno-obrazovnog procesa.

Fundamentalno gledano, teza glasi: *Nekontrolisani tehnički progres društva podstiče negativni duhovni i moralni regres pojedinca.* U operativno-metodološkom smislu biće tretirana deskriptivnim pristupom a pretežno nošena dedukcijom brojnih paradoksa koji prate razvoj nauke, tehnike i tehnologije prema vaspitno-obrazovnim ciljevima. Ti

paradoksi imaju dosta uticaja na stanje i perspektive humanističkog vaspitanja. Zato je danas više nego ikada važno na ozbiljan način pristupiti protivrječnostima razvojnih društvenih procesa i posvetiti se uspostavljanju najboljih modela vaspitno-obrazovnog rada.

U najvećem dijelu, ključne pretpostavke navedenog problema nalaze se u zakonitostima kapitalističkog ustrojstva kao sveprisutne društveno-ekonomske formacije. U kapitalizmu su, između ostalog, obrazovno-vaspitni sistemi konfigurisani na fonu prilično nefunkcionalnih humanističkih orijentacija što bi značilo da uglavnom imaju deklarativno značenje i veoma slabu primjenu. Zato je u tekstu, posebna pažnja posvećena izborima u domenu masovne kulture sa kojom su neizostavno povezani simptomi kolapsa vrednosnih sistema i korozije duhovnih i moralnih determinanti. Generalno, uzeti su i kao posljedice i kao uzroci u kružnom toku atrofiranih uloga države, porodice, medija i škole.

Ako čovjek u savremenom društvu živi pod stalnom presijom materijalnog postignuća i u značajnoj mjeri to prenosi na druge, ako škola sve manje i ređe pravi otklon prema navalici štetnih uticaja i opijena kvazi-imperativom humanizacije dodatno liberalizuje okoštale standarde umjesto da pravi odlučne rezove, onda je sasvim izvjesna dominacija forme a potiskivanje sadržaja. Vaspitanik u takvom sistemu ne percipira na istinski način svoje mjesto, ulogu, obaveze, dužnosti i značenja ko-egzistencije. Efekti humanističkog vaspitanja su mali i nedostatni i to se mora konačno priznati. Jer da su veliki i značajni i da je u pitanju uspješan vaspitno obrazovni proces, društvo bi svakako bilo bolje. Bilo bi manje nasilja u školama, u porodici, u medijima, u brojnim društvenim okolnostima, bilo bi više razumijevanja za različitosti, više tolerancije i empatije. Zapravo, sve to bi kao ključni benefit humanističkog vaspitanja bilo integralno svojstvo pozitivne i emancipovane ličnosti i društvo bi bilo bolje.

Stoga, nećemo pretjerati ako zaključimo da je jedan od ključnih kauzalnih odnosa takvog stanja oličen u težištu polazne tvrdnje da *tehnički progres podstiče duhovni i moralni regres*.

2. KULTUROLOŠKE PRETPOSTAVKE VASPITANJA

Vaspitanje i kultura su dvije povezane koncepcije koje se tiču načina na koji ljudi razvijaju svoje ponašanje, stavove i vrijednosti unutar društvenog konteksta. Ontološki gledano, čovjek je za razliku od životinje *biće kulture*, jedino biće koje stvara kulturu. A u tome što stvara, sasvim jedinstveno gradi i vaspitanje. Vaspitanje kao integralni segment kulture i podržavajući proces onoga za šta se čovjek opredjeljuje. U svakom slučaju i jedno i drugo su aktivni odnos prema svijetu, kultura uopšteno gradivno, vaspitanje parcijalno usmjereno prema svakom novopridošlom čovjeku (djetetu).

Međutim, kako se društvo sve intezivnije širi i razvija, tako se sve češće događa disharmonija u korelacijama kulture i vaspitanja. Na sve agense vaspitanja koncentriše se sve jači pritisak umnoženih potreba savremenog čovjeka pa novi kulturološki obrasci načelno, više nisu u službi procesa njegovanja, oblikovanja, kultivisanja,

očovječenja djeteta u smislu razvijanja vrlina, sposobnosti kritičkog razmišljanja, razvijanja pozitivnih emocija, empatije i ljubavi prema svijetu. Dakle, u službi suštine humanističkog vaspitanja. Stoga, vaspitanje više nije jasno aktivan, kontrolisan i kontinuirani proces kojeg nezaobilazno očekujemo prvobitno od porodice, a strukturalno ga nastavljamo, osmišljavamo, unapređujemo i na različitim nivoima primjenjujemo u obrazovnom sistemu. To više nije kontrolisani plan koji podrazumijeva jedinstvene ciljeve i sinhronizaciju aktivnosti više subjekata. Roditelj uči dijete da “gleda svoga posla” ili da se brani agresivno ako je napadnuto ili da bježi ako svi bježe, škola uspostavlja drugačiji etos, a vršnjačke kategorije nude sasvim druge, uglavnom popularne potkulturalne obrasce pretežno neselektivno imitativno pokupljene iz medija. A još kad dodamo latentne procese usmjerene globalnim interesima, vaspitanje gotovo da gubi i osnovne definicije.

Razmotrimo jednu od dilema. Ako se vaspitanje pretežno odnosi na proces oblikovanja i razvoja ponašanja, navika i vještina kod djece i mladih kako bi se osiguralo njihovo uspješno funkcioniranje u društvu, koji to onda postulati imaju imperativnu prednost - da li potreba za formiranje sjajnih menadžera, stručnjaka, radnika, koji će odlično funkcionisati u tržišnoj utakmici, ili osrednje sposobnih mladih ljudi za adaptaciju na surove tržišne uzuse, ali zato sjajne ljude koji će osnovne vrijednosti potraživati u humanom odnosu i kvalitet života izmještati iz zone materijalističkog komfora u neki drugi socijalno poželjni kontekst. Da li je bolje vaspitavati po modelu tržišnog predatora gladnog novca i željnog moći i uspjeha po svaku cijenu, ili je imperativ postulirati cilj koji uključuje plasman osnovnih socijalnih vještina poput dijeljenja, empatije, poštovanja drugih i stvaranja boljeg, u humanističkom smislu zdravijeg društva.

Šta se nameće kao korisnije i za koga bolje, a šta je izvjesnije? Da li je u suštini ova distinkcija vještačka? Zar sam čovjek nije dualno biće i o sebi vodi brigu u fizičkom i netjelesnom smislu?

Začuđuje ako iko smatra da su obje, iako ponekad dijametralno suprotne dimenzije usmjerenog vaspitanja zapravo jedan jedinstveni razvojni kontekst. Po tom shvatanju, djecu možemo izrazito kompetitivno usmjeravati, slaviti njihove pobjede, forsirati šampione razočaravati se neuspjehom, sve pretvarati u utakmicu a istovremeno, očekivati zdravu ličnost sa izrazito inkluzivnim pristupom, super tolerantnu i spremnu da slijedi navalicu intenzivne empatije...Teško.

To se jasno vidi po svim pokazateljima iz pakla surovosti kapitalističkog ustrojstva, po načinu na koji funkcionišu kompanije, po opštoj pohlepi, po nezasićenosti u akumulaciji kapitala ili po totalnoj pomami kada se ponuda svodi na minijaturu a potražnja eksponencijalno raste kada mnogi stradaju na račun interesa malobrojnih. U takvim i sličnim okolnostima do izražaja dolazi osnovni format vaspitanja koji podrazumijeva dominantno ovladavanje sposobnostima i vještinama za tržišno i ego-životno preživljavanje, a ne za miroljubivu koegzistenciju i bezinteresni respekt.

U svakom slučaju, ukoliko se briga o vaspitaniku ne tretira kao društveno-obavezujući proces u kojem se polazi od ličnosti kao suštinske odlike ljudskog bića, od njegovog dostojanstva i cjelovitog razvoja, takav pristup ne obezbjeđuje tzv. **humanističko**

vaspitanje (Abraham H. Maslow). Vaspitanje koje se ne obazire na vaspitanikove potrebe, koje nije usmjereno njezi i razvoju ljudskih moći kao stvaralačkih moći ili slobode, antikulturno je. Kao takvo udara na suštinu kulture, te stoga i nije vaspitanje, već borba za interes i po pravilu vrsta perfidne manipulacije.

3. SIMPTOMI KRIZE HUMANISTIČKOG VASPITANJA

Gotovo svakodnevno čitamo i slušamo o slučajevima brutalnih obračuna maloljetnika i to u sred obrazovnih institucija i bez ikakvog obzira, bez ikakvih pokušaja ublažavanja posljedica. I ne samo maloljetnika. Uključeni su i roditelji, nasilje je dio svakodnevice ne kao rezultat konflikta, nego na žalost i kao izbor za individualna rješavanja problema. A kad se to događa, jasno je da institucionalna rješenja ne postoje ili su izrazito neuspješna i slaba.

Međutim, nije samo nasilje udar na školu koja treba da baštini fundamentalne humanističke vrijednosti i ulaže trud da se u punom kapacitetu unese u naručje mladim ljudima kao ciljane budućnost svake zdrave zemlje, svakog civilizovanog i prosperitetnog društva. Uz nasilje tu je i nezdravi otpor prema autoritetima, omalovažavanje nastavnika, ružan i iskvaren jezik i svjedočimo modelima ponašanja koji nedvosmisleno pokazuju da preuzeti životni stilovi kod omladine nisu plod ciljanog kultivisanja, forsiranja ideje dobra, estetizacije i kreacije, već jasan znak prihvaćene degradacije i primitivizma. U svakom slučaju, kriza humanističkog vaspitanja označava smanjenje značaja ljudskih vrijednosti i stavljanje fokusa na tehnički napredak u društvu. Simptomi krize humanističkog vaspitanja prije svega jasno uključuju deficit empatije i saosjećanja prema drugima. U društvu u kojem je naglasak na individualizmu i konkurenciji, manje je vremena i prostora za razvijanje empatije. A to najbolje znaju stručnjaci u danskom obrazovnom sistemu koji su se između ostalog (dominacija igre, kreacije, ustrojstva poštovanja) opredijelili i za uvođenje obaveznog predmeta – *Empatija*, za mlade 6-16 godina. To je zasigurno jedan od razloga zašto su Danci sa najmanje problema među omladinom i zašto je njihov vaspitni pristup ponajbolji u Evropi. Kod njih je nedostatak poštovanja i tolerancije prema drugačijim kulturama i stavovima na izrazito niskom nivou. Odlično znaju da društvu u kojem se različitosti ne prihvaćaju i gdje se stvara neprijateljstvo prema onima koji se razlikuju, manje je prostora za razvoj poštovanja i tolerancije. I to što znaju, praktično primjenjuju.

Očigledno, svjedoci smo i akteri deformisanog vaspitnog procesa i to na svim pozicijama i u brojnim ulogama. Naročito porodičnim i školskim. Kao djeca, kao učenici, kao roditelji, kao građani savremenog svijeta, kao konzumenti masovne kulture.

Stoga, ako želimo oporavak, moramo vratiti fokus na ljudsku dimenziju u vaspitanju i društvu generalno i napraviti otklon svemu što može dovesti do osiromašenja ljudske duše i moralne krize.

4. MASOVNA KULTURA I CILJEVI HUMANISTIČKOG VASPITANJA

Rukovodeći se pomenutim dilemama, videći brojne protivrječnosti sa često destruktivnim ishodima koji sasvim očigledno ugrožavaju humanističke premise naprednih snaga savremenog svijeta, možemo izdvojiti nekoliko karakteristika savremenog društva koje ujedno daju i svojevrsnu mapu aktivnosti prema ozdravljenju budućih društvenih procesa:

- Kriza porodice
- Kriza identiteta

4.1. Kriza porodice

Sve češće čujemo kategorične tvrdnje – *kriva je porodica, sve počinje od porodice, to je kućno vaspitanje, nije čudo šta se dešava ko ih vaspitava...*

Porodica jeste u krizi i tu nema spora. U razvijenim društvima razni vidovi alijenacije i raznih destrukcija i deformacija u sistemu vrijednosti pod patronatom masovne kulture rezultiraju sve češće nestabilnim porodičnim odnosima i sve kraćem vijeku bračnog statusa. Sa druge strane, u nerazvijenim društvima stege tradicionalnih patrijarhalnih konzervativnih uzusa u dodiru sa informacijama o tamo nekom bajkovitom *drugom svijetu* dovode do žestokog unutrašnjeg konflikta i gubljenja orijentacije, što sve dovodi u najboljem slučaju bar do problematične socijalizacije. Kako god, u disfunkcionalnim porodicama, u razorenim brakovima, u teškim ekonomskim i socijalnim okolnostima, u nemaštini i nasilju, dijete je pod velikom tenzijom i u vaspitnom procesu sa dosta lomova. Otuda nije za čuđenje što današnja djeca vrlo rano imaju asocijalno ponašanje ili iskazuju nestabilnost ili ne poštuju autoritete, ne usvajaju prave uzore, ne razvijaju empatiju. Te su posljedice sve češće i u porodicama koje bar na prvi pogled nisu disfunkcionalne gdje roditelji sopstveno odsustvo kompenzuju novcem ili su prisutni agresivno ili prosto ne umiju i ne znaju kako da odgovore svim izazovima.

Međutim, navedeni ambijenti nisu jedini problem jer proizvode razne destruktivne obrasce počevši od neprimjerenog ponašanja i vršnjačkog nasilja preko maloljetničke delinkvencije sve do ozbiljnih kriminogenih aktivnosti. Tu je i pogrešna percepcija da ne treba dizati paniku jer postoji - škola. Prilika za popravni ispit. Što propusti porodica nadoknađiće škola. I to sve dotle, dok čak i ne zaboravimo da dijete nije rođeno u školi pa sve požurimo da svalimo punu odgovornost za sva nezadovoljstva i neugodnosti i neobjašnjive promjene ponašanja današnje mladeži upravo na nastavnike i obrazovni sistem.

Takav odnos, razorene porodice, besomučna trka za egzistencijom, bujanje nasilja, atrofija primarnih socijalnih odnosa i vještina na račun primata novih medija (izrazita zloupotreba društvenih mreža, video igara i mobilnih telefona) uz pogrešan odnos prema školi odnosno

precjenjivanje ili potcjenjivanje njene uloge u procesu vaspitanja, na žalost postaju nezaobilazna stvarnosna činjenica sa kojom još uvijek nije uspostavljena prava, ozdravljajuća institucionalna konekcija. Ni od strane države generalno uz mobilisanje svih kapaciteta, niti od aktuelnih pojedinačnih obrazovnih politika.

Nažalost, kriza porodice i škole ne otvara provaliju samo za vaspitne procese, socijalizaciju i fundamentalne humanističke odnose. Širom su otvorena vrata i za sukobe identiteta gotovo na svim nivoima.

4.2. Kriza identiteta

U prirodi čovjekovoj dominira nagon za isticanjem, vladanjem i potpunom kontrolom stvari, odnosa i ljudi. Ali, takvo stremljenje u uslovima u kojima živimo u uslovima masovne kulture i kapitalizma koji ne razvija univerzalne potrebe čovjeka, već univerzalne oblike manipulacije čovjekom sa interesnim ishodom, dobija transformisana i degenerisana obilježja. Istisnut iz sebe, gonjen drugima, čovjek gubi šansu sopstvenog dosezanja i samo jedna stvar može obezbijediti važnost i svrhu, potvrdu i smisao daljeg opstanka. Izbor da je jak, snažan, najjači, da je moćan. Zapravo izbor iz straha kao rezultat stanja presije i opterećujućih limitirajućih odnosa masovne kulture u kojoj se sve podređuje homogenizaciji. Zanimljivo, što je intezivnije ujednačavanje i depersonalizacija, to je jača glad za konzumacijom, za efemernim zadovoljstvom i moći. Moć dobija karakter sredstva i cilja i amputiranog dijela prirode koji zasebno zaživljava. Upravo u tome je i jedan od ključnih razloga zašto se u ego-orjentisanoj kulturi ne mogu uspostaviti i zadržati fundamentalni humanistički ciljevi. Moć i uspjeh imaju magično, omamljujuće dejstvo ali kao svaka droga, prije ili kasnije razori svako mjesto na koje se navikne. Interesantno, upravo u elitnim krugovima u kojima je najintezivnija akumulacija i distribucija moći, najraznovrsnije su i najintezivnije destrukcije i najvidljiviji degenerativni procesi. A ako je tako na vrhu, šta očekivati od običnog naroda koji je navikao da slijedi lidere, da prati globalne tendencije, da vjeruje u šta je postavljeno da se vjeruje. Naročito pod dejstvom medijske hipnoze.

Očigledno, u ovako koncipiranom potrošačkom društvu, male su šanse da se vaspitni proces oblikuje od porodice do škole sa jasnom vizijom formiranja i očuvanja čovjeka, usmjerenja prema vrlini i čistom moralnom imperativu njegovanja ideje dobra.

Danas su materijalno postignuće, slava i moć opijati *sui generis* koji nagriza osjećaj jedinstvenosti individue, njegov zdravi identitet i težnju da se kreira život na bazi humanističkih preokupacija. Stoga je, u kvazi ego-orjentisanoj kulturi humanističko vaspitanje izrazito zahtjevan, izazovan i nažalost sve češće realno nemogući proces.

5. TEHNIČKI PROGRES I VASPITANJE

Tehnički progres ima značajan uticaj na različite aspekte života, uključujući i vaspitanje. Novi tehnološki alati i uređaji, kao što su kompjuterska tehnologija, internet i društvene

mreže, promijenili su način na koji učimo, komuniciramo i provodimo slobodno vrijeme. To zahtijeva da se vaspitni pristupi i strategije prilagode novim tehnološkim izazovima. Jedna od ključnih prednosti tehnološkog napretka u vaspitanju je pristupačnost znanja. Internet i drugi digitalni alati omogućuju učenicima da pristupe informacijama i znanju iz cijelog svijeta. To pruža raznovrsne opcije za samostalno učenje i istraživanje a takođe i kvalitativno novi pristup učenju. Interaktivna nastava, online diskusije i saradnja učenika u virtuelnom svijetu nisu samo tehnološke prednosti već i novi komunikacijski kanali za različite vaspitne uticaje, interkulturalne modele, razvoj kritičkog mišljenja i unapređenje potencijala ka postizanju željenih ciljeva.

Međutim, nije svejedno koji su ciljevi i ko ih i kako postavlja. Tehnološki napredak nije omogućen da bi se neko lijepo edukovao i razvio u pozitivnu ličnost već da bi razne kompanije i centri moći ostvarili interes. Stoga, u tehnološkom napretku odnosno tehničkom progresu mnogo toga može predstavljati ne samo izazov za vaspitanje djece i omladine, već dovesti do izrazito štetnih posljedica. Na primjer, povećana upotreba digitalnih uređaja i društvenih mreža može uticati na društvene interakcije i razvoj socijalnih vještina učenika. Takođe, tehnologija može uticati na mentalno zdravlje, smanjiti koncentraciju i uticati na kvalitet sna, a o opasnostima, kriminalu i nasilju na društvenim mrežama da i ne govorimo.

Prije svega, temeljno je važno da se vaspitni pristupi i strategije prilagode novim tehnološkim izazovima, kako bi se iskoristile prednosti tehnološkog napretka, a istovremeno se izbjegle eventualne štetne posljedice. Osim monitoringa od strane države i resornih institucija, to zahtijeva i zavidnu saradnju između roditelja, nastavnika i djece, kao i kontinuirano osposobljavanje nastavnika i roditelja u korišćenju tehnologije na profesionalno ispravan, umjeren i društveno i lično odgovoran način.

Uopšteno, imajmo na umu: Na jednoj strani je evidentan uspon nauke, tehnike i tehnologije, svjetsko tržište roba i kapitala rapidno napreduje, konzumerizam prelazi u razne faze patologije, dok na drugoj strani raste nezaposlenost, teška je nemaština i glad, patnja i neizlječive bolesti, nepismenost, primitivizam, borba za opstanak u kojoj *animal symbolicum* očigledno sve podređuje imperativu – *primum vivere*. A sve to na izgleda nepovratnu štetu kulture koja je sve manje intelektualno osvajanje svijeta uz dozu estetskog i uz afinitete duha pomoću dugih tradicija, a sve više mlitava i obezličena stvarnost u kojoj neprestano jača utisak propadanja i gubitka.

Stoga, djelujmo protiv izrazito materijalističke koncepcije svijeta koja otkriva lice savremenog društva kao jednosmjerno bujanje naučnih saznanja u službi surovog kapitalizma. Neoprostivo je mirovanje tokom kolapsa temeljnih premisa kulture, u prvom redu etike i estetike civilizovanog svijeta. Za sada, to je stanje sa više nego uzdrmanim smislom bazičnih humanističkih ciljeva, a za buduće generacije više nego konfuzno nasleđe koje će vrlo teško pomoći pri izboru pravog puta i pravog sistema vrijednosti.

6. KONCEPCIJA NOVE ŠKOLE I HUMANISTIČKOG VASPITANJA

U prethodnom dijelu govoreno je o realnom stanju savremenog društva i brojnim kontrastima koje prvo treba upoznati i shvatiti a potom se baviti strategijama borbe protiv

raznovrsnih štetnih uticaja i posljedica. Nesumnjivo, glavni front takvog otpora i otklona deformacijama modernog svijeta svoje glavno uporište ucrtava u vaspitno-obrazovnim procesima.

Evropska unija kao jedan od većih sistema koji kontinuirano vodi računa o brojnim reformama u svim oblastima društvenog djelovanja i organizovanja pa i u školstvu, nadležnim institucionalnim pozicijama unutar mreže a i zemljama koje željno iščekuju svoje mjesto u zajednici usmjerava intenzivno i sasvim odlučno brojne zahtjeve po pitanju kvaliteta obrazovanja i vaspitanja. Po imperativima koje zadaje, škola budućnosti nije samo ambijent za puko fabrikovanje znalaca koje potražuje sve raznovrsnije tržište, već u važnim segmentima mora biti usmjerena i

razvoju posebnosti ličnosti, obogaćena igrom kao komponentom stvaralačkog rada te zadovoljstvom učenika. Shodno takvom humanističkom usmjerenju kao obavezujućem za ogroman broj zemalja može se očekivati solidan otpor započetoj totalnoj demontaži savremenog društva, pretpostavljamo u dužem periodu. Čak ni pesimistički orijentisane prognoze po kojima će tehnologija u većem dijelu zamijeniti nastavnika ili će redefinisati neke njegove ustaljene, uobličene tradicionalne radne funkcije, ne potcjenjuju niti udaljavaju ciljeve koje ucrtava humanističko vaspitanje. Prosto, škola dominantno traži znanje, vještine i kompetencije i jeste dominantno obrazovnog lica i naličja ali nije bez, u osnovi bar očuvane obaveze da njeguje i vaspitnu dimenziju. I dok se god to ima u vidu, biće prostora za humanističko djelovanje.

6.1 Novi modeli

Savremena škola je u teškoj poziciji jer trpi posljedice već opisanog sunovrata vrijednosti i mnogo više napora mora ulagati nego što je bilo potrebno u tvrdim tradicionalnim obrascima. Prinudena je da iznalazi nove motivacione i sadržajno prihvatljive načine kojima bi se koliko toliko popravljala „šteta“ sa kojom nije bilo nikakvog posla ni dodira u nekim ranijim vremenima u kojima je porodica (i kompletno društvo) imala snažniju i efikasniju ulogu u vaspitanju omladine.

U savremenim programima u najvećem dijelu sa pozitivnim efektima ističu se tzv. *izborni sadržaji*. Još od osnovne škole nude se građansko vaspitanje i vjeronauka, a nešto kasnije i evropske integracije, debata, medijska pismenost, zdravi stilovi života, sport za sve, etika... Dakle, programi odabrani sa ciljem da se u najvećem dijelu razvijaju humanističke pretpostavke i gro pažnje, energije i promišljenih reformskih zahvata usmjerava pravilnom oblikovanju – humanističkom vaspitanju djece.

Veći dio tih popularnih izbornih sadržaja postavljen je anticipiranjem savremenih društvenih tokova, potreba i zahtjeva pa se može reći da predstavljaju jednu vrstu ogledala manifestne i latentne društvene interakcije.

Uzmimo na primjer tzv. *Debatni program* koji učenicima i preko redovne nastave i na fonu vannastavnih aktivnosti omogućava brojne benefite: kognitivne (uče, istražuju, usvajaju nova znanja), karakterne (podizanje nivoa svijesti, borba sa predrasudama, stereotipima i okoštanim konzervativnim stavovima). Strukturirana formatirana *debata*

jednostavnom i što je najbitnije za učenike atraktivnom metodologijom obezbjeđuje pristup gotovo svim aktuelnim temama ali i onim koje se protežu vjekovima kao neizostavna dilema nad ljudskim rodom (eutanazija, abortus, smrtna kazna...). Promišljanje *pro et contra* udaljava centralističke težnje tradicionalne škole i stvara komoditet za stabilan i progresivan razvoj i što je veoma važno, pospješuje proces uočavanja, razumijevanja i prihvatanja različitosti i osposobljavanja za budući kvalitetan, produktivan, bezkonfliktn i funkcionalan život u zajednici.

Učenicima su takođe omiljene forme - *Đački parlament* i sve vrste vannastavnih aktivnosti (sekcije) u kojima može doći do izražaja njihova kreativnost i svježina mladalačkog zanosa a naročito pozicije na kojima ostvaruju izvjesne rezultate koji afirmišu njihovu ličnost. Ne treba bježati od činjenice da tzv. *društvena priznatost* ima dalekosežne motivacione projekcije i da škola mora imati kontinuitet valorizovanja i pozitivnog, javnog, apsolutno vidljivog tretmana vrijednog rada, ali, i zalaganja za vrijednosti. Posebno se djeca osjećaju dobro i mobilno u humanitarnim aktivnostima poput prikupljanja sredstava za ugrožene vršnjake ili za stare i nemoćne i bolesne. Sjetimo se učenika pirotске gimnazije koji su se odrekli glamurozne proslave maturalne večeri i sav predviđeni novac za haljine i odijela i slično opredijelili za djecu sa posebnim potrebama. Ili djece brojnih regionalnih škola u kampanji prikupljanja pomoći za ugrožene ljude sa ratom zahvaćenih područja ili od prirodnih katastrofa...U posljednje vrijeme bilježi se veliko interesovanje i za dobrovoljno davalatstvo krvi. Dakle, nesumnjivo je na sceni rezultat vaspitnog procesa u kojem humanistički principi imaju primat i to treba njegovati. U situaciji u kojoj je porodica napadnuta skandaloznim medijskim sadržajima i pervertovanom idejom dobra uz nedostatak vremena i načina za ostvarenje kvalitetnog socijalnog dodira i socijalizacije, ne smije se dopustiti i da je škola kao kontrolisana institucija napadnuta sa svih strana. Iako u futurističkim pričama ne stoji baš najsrećnije i najbolje jer se uglavnom potencira razvoj obrazovnog potencijala dok vaspitna funkcija gotovo iščezava u pjeni masovne kulture, još uvijek, to je jedino mjesto za predah od zahuktale materijalističke mašine savremenog društva, jedino čisto mjesto koje nosi oreol prosvetiteljstva.

7. ZAKLJUČAK

Polazna pretpostavka ovog rada je bila, da se **tehnički progres** označava kao glavni podsticajni a može se reći i gradivni elemenat duhovnog i moralnog sunovrata. Stoga, predstavljena relacija **masovna kultura – ego kultura** (kao produkt tehničkog progressa) sa markiranjem postojećeg vrednosnog sistema masovnog društva i njegovih dominantnih projekcija (uspjeh po svaku cijenu, moć, komercijalizacija, pasivno primanje kulture) nedvosmisleno upućuje na to, da se može zaključiti da između tehničko-tehnološkog progressa i masovne kulture postoji povratna sprega i da shodno tome, postoji jasna kauzalna veza između ekspanzije tehničko-tehnološkog razvoja i gubljenja svega onoga što su tradicionalna društva čuvala kao kohezivnu energiju i najvažnije determinante – primarni respekt obrazovanja, duhovnu snagu i moralne vrijednosti.

Ako je danas glavna deviza - vrijeme je novac, i osnovni instrument za vrijednost - koliko imaš, toliko vrijediš - sasvim je izvjesno šta generiše krizu kulture, kao tešku bolest modernog doba. I jasno je, da će savremeno društvo vrlo brzo morati da prestrukturiira ili preformuliše takve prioritete i ciljeve. Naravno, ukoliko se šanse za to nisu nepovratno izgubile pod presijom neumoljive tržišne globalizacije i patronatom pomahnitalog kapitalizma.

Upravo u odnosu prema tom procesu i generalno prema tržišnoj globalizaciji treba tražiti rješenja koja zadovoljavaju omjer ponude i potražnje u domenu ljudskih resursa ali nikako na uštrb fundamentalnih humanističkih orijentacija i kapaciteta. **Humanističko vaspitanje stoga mora biti u fokusu interesa svih obrazovnih koncepcija i nezaobilazan cilj vaspitno obrazovnog procesa – graditi i održati čovjeka.**

Dakle, osnovni zadatak je - *sačuvati duhovne i moralne kapacitete kao jedinu povratnu spregu, ogledalo i kontrolni mehanizam rezultata materijalne intervencije ljudskog društva. Sačuvati čovjeka. Pretpostavke za tako što leže sasvim nesumnjivo i alarmantno pozivno u – školskom obrazovanju i vaspitanju.*

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PERSPECTIVES OF HUMANISTIC EDUCATION IN THE CONTRASTS OF MODERN SOCIETY

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ABSTACT: *The basic thesis of the paper reflects the criticism of the characteristics of consumer society i.e. negative consequences of the mass culture which, directly or indirectly, interfere with the educational dimension of school but they obviously improve the environment emphasising the education model in which the competences projected by the labour market and capital are crucial. As the target of the interest, we recognise dominantly materialistic version of the world in which the author sees numerous reason for pessimism regarding the prediction of humanistic orientation and the perspective of education process. In one of 6 chapters this dominant opinion is supported by numerous examples of increased school violence, decrease in authority and motivation, disregard of traditional models and general value system disorder.*

Key words: *Humanistic education, mass culture, destruction.*

ANGAŽOVANJE POLICIJSKIH SLUŽBENIKA NA DODATNIM POSLOVIMA

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SAŽETAK: *Policija je struktuirana od različitih organizacionih jedinica u kojima funkcionišu policijski službenici sa brojnim specijalizacijama. Upravo vještine policijskih službenika proistekle iz tih specijalizovanih poslova postaju interesovanje i u privatnom sektoru. Postaje evidentno da policijska zajednica ne može spriječiti to interesovanje a ako tome dodamo kontinuiranu potrebu za većom bezbjednošću i potrebu policijskih službenika za dodatnom zaradom onda treba osmisliti ona rješenja koja će pokušati pomiriti javni i privatni interes. Autori u ovom radu imaju za cilj da elaboriraju inostrana iskustva, prirodu, potrebu i proces angažovanja policijskih službenika u privatnom sektoru što podrazumijeva i sektor privatne bezbjednosti uz poštovanje propisa koji uređuju ovu materiju. Iznose se modeli zapošljavanja policijskih službenika van dužnosti, izazovi koji se pri tom javljaju, mehanizmi kontrole privatnog interesa kao i moguća ravnoteža između pomenutih interesa. U krajnjem, u interesu zajednice je angažovanje policajaca čijim se učesćem garantuje jačanje usluga sveukupne bezbjednosti.*

Ključne riječi: *privatno, policija, modeli, van dužnosti, dodatni rad*

EXTRA-DUTY EMPLOYMENT OF POLICE OFFICERS

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SUMMARY: *The police is structured from different organizational units where police officers work with numerous specializations. The skills of police officers derived from these specialized jobs are becoming an interest in the private sector as well. It becomes evident that the police community cannot prevent that interest, and if we add to that the continuous need for greater security and the need of police officers for additional income,*

then solutions should be devised that will try to reconcile public and private interest. In this paper, the authors aim to elaborate on foreign experiences, the nature, need and process of engaging police officers in the private sector, which includes the private security sector, while respecting the regulations governing this matter. Models of employment of off-duty police officers are presented, the challenges that arise in doing so, the mechanisms of private interest control, as well as the possible balance between the aforementioned interests. Ultimately, it is in the interest of the community to hire police officers whose participation guarantees the strengthening of overall security services.

Keywords: private, police, models, off duty, extra work

1. UVOD

Nesporno je da država danas nije jedini pružalac usluga bezbjednosti usled čega privatna bezbjednost kao poslodavac dobija na zamahu. Sa druge strane, usled tog zamaha policijski službenici u tom vide svoju šansu uglavnom zbog lošeg ekonomskog položaja pa se odlučuju za dodatni rad na onim poslovima koje najbolje poznaju - u oblasti bezbjednosti. Dakle, pojavom „privatizacije“ bezbjednosti značajno se rasteretio nacionalni budžet ali je to podstaklo razvoj drugih pojava. Novonastale pojave imaju širok raspon i to od onih krajnje neetičnih, nelegalnih i negativnih kao što je rad za kriminogene strukture pa do onih koji se odnose na dopunu porodičnog budžeta radeći u ugostiteljskim objektima na poslovima održavanja reda. Ovdje se postavlja više pitanja - od rada bez odobrenja, dakle - nelegalnog rada, pa do zakonitosti primjene policijskih ovlaštenja prilikom vršenja takvog rada.

Imajući u vidu da kod nas nije bilo sistematičnog istraživanja koje se odnosi na rad policijskih službenika van dužnosti sagledana su iskustva savremenih država kako ona pozitivna koja mogu uticati na opravdanost angažovanja policajaca u privatne svrhe tako i ona negativna koja opominju. Prikaz pogodnosti i problematizovanje ovih aktivnosti treba da pomogne u sagledavanju ovog istraživačkog problema i stvori osnovu za dalje empirijsko istraživanje u Crnoj Gori.

2. TERMINOLOŠKO ODREĐENJE DODATNOG RADA

Suprostavljenost privatnog sektora bezbjednosti (PSB) i policije može se posmatrati u kontekstu konkurencije u smislu „*angažovanja pripadnika policije u privatne svrhe - moonlighting* (engl. moonlighting)” i to na poslovima koji su u nadležnosti privatnog sektora bezbjednosti. Prema ovom pitanju stručna javnost je podijeljena - od protivljenja PSB do odobravanja policijskih zvaničnika (Kesić, 2008, str. 209). Moonlighting označava termin za

drugi posao koji se radi pored redovnog ili primarnog posla a realizuje se tajno (bez saglasnosti) i u noćnim satima. Za dodatni posao, u literaturi na engleskom jeziku, mogu se naći izrazi zaposlenje van dužnosti i dodatna dužnost (engl. „off-duty“ i „extra-duty“ employment).

Prema iskustvima iz SAD, munlajting je ozbiljna i jedinstvena briga za agencije za sprovođenje zakona iz dva razloga. Prvo, neke agencije striktno zabranjuju takav radni odnos dok ga druge aktivno podstiču. Razlike između agencija za sprovođenje zakona čine ovo zabrinjavajućim, stvaraju konfuziju, nesuglasice u policijskim redovima i eventualne pravne posledice za one policijske agencije koje pokušavaju da sprovedu stroge politike. Drugo, policijski službenici zadržavaju puna ovlašćenja za sprovođenje zakona čak i kada nijesu na dužnosti (Jenks, 2009, p. 87).

Na osnovu propisa u Crnoj Gori prepoznamo *dopunski rad* za koji možemo reći da je to odobrena (legalna), na osnovu ugovora zaključena stručna djelatnost van radnog vremena ograničenog trajanja (do jedne polovine punog radnog vremena) kojom zaposleni nadoknađuju nedostajući novac za svakodnevne potrebe.

Pored ovog termina postoji i *dodatni rad* koji je, takođe, stručna djelatnost van radnog vremena koja se obavlja na osnovu pisane saglasnosti starješine organa. Ovdje se ističe da je to djelatnost nad kojom određeni organ državne uprave ne vrši nadzor, ne predstavlja sukob interesa ili ta djelatnost ne šteti ugledu tog organa državne uprave. Ipak, prostor nam ne dozvoljava da ovdje bliže razmatramo termine dopunskog i dodatnog rada pa ćemo u nastavku, prvenstveno u svrhu pisanja ovog rada, upotrebljavati termin dodatni rad.

3. MODELI ZAPOSŁJAVANJE POLICIJSKIH SLUŽBENIKA

U odjeljenjima policije širom SAD postoje Kancelarije za ugovore koje zabranjuje poslodavcima direktno plaćanje policijskom službeniku, dok prvi policijski službenik (šef grupe koji vodi posao - *dodali autori*) i sindikat kao posrednik omogućavaju direktna plaćanja. Većina odjeljenja policije zabranjuje isplate jednom službeniku koji zatim raspoređuje plaćanje ostalim pripadnicima policije čije je usluge dogovorio prvi policijski službenik (Reiss, 1988, p. 3).

Prepoznata su tri modela zapošljavanja policijskih službenika van dužnosti (ibidem):

- a) model ugovora samostalnog policijskog službenika,
- b) sindikalni posrednički model, i

- c) model ugovora preko policijske organizacije (odjeljenje policije sklapa ugovore sa privatnim organizacijama, odakle dobija honorar za isplatu policajaca).

Svaki model ima svoje prednosti i nedostatke. Za implementaciju bilo kog modela treba uspostaviti jasne standarde i uslove sa kojima treba da se saglase svi akteri u procesu ali i da se uspostavi odgovoran i pravedan regulatorni postupak za praćenje implementacije tih standarda. U svim modelima treba ići na opciju kratkotrajnih ugovora i uspostavljanje cjenovne politike za određene uluge za aktivnosti kao što su npr. angažovanje policijskih vazduhoplova, posebno dresiranih pasa, protivdiverzioni pregledi ...

U samostalnom policijskom modelu ugovora: svaki policajac samostalno traži dodatni posao, policajac samostalno ugovara radne uslove i zaradu, nakon ovog policajac podnosi molbu odjeljenju policije za dozvolu da prihvati posao van dužnosti, odjeljenje policije daje dozvolu pod uslovom da posao ispunjava minimalne standarde, poslodavac plaća policajca u gotovini (rad se zove „detalj o gotovini“, engl. „cash detail“) (ibidem).

Autor Albert Reis (Albert. J. Reiss) naglašava da odjeljenja policije u Atlanti, Šarlotu, Sinsinatiju, Mineopolisu i Omahi, uglavnom koriste ovaj model koji se razlikuje po tome koji rad je dozvoljen.

U sindikalnom posredničkom modelu sindikat ili udruženje policije: propisuje detalje o uslovima plaćanja (engl. paid details) posla van dužnosti, procjenjuje policajce koji su se dobrovoljno prijavili, postavlja uslove u vezi plaćenja posla van dužnosti, dogovara se sa odjeljenjem policije oko statusa, zarade i detalje u vezi plaćenja posla van dužnosti (ibidem).

Tako, prema Reisu većinu zapošljavanja policije Sijetla van dužnosti koordinira Savez policijskih službenika Sijetla, iako policajci deluju kao nezavisni ugovarači bezbjednosnih usluga. Prilikom održavanja privatnih događaja u kompleksu Sijetl centra, službenici van dužnosti su zaposleni od strane službenika obezbjeđenja centra i plaćeni su preko spoljne računovodstvene firme.

U modelu ugovora preko policijske organizacije, policijska organizacija: sačinjava ugovore sa poslodavcima, raspoređuje službenike i isplaćuje ih od naknade poslodavaca, određuje dežurnog koordinatora za zapošljavanje da prima zahteve poslodavaca, izdaje dozvole za rad i saopštava policajcima detalje plaćanja, pregovara sa sindikatom ili udruženjem o zaradi, uslovima, propisima koji regulišu zapošljavanje (ibidem).

Reis nam kaže da gradovi Boston, Kolorado Springs, Nju Hejven i Seint Piterzburg primjenjuju model zapošljavanja preko policijske organizacije. Metro Dade Odjeljenje policije na Floridi sklapa ugovore o policijskim poslovima (uključujući, za razliku od većine odjeljenja policije, rad za privatne firme za obezbjeđenje), dozvoljava policajcima da ugovaraju poslove koji nisu policijski, ali se za svaki posao zahtijeva dozvola.

Pored ovih modela možemo isvesti postojanje modela koji postoje u tzv. „sivoj” i „crnoj” zoni: neformalni preduzetnik – policajac šef – rukovodilac u legalnom ili nelegalnom obezbjeđenju, članstvo policijskog službenika u nelegalnoj unutrašnjoj službi obezbjeđenja organizovana od strane vlasnika objekta, legalna agencija za obezbjeđenje koje nelegalno angažuje policajce.

4. ANGAŽOVANJA POLICIJSKIH SLUŽBENIKA VAN DUŽNOSTI

Angažovanja policijskih službenika van dužnosti treba sagledati sa aspekta kada policijski službenici koriste za takvo angažovanje službenu uniformu i koje i kakve politike i procedure postoje za dodatni rad policijskih službenika.

4.1 Rad policijskih službenika u policijskoj uniformi van dužnosti

Kao relevantan primjer rada policijskih službenika u policijskoj uniformi van dužnosti izdvojicemo iskustva policijskih odjeljenja u SAD.

Sve do 1950-ih, većina odjeljenja policije u SAD je zabranjivala svako privatno zaposlenje van dužnosti koje je zahtijevalo da službenici rade u uniformi za privatnog poslodavca ili da vrše policijska ovlašćenja u ime tog poslodavca (Reiss, 1988, p. 2).

Ove zabrane su bile zasnovane na zabrinutosti zbog sukoba interesa i potencijalne zloupotrebe policijskih ovlašćenja za služenje privatnim ciljevima, na račun javnih ciljeva. Rast zapošljavanja uniformisanih policajaca van dužnosti, u SAD, dolazi iz tri oblasti potražnje: privatna potražnja za uniformisanim policijskim službenicima, koju odjeljenje policije nije moglo da ispuni, podstaknuta je eskalacijom stope kriminala 1960-ih i 1970-ih; zahtev za zaštitom lica i imovine na privatnim radnim mjestima; i zahtjev policijskih službenika za povećanjem zarade što bi se djelimično moglo zadovoljiti radom van primarnog radnog mjesta (ibidem).

Kako navodi autor Dejvid Sklanski prema jednom istraživanju iz 1990. godine, tokom 1980-tih godina u SAD je radilo oko 150.000 policajaca kao privatno obezbjeđenje, često u policijskim uniformama. U većem broju slučajeva policijske uprave same su sklapale

ugovore za svoje policijske službenike sa trgovcima ili stanovništvom, a zatim isplaćivali te službenike iz stečenih prihoda (Sklansky, 1998, p. 1176).

U proljeće 1998. godine, policijska uprava Njujorka uvela je program koji omogućava njujorškim policajcima da obavljaju uniformisane poslove obezbjeđenja van dužnosti u Njujorku. Ovaj program koordinira Jedinica za isplaćivanje policije (engl. Paid Detail Unit). Ovo je jedini odobreni program za zapošljavanje u uniformi Njujorške policije van službe. Dodatni poslovi se ne mogu vršiti u objektima u kojima se prodaje alkohol, vladini objekti, Centralna banka SAD, u kompanijama za obezbjeđenje i isključeni su poslovi zaštite ličnosti (telohranitelji). U svim drugim okolnostima, međutim, njujorška policija zadržava pravo da odluči o učešću svojih policajaca. Dalje, od potencijalnih naručilaca policijskih usluga se traži da dostave informacije u vezi sa svojom kompanijom. Policija Njujorka će zatim izvršiti opštu provjeru prošlosti i kreditne sposobnosti te kompanije. Na osnovu toga, potencijalnim kompanijama će biti dat formalni ugovor na potpisivanje u kom se navode specifičnosti programa (Bratton, 2016, ¶2).

Sledeće pitanje koje treba razmotriti je percepcija policajaca koji rade van dužnosti. Zbog velike vidljivosti nekih poslova kada su policajci dodatno angažovani (kao što su usmjeravanje saobraćaja ili obezbjeđenje na javnim događajima), iz perspektive građana, teško je prepoznati za koga ovi policijski službenici rade, odnosno da li su na redovnoj policijskoj dužnosti ili su na dodatnom poslu. Ipak, građanin će prije poštovati naredbe uniformisanog policijskog službenika nego npr. zaštitara (Jenks, 2009, p. 90). Uniformisane policijske službenike koji su privatno angažovani javnost smatra da djeluju u svom službenom, javnom svojstvu. Takođe, zakoni u većini država podržavaju pretpostavku: ako policijski službenik na privatnom poslu bude svjedok kriminala, onda mora djelovati u svom javnom svojstvu i intervenisati (Boghossian, 2005, p. 204).

4.2 Politike i procedure za dodatni rad policijskih službenika

Svaki policajac koji ima dodatni posao odnosno van policijske dužnosti mora da se pridržava politika, procedura, propisa i odobrenja koji uređuju dodatni rad.

Kako su odjeljenja policije u SAD ublažila zabrane zapošljavanja uniformisanih policajaca van dužnosti, počela su da razvijaju politike i procedure kojima će to regulisati. Zabrinutost koja je bila u osnovi prvobitnih zabrana, ostala je zajedno sa ostalim, a odnosi se na: imidž odjeljenja, povredu policijskih službenika, potencijalnu korupciju, pravnu odgovornost, mogućnosti tužbi za odgovornost zbog nedoličnog ponašanja i percepciju javnosti. Danas mnoga odjeljenja policije ne samo da tolerišu već aktivno dogovaraju

zadatke van dužnosti za svoje policijske službenike. Nije istražen ni efekat zadatka uniformisanih policijskih službenika van dužnosti — u smislu povećane vidljivosti policije, prevencije i kontrole kriminala, ili percepcije javnosti o efikasnosti policije (Reiss, 1988, p. 2).

Kako navodi Šarp u svom istraživanju, 96% anketiranih odjeljenja policije izjavilo da ograničavaju vrste poslova van dužnosti koje njihovi policijski službenici obavljaju, a ostalih 4% da ponekad ograničavaju službenike. Pored toga, 20% je imalo puno radno vrijeme privatnih koordinatora bezbjednosnih poslova, a 11% policijskih odjeljenja je tražilo poslove van dužnosti za svoje službenike. Šarp je sugerisao da politika policije Bangora u Mejnu o zapošljavanju karakteriše tipičnu politiku. U toj politici je pisalo: „Dopunsko zapošljavanje se ne podstiče, ali može biti dozvoljeno uz odobrenje šefa policije“. U anketi ovog odjeljenja policije, otkrio je da je 43% policajaca bilo ravnodušno po pitanju dodatnog rada, navodeći: „Nije nas briga sve dok ovi zadaci ne ometaju učinkovitost policajaca“. Ista anketa je zaključila da 14% službenika ne odobrava zapošljavanje van službe, a samo 33% je izjavilo da ne podstiče zapošljavanje van službe (Sharp, 1999; citirano kod Jenks, 2009, pp. 89-90).

Politika angažovanja policajaca na drugi posao je takva da mora da ima odobrenje koje sadrži: mjesto zaposlenja, vrsta dužnosti, broj dnevnih/nedjeljnih sati angažovanja, mora imati dopunu ugovora ako dođe do promjena i na kraju policajac prihvata dodatni posao tek nakon odobrenja šefa policije.

U SAD je prisutna praksa naplate usluga koje su ranije bile besplatne kao što je intervencija na alarme protiv provala i požara, obezbjeđenje javnih skupova, regulisanje saobraćaja pored gradilišta, obezbjeđenje transporta novca. Prema jednom istraživanju, 47% policajaca u Sijetlu i 53% policajaca Koloradu Springsu ima odobrenje da van radnog vremena rade kao službenici obezbjeđenja i nose svoje uniforme, nose policijsku opremu uključujući radio uređaje i vozila (Dempsey & Forst, 2005, citirano kod Kesić, 2008, str. 210).

5. OGRANIČENJA RADA POLICIJSKIH SLUŽBENIKA VAN DUŽNOSTI

Naredbe ili propisi odjeljenja policije obično ograničavaju vrste zapošljavanja koje službenici mogu prihvatiti pa je tako zabranjeno da preuzimaju poslove koji uključuju: sukob interesa između dužnosti policijskog službenika i djelatnosti spoljnog poslodavca,

prijetnje dostojanstvu i ugledu policije, i neprihvatljiv rizik od povreda koje bi onesposobile policajca za redovnu dužnost (Reiss, 1988, p. 3).

5.1 Zabrane zbog sukoba interesa ili nodoličnosti

Većina odjeljenja policije u SAD kategorično zabranjuje zapošljavanje policijskim službenicima koji mogu na neprikladan način služiti privatnim, a ne javnim interesima. Konkretno, policajac ne smije da radi poslove koji se tiču vraćanje imovine, ne smije da prinudno ili na drugi način naplaćuje predmete za kreditnu kompaniju kada kupac ne izvrši plaćanje, ne može biti inkasant računa, dostavljač sudskih naloga, izvršitelj, ne može biti kreditni istražitelj, kao ni istražitelj ili istražitelj prije zapošljavanja u nekom preduzeću, ne može pripremati predmet za krivičnu odbranu, ne može vršiti rad za jemstvo ili zaposlenje u kompaniji pogođenoj štrajkom ili stečajem (ibidem, pp. 2-3).

Drugo, policijskim službenicima je zabranjeno da rade za ustanovama koje profitiraju od aktivnosti, kao što je kockanje i igre na sreću. Odjeljenja policije se razlikuju i po tome da li se policajci mogu zaposliti van dužnosti na mjestima, kao što su barovi, koji su registrovani za određene usluge. Takvi zadaci mogu suočiti službenike sa potrebom da sprovedu zakon protiv interesa poslodavca — na primer, zakone o služenju pića posle radnog vremena ili maloljetnicima (ibidem, p. 3).

Dalje, policijski službenici ne mogu da rade pod uslovima koji daju posebnu prednost privatnim interesima na štetu javnog interesa. Službenik van dužnosti na poslovima kontrole saobraćaja mora služiti interesima svih vozača, a ne samo onih koji ulaze ili izlaze sa parkinga njegovog poslodavca (ibidem).

Treće, većina odjeljenja policije zabranjuje policijskim službenicima da budu samozaposleni ili da upravljaju preduzećima u kojima se pretpostavlja sukob interesa a posebno u istražnim ili bezbjednosnim službama (npr. da rade kao agenti za zapošljavanje drugih policijskih službenika i da dobijaju procenat od zapošljavanja za svakog novoprimljenog) (ibidem).

Četvrto, potrebno je spriječiti sukob interesa od strane policajskog službenika koji radi dodatni posao u situaciji kada treba da sprovede zakon protiv svog sekundarnog poslodavca. Sukob interesa možemo prikazati kroz primjer rada policijskog službenika u nekom ugostiteljskom objektu kada policijski službenik interventne jedinice radi dodatni posao u tom objektu a onda narednog dana sprovodi aktivnost izvršenja operativno taktičke radnje – racija u istom tom objektu kod istog privatnog poslodavca.

Peto, pored navedenih zabrana policijskim službenicima treba ograničiti ili zabraniti da na dodatnom radu dobijaju: poklone koji se odnose na novac, hartije od vrijednosti ili dragocjene metale, besplatni alkohol i seksualne usluge, besplatne različite usluge (ljetovanje, liječenja, sahrane...), plaćanja za pružanje usluga neformalnog obezbjeđenja u ugostiteljskim objektima, novčane donacije ili opremu za sportske timove ili klubove u kom je angažovan policijski službenik.

Na kraju, nasuprot zabranama neki tipični poslovi koji su dozvoljeni su rad u: maloprodajnim lancima, robnim kućama, supermarketima, vjerskim objektima, sportskim kompleksima, bankama, poslovnim zgradama (Bratton, 2016, ¶15).

5.2 Prijetnje dostojanstvu i ugledu

Smjernice za održavanje policijskih profesionalnih standarda su uglavnom zabrane određenih vrsta sekundarnog zapošljavanja, a nijesu definisani standardi ponašanja. Zabranjen je rad koji umanjuje dostojanstvo policije (Reiss, 1988, p. 3). Policijski službenici angažovani u privatnom sektoru bez preciznog uređenja oblasti drugog zaposlenja - moraju istovremeno da služe javnom i privatnom interes pa je neophodno pažljivo definisati šta predstavlja zaštitu ugleda i dostojanstva ili šta to narušava dostojanstvo policijskog službenika i ugled policije.

5.3 Rizik od povreda

Ograničenja rizika imaju za cilj da se izbjegnu povrede policijskih službenika koje bi policijskom odjeljenju ograničile vršenje policijskih poslova. Takva ograničenja takođe uključuju pitanje ko treba da plati odštetu za povredu i prijevremeni odlazak policijskog službenika u penziju zbog trajne nesposobnosti za rad. Postavlja se pitanje - da li javnost treba da plati troškove saniranja povrede kada policijski službenik radi za drugog poslodavca (ibidem) ili je to uključeno u opšte zdravstveno osiguranje?

6. OGRANIČAVANJE RADNIH SATI I PLAĆANJE

Većina odjeljenja policije u SAD ne ograničava broj sati van dužnosti koje službenik može da radi u sedmici, ali se umjesto toga ograničava broj sati koji se mogu raditi u redovnom radnom danu. Uglavnom, policijski službenik može da radi 8-časovni dežurni obilazak, a zatim još osam sati van dužnosti (ibidem). Policijsko odjeljenje Metro Dade na Floridi procjenjuje da je plaćanje za uniformisane policijske službenike van dužnosti 1986. godine premašilo četiri miliona dolara (ibidem, p. 2).

U Njujorku je stopa zarade van dužnosti zasnovana na činu, kao što je prikazano u nastavku. Službeniku mora biti naslovljeno plaćanje na njegovo/njeno ime i poslato Jedinici za plaćanje u roku od 14 dana od dodjele zadatka. Takođe, plaća se administrativna taksa od 10% gradu Njujorku. Jedinica za plaćanje koordiniše plaćanje administrativne naknade sa naručiocem usluge putem mjesečne fakture. Određeni događaji mogu zahtijevati plaćanje usluga unaprijed (Bratton, 2016, ¶1).

Tabela 1:
 Plaćanje policijskih službenika po činu

Satnica prema rangu			
Cijene su na snazi od 1. jula 2016			
Rang	Cijena	Administrativna nadoknada	Ukupni troškovi
Policajac/inspektor	\$41,00	\$4,10	\$45,10
Narednik	\$51,00	\$5,10	\$56,10
Poručnik	\$57,00	\$5,70	\$62,70

Izvor: Bratton. J. W. Paid Details, Police Department City of New York

U San Dijegu policijski službenici kada ne rade na svojim redovnim policijskim poslovima, štite objekte, zarađujući pri tome 13 do 30 dolara na sat (Spencer, *n.d.*, ¶36).

Slična iskustva su i u Engleskoj kada se obezbjeđuju fudbalske utakmice. Zanimljivo je da je Skupština grada Liverpula „unajmila” dodatnih 12 policajaca da patroliraju u centru grada po cijeni od 350.000£, a policija Južnog Velsa je iznajmila svoje policajce za čuvanje fabrika i poslovnih objekata (Button, 2002, citirano kod Kesić, 2008, str. 210).

Bugarsko Ministarstvo odbrane je formiralo svoju firmu, „MOBA” koja je bila odgovorna za bezbjednost vojnih skladišta. Takođe, u Bugarskoj policija, na osnovu zakonskih odredbi, nudi uslugu Jedinice za obezbjeđenje Nacionalne policije za brzo reagovanje - klijentima koji plaćaju te usluge. Ova jedinica, uz mjesečnu naknadu, instalira alarme u privatnim kućama a policijske patrole odlaze na intervenciju u slučaju oglašavanja alarma. Na ovaj način policija dodatno štiti bogate a kriminalne aktivnosti se šire u siromašne djelove naselja (Page, Rynn, Taylor & Wood, 2006, str. 31).

U Rumuniji, žandarmerija iz Ministarstva uprave i unutrašnjih poslova, na komercijalnoj osnovi, pruža usluge tehničkog obezbjeđenja. Žandarmerija je 2003. godine čuvala ukupno 1.196 zgrada i 1.222 km cjevovoda (ibidem, str. 70-71).

7. IZAZOVI TOKOM RADA VAN DUŽNOSTI

Kao dobar primjer izazova koji proističu iz rada van dužnosti iznosimo izvještaj Ministarstva pravde SAD iz 2011. godine gdje je procijenjeno da je policijsku upravu Nju Orleansa sistem plaćanja posla van dužnosti na više načina ugrožavao efikasnost i kredibilitet policijske službe. Ministarstvo pravde je identifikovalo sledeće probleme: raspoređivanje preko dvije trećine uniformisanog osoblja van dužnosti, prijem hronično umornih službenika u redovne policijske poslove, preusmeravanje policijskih resursa sa primarnih policijskih poslova na poslove van dužnosti, doprinos nepravednom radu policije, podsticanje korupcije i zloupotrebe (O'Hara & Sainato, 2015, p. 156).

Navedenom treba dodati još nekoliko opservacija kojim se ugrožava kredibilitet policije tokom dodatnog rada: vršenje krivičnih djela i prekršaja od strane policijskih službenika (npr. korupcija, prekoračenje ovlašćenja, omalovažavanje, odavanje tajnih podataka nepozvanim licima, krađa, davanje lažnih iskaza, nasilje u porodici, vožnja u alkoholisanom stanju); nesavjesno vršenje dužnosti zaštite imovine građana i proizvodavanje štete drugim licima, upotreba nedozvoljenih supstanci i prekomjerno konzumiranje alkohola; diskriminacija građana po raznom osnovu, neprofesionalizam, politička pristrasnost; druženje policijskog službenika sa bezbjednosno interesantnim licima i pripadnicima kriminalnih grupa; neopravdano odsustvo sa redovnog posla, zloupotreba bolovanja, odsustva i godišnjeg odmora; širenje dezinformacija i ogovaranje drugih policijskih službenika; nesavjestan odnos prema materijalno-tehničkim resursima.

8. PRAVNI ASPEKT DODATNOG RADA U CRNOJ GORI

Već je bilo riječi o terminološkom određenju dodatnog rada uz napomenu da je zasnovan na neadekvatnoj zaradi policijskog službenika ali može dovesti i do sukoba interesa.

Dakle, na osnovu Zakona o radu, rad van dužnosti naziva se dopunski rad a zaposleni koji radi puno radno vrijeme može da zaključi ugovor o dopunskom radu sa istim ili drugim

poslodavcem, u trajanju do jedne polovine punog radnog vremena (Zakon o radu, „Sl. list CG“, br. 074/19, 008/21, 059/21, 068/21, 145/21, član 202)¹.

Sekundarno zaposlenje zovemo i dodatni rad koji je tretiran zakonom (Zakon o državnim službenicima i namještenicima, „Sl. list CG“, br. 2/2018, 34/2019 i 8/2021, član 79) prema kom državni službenik, može van radnog vremena, obavljati poslove ili pružati usluge fizičkom ili pravnom licu ali samo ako prethodno postoji dobijeno pisano odobrenje starješine državnog organa. Takođe, dodatni rad kod pravnih ili fizičkih lica odobrava se samo ako nad njihovim djelatnostima ili radom državni organ u kojem radi državni službenik ne vrši nadzor ili ako takav rad nije zabranjen posebnim zakonom. Značajno je da se ovdje naglašava i da se rad odobrava samo ako ne predstavlja sukob interesa ili prepreku za vršenje redovnih zadataka, odnosno ne šteti ugledu državnog organa.

Pored navedenog, kako stoji u ovom zakonu, državni službenik može, uz prethodnu saglasnost starješine državnog organa, obavljati rad u naučno - istraživačkoj, pedagoškoj i humanitarnoj djelatnosti, objavljivati stručne radove i obavljati poslove predavača na stručnim seminarima i savjetovanjima.

Identično iznijetom, dodatni rad je tretiran i pozitivnim Zakonom o unutrašnjim poslovima („Sl. list CG“, br. 070/21, član 156) gdje se, pored ostalog, ponavlja da rad van radnog vremena nije odobren na onim poslovima nad kojima MUP vrši nadzor, predstavlja sukob interesa ili smetnju za vršenje dužnosti i šteti ugledu MUP-a.

Od nedavno u MUP-u postoji Interno pravilo o bližim uslovima za obavljanje dopunskog rada gdje su uređeni način, postupak i uslovi za dopunski rad zaposlenih u MUP-u. Ovim aktom se mogu zaključiti ugovori o radu sa drugim poslodavcem van radnog vremena na osnovu zahtjeva i *odobrenja neposrednog rukovodioca (italic autora)* (Ministarstvo unutrašnjih poslova, broj: 01-40/20-16038, Podgorica, 29.09.2020, član 4). Ugovor se zaključuje na period do 12 mjeseci i mora biti utvrđeno da se dopunski rad obavlja radnim danima van radnog vremena, kao i vikendom u trajanju do jedne polovine punog radnog vremena (ibidem, član 6). Dakle, ako policijski službenik ima mjesečno 174 radna sata

¹ Prema ovom članu Ugovor o dopunskom radu zaključuje se u pisanoj formi i sadrži: naziv i sjedište poslodavca; ime i prezime i JMB angažovanog lica; opis poslova; mjesto rada i način obavljanja poslova; period na koji se ugovor zaključuje; podatke o radnom vremenu; visinu novčane naknade za obavljeni rad; rokove za isplatu naknade; prava, obaveze i odgovornosti o pitanjima zaštite i zdravlja na radu; razloge za otkaz ugovora i druga prava i obaveze po osnovu rada.

punog radnog vremena, dopunskog rada može imati 87 sati a što se tiče subote i nedjelje može imati osam sati za jedan vikend odnosno za četiri vikenda ukupno 32 radnih sati van radnog vremena. Nadoknada za dopunski rad ne može biti veća od 50% utvrđene nadoknade za to radno mjesto za koje se obavlja dopunski rad.

Da bi zaposleni u MUP-u dobio odobrenje za obavljanje dopunskog rada mora da: poštuje propisano radno vrijeme svog redovnog radnog mjesta, radi puno radno vrijeme, na svom radnom mjestu u punom obimu i u propisanom radnom vremenu kvalitetno obavlja radne zadatke, obavlja dodatni posao iz svoje struke, u zadnje tri godine ima ocjenu „ističe se” ili „dobar” i da u zadnjih pet godina nije disciplinski kažnjavan (ibidem, član 7).

Ono što svakako preostaje u odnosu na odredbe propisa je sukob interesa i prepreke za vršenje redovnih policijskih zadataka na šta ćemo dalje usmjeriti našu pažnju.

Sukob interesa je uređen Zakonom o sprječavanju korupcije gdje ova pojava postoji kada u vršenju javne funkcije privatni interes javnog funkcionera utiče ili može uticati na nepristrasnost javnog funkcionera u vršenju javne funkcije (Zakon o sprječavanju korupcije, „Sl. list CG”, br. 53/2014 i 42/2017 - odluka US, član 7). U odnosu na obaveze iz ovog antikorupcijskog zakona - u članu 169 pomenutog Zakona o unutrašnjim poslovima policijski službenici u zvanju glavni policijski inspektor, viši policijski inspektor I klase, viši policijski inspektor, samostalni policijski inspektor i glavni policijski savjetnik, viši policijski savjetnik I klase, viši policijski savjetnik i samostalni policijski savjetnik, tretiraju se kao javni funkcioneri jer su izabrani, imenovani ili postavljeni u državnom organu i dužni su da podnesu izvještaj o imovini i prihodima. Proističe da policijski inspektor I klase, policijski inspektor, mlađi policijski inspektor, stariji policijski narednik I klase, stariji policijski narednik, policijski narednik, stariji policajac I klase, stariji policajac, policajac i policijski savjetnik ne podliježu ovom propisu – nijesu javni funkcioneri, nemaju javnu funkciju, pa, dakle, nijesu u konfliktu interesa ako rade u turističko-ugostiteljskim djelatnostima.

Ovom treba dodati zanimljivi dokument Agencije za sprječavanje korupcije (2022, str. 3-4) gdje stoji da je „suština korupcije u javnoj upravi [...] zloupotreba ovlašćenja, stavljanje privatnog interesa iznad opšteg [...], ogleda se u prevari, pronevjeri, favorizovanju i nepotizmu, zloupotrebi ovlašćenja i sukobu interesa”. U dokumentu se dalje razmatra da sukob interesa ipak ne predstavlja korupciju ali predstavlja sukob između dužnosti službenika i privatnog interesa koji može negativno uticati na vršenje neke dužnosti i dovesti do pojave korupcije.

Objektivnosti radi, značajno ograničenje u vršenju dodatnog posla je dato u Kodeksu policijske etike gdje se tretira zaštita ugleda policije i da prilikom vršenja privatnih poslova policijski službenik ne smije koristiti službenu legitimaciju i službeni položaj koji ima u policiji (2019, član 6). Bez obzira koja je vrsta dodatnog rada na kom je angažovan policijski službenik - nedvosmisleno se radi o privatnom poslu. Dalje, u Kodeksu nije precizirano šta predstavlja zaštita ugleda policijskog službenika i ugleda policije pa ostaje da Etički odbor promoviše etičke standarde koje nijesu uspostavljeni u vidu nekog akta.

I u Etičkom kodeksu državnih službenika i namještenika („Sl. list CG”, br. 050/18, član 5) tretira se zaštita ugleda državnog službenika i državnog organa tako što se van radnog vremena službenik se ne smije negativno ponašati na način koji negativno utiče na njega i organ. Postavlja se pitanje na kakav se negativni uticaj misli?

U Crnoj Gori može se pronaći legalna veza između privatnog sektora i policije na osnovu Cjenovnika usluga koje Uprava policije pruža pravnim i fizičkim licima („Sl. list CG”, br. 001/16), prilikom održavanja javnih priredbi¹ gdje organizator može, pored agencije za obezbjeđenje, da angažuje i policiju pa će na jednom mjestu policija i zaštitarske agencije raditi zajedno. Na osnovu bezbjednosne procjene organizator može da preduzme pojačane mjere obezbjeđenja što znači dodatno angažovanje zaštitara ali i mogućnost angažovanja policijskih službenika.

Istovremeno, cjenovnik usluga policije uređuje visinu naknade za usluge za fizička i pravna lica kada žele da angažuju policijske službenike. Angažovanje policije na tržišnoj osnovi je moguće prilikom održavanja pomenutih javnih priredbi, prilikom vršenja bezbjednosnih poslova tokom održavanja sportskih priredbi sa preciznom visinom naknada za angažovanje policijskih službenika, motornih vozila i motocikala ali i policijskih službenika sa posebnim znanjima kao što je oblast protivdiverzione zaštite. Angažovanje policije prilikom održavanja kulturnih priredbi je takođe moguće na osnovu cjenovnika usluga, i to pored navedenog, za angažovanje plovila, službenih pasa i službenih konja.

¹ Javna priredba podrazumijeva okupljanje ljudi u cilju realizacije privredne djelatnosti (sportske, kulturne, zabavne priredbe, svečanosti i proslave, povorke, sajmovi) gdje organizator javne priredbe ima obavezu održavanja reda angažovanjem privrednog društva koje se bavi djelatnošću zaštite (zaštitarska agencija ili kako je još naziva – agencija za obezbjeđenje).

Novčana naknada za bezbjednosne usluge koje Uprava policije pruža zainteresovanim stranama uplaćuje se u državni bužet pa policijski službenik koji je nosilac te usluge nema dodatnu zaradu od te usluge. Ovdje se otvara dilema zašto dio te naknade ne dobija policijski službenik?

Tabela 2

Visina naknade za policijske službenike, opremu i prevozna sredstva

Angažovanje ili korišćenje	Visina naknade		
	Prilikom pratnje prevoza opasnih materija, vangabaritnog tereta, oružja, novca, hartija od vrije-dnosti, plemenitih metala, umje-tničkih i drugih dragocjenosti	Prilikom snimanja filmova, pozorišnih predstava, spotova i drugih kulturnih manifestacija	Za usluge protivdiverzione zaštite
Policijskog službenika	6,00 eura/čas (po započetom času)	5,00 eura/čas (po započetom času)	15,00 eura (po započetom času)
Putničkog policijskog vozila	2,00 eura/km		
Policijskog motocikla	1,00 euro/km.		
Uniforme polici-jskih službenika		200,00 eura na dan,	
Radio uređaja i njihovih dodataka		1 kom 15,00 eura na dan	
Službene palice, sredstava za vezivanje, zaštitnih sredstava i tablice za regulisanje saobraćaja		10,00 eura na dan,	
Patrolnog čamca		100,00 eura/čas	

Izvor: Uprava policije, Cjenovnik usluga koje Uprava policije pruža pravnim i fizičkim licima

Navedeno se može tumačiti kao legalna veza između PSB i policije i može podpadati pod model angažovanja preko policijske organizacije. Moguće oblasti saradnje PSB i policije, pored održavanja reda na javnim priredbama, mogu biti u zaštiti objekata kritične infrastrukture i obavezno štićenih objekata, suprostavljanju terorističkim aktivnostima, u oblasti privrednog kriminaliteta...

9. ZAKLJUČAK

Ne možemo a da ne napomenemo da razlike u modelima zapošljavanja policijskih službenika među policijskim odjeljenjima u SAD proističu zbog policijskog sistema koji je zastupljen u SAD. Naime, u SAD je zastupljen tzv. američki odnosno složeni (nekoordinirani i decentralizovani) policijski sistem pa otuda i razlike u pristupu u vezi zapošljavanja jer je svako policijsko odjeljenje nezavisno u svom radu. Sa druge strane, policijski sistem u Crnoj Gori pripada jednostavnom i centralizovanom policijskom sistemu pa otuda i teškoće koje se javljaju u mogućem odabiru modela zapošljavanja policijskih službenika van dužnosti.

Dakle, da istaknemo da je dodatni rad policijskih službenika u Crnoj Gori definisan Zakonom o unutrašnjim poslovima gdje se jasno implicira da policijski službenici ne mogu vršiti poslove privatne bezbjednosti jer nad tim poslovima Ministarstvo unutrašnjih poslova vrši nadzor. Isto tako, na drugom mjestu nalazimo da bi policijski službenik dobio odobrenje za obavljanje dopunskog rada mora da obavlja dodatni posao iz svoje struke pa se stvara prostor za diskreciono pravo starješini organa da tumači šta se smatra radom koji predstavlja sukob interesa ili šteti ugledu. Postavlja se pitanje – da li dodatni rad, na primjer, u turističko-ugostiteljskoj djelatnosti šteti ugledu MUP-a posebno imajuću u vidu da se policijski službenici najčešće neformalno angažuju upravo u ovoj oblasti koja predstavlja jednu od važnijih privrednih djelatnosti Crne Gore. Takođe, u ovoj oblasti MUP ne vrši nadzor ali, objektivnosti radi, vrši nadzor nad poslovima PSB odnosno nad fizičkom i tehničkom zaštitom. Iskustvo autora pokazuje da se odobrava dodatni rad prilikom obavljanja poslova predavača na stručnim obukama u turističko-ugostiteljskoj djelatnosti upravo pripadnicima fizičke i tehničke zaštite.

Sledeća opservacija je da policajski službenici koji dodatno rade bez dozvole mogu biti nelojalna konkurencija za zaštitare koji vrše poslove obezbjeđenja. Sa druge strane,

kvalitetniji rad zaštitara bi umanjio potrebu angažovanja policijskih službenika jer bi ih privatni sektor angažovao i imao priliku da više utiče na njih pa dok se njihov radni kvalitet ne podigne na veći nivo postojaće potreba za policijskim službenicima.

Ne treba zaboraviti iskustva da pojedini policijski službenici imaju svoj privatni posao u kom vrše poslove projektovanja, prodaje, ugradnje, održavanja uređaja za tehničku zaštitu (video nadzor, specijalne brave, alarmi, kontrola pristupa) ili obavljaju neke zanatske poslove.

Nadalje, nije uređeno da starješina organa imperativno donosi upravni akt kojim se ne odobrava zahtjev za davanje saglasnosti za dodatni rad čime je onemogućeno stranki, odnosno policijskom službeniku kao podnosiocu zahtjeva da kroz upravni postupak traži svoje pravo na dodatni rad ako nije zadovoljan rješenjem.

Iz svega iznesenog pokušaćemo dati doprinos uspostavljanju nekog od navedenih modela angažovanja policijskih službenika. Postupak dodatnog rada prvo mora biti bliže normativno uređen sa preciznim odredbama koji su poslovi dozvoljeni, koji su nedozvoljeni, koje su neprihvatljive radnje i postupci u obavljanju poslova, kakvi su uslovi otkazivanja usluge, koje su kaznene odredbe, koji su uslovi za izdavanje dozvola za dodatni rad i da li se mogu koristiti policijski materijalno-tehnički resursi. Mora biti naznačeno da ako tokom dodatnog rada policijski službenik primijeti nezakonito ponašanje ili otkrije krivično djelo to predstavlja postupanje kao da je na redovnom policijskom zadatku pa se dodatni rad potčinjava službenoj dužnosti.

Dalje, procedura bi bila usmjerena tako da nadležno tijelo unutar policije prima zahtjev od naručioca bezbjednosnih usluga, vrši opštu provjeru prošlosti i kreditne sposobnosti tog fizičkog ili pravnog lica i ako je provjera pozitivna - pristupa se postupku potpisivanja ugovora. Isplata davanja bezbjednosne usluge mora ići kroz legalne tokove kako bi se platio porez državi ili lokalnoj samoupravi a nakon toga ispatila zarada policijskom službeniku.

Na kraju iz svega iznesenog primjećujemo da nedovoljne ili slabe zarade policijskih službenika u svijetu podstiču dodatni rad ali je razlika u tome što su neke policijske organizacije spremne da politikama i propisima uređuju tu pojavu a neke policijske organizacije nemaju taj kapacitet i imaju rigidan odnos prema dodatnom radu pogotovo u turističko-ugostiteljskoj djelatnosti. Najzad, policijske sindikalne organizacije koje brinu o životnom standardu svojih članova morale bi aktivnije učestvovati i pristupati iznalaženju modela za povećanje životnog standarda policijskih službenika.

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AKTIVNOSTI MENADŽMENTA PENALNIH USTANOVA U TRETMANU OSUĐENIH LICA KROZ RADNO ANGAŽOVANJE

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APSTRAKT: Tokom izdržavanja kazne zatvora tretman prema osuđenim licima najčešće se primenjuje kroz radne aktivnosti. Radno angažovanje osuđenika je jedan od bitnih preduslova za resocijalizaciju kao svrhu kažnjavanja. Svrha rada je da osuđeni stekne, održi i poveća svoje radne sposobnosti, radne navike i stručno znanje kako bi mu se omogućili uslovi za uspešnu reintegraciju u društvenu sredinu posle izdržane kazne zatvora. Iz tog razloga menadžment zatvora mora da preduzme sve mere kako bi omogućio radno angažovanje osuđeničke populacije. Radno angažovanje osuđenih lica se organizuje na poslovima od zajedničkog interesa za život i rad osuđenih lica u penalnoj ustanovi. Pored efekta resocijalizacije koji se postiže radnim angažovanjem veoma bitno je istaći i ekonomski efekat rada osuđenika. Za vreme radnog angažovanja osuđena lica dobijaju i određenu novčanu naknadu koja je predviđena zakonom. Ostvareni prihod koji je posledica radnog angažovanja osuđenih lica tokom izdržavanja zatvorske kazne pripada ustanovi i ta sredstva se ulažu u poboljšanje standarda i uslova boravka osuđenih lica u ustanovi.

Ključne reči: osuđenik, zatvor, menadžment zatvora, radno angažovanje, resocijalizacija.

1.UVOD

U dosadašnjoj praksi rađena su mnoga istraživanja zatvora kao društvenog sistema koja su donela teorijski značajna saznanja koja su korištena u procesu resocijalizacije osuđenih lica i njihovoj pripremi za uključanje u socijalnu sredinu posle izdržane kazne.. Sva ta saznanja uglavnom su se bazirala na stavu naučne i stručne javnosti o tretmanu koji se primenjuje prema osuđenim licima. Cilj ovog rada jeste da se osvetli ovaj problem, sa aspekta radnog angažovanja osuđenih lica tokom izdržavanja zatvorske kazne, ne sa polazišta oštećene strane (žrtve kriminala, oštećenog pojedinca ili države koja reaguje na kriminalitet), već sa aspekta lica koja izdržavaju zatvorsku kaznu. Jedna od reakcija države na kriminalitet i kršenje pozitivnih zakonskih propisa jeste kažnjavanje prestupnika vremenskom kaznom zatvora i njegovo upućivanje na izdržavanje kazne u neku od Ustanova za izvršenje krivičnih sankcija. Samim činom izdvajanja pojedinca iz društvene sredine nismo rešili kompletan problem, već smo samo zadovoljili zakonsku regulativu i stvorili osećaj kod oštećenih da je "pravda zadovoljena". Stavljanjem prestupnika "iza rešetaka" započinju, u penalnim uslovima, aktivnosti usmerene na resocijalizaciju kao

svrhu kažnjavanja i pripremu lica da se, po izdržanoj kazni, vrate u društvo i nastave normalan život na slobodi i u sredini gde je, uslovno rečeno, prekinut u određenom kontinuitetu. U kojoj meri će resocijalizacija biti izvršena zavisi od niza faktora, a pre svega od adekvatnog tretmana koji će osuđenik imati tokom izdržavanja kazne i od njegovih socijalnih i ličnih karakteristika. Za uspešno sprovođenje procesa resocijalizacije neophodno je veliko zalaganje i požrtvovanost menadžmenta penalne ustanove u obezbeđenju preuslova za takav jedan proces. Kao najčešći vidovi programa postupanja u procesu resocijalizacije u zatvorskim uslovima primenjuje se radno angažovanje osuđenih lica, organizacija slobodnog vremena, učešće u sportskim aktivnostima, sekcijama, potom kroz razne vidove obrazovanja i stručnog osposobljavanja osuđenih lica, slobodu veroispovesti i slično. Sve ovo zahteva od menadžmenta zatvora maksimalno angažovanje za organizaciju proizvodnje u penalnim ustanovama kako bi osuđena lica u većem broju bila radno angažovana, saradnju sa obrazovnim institucijama u mestu ustanove kako bi se sproveo proces obrazovanja, kao koordinaciju sa svim službama u ustanovi kako bi se planirane aktivnosti sprovele.

U savremenoj današnjici, penalna ustanova nije samo mesto za odsluženje kazne, već, u različitim razmerama, može poslužiti odvratanju od kriminalnih radnji, onesposobljavanju počinioca (udaljavanjem iz društva) i rehabilitaciji. Penalna ustanova pruža mogućnosti za promenu načina života osuđenika kako bi postali produktivniji i kontributivniji članova društva. Osim rehabilitovanih zavisnika i beskućnika, bivši zatvorenici su najizloženija grupa na tržištu rada, kojima nije posvećena adekvatna pažnja, te je njihovo radno angažovanje u društvu gotovo nemoguće. Međutim, ukoliko se u penalnim ustanovama promovišu adekvatni programi preduzetništva i radi na razvijanju preduzetničke inicijative osuđenika, to im u velikoj meri, može olakšati i ubrzati dobijanje statusa ravnopravnih učesnika na tržištu rada ili pokretanje sopstvenog biznisa. To, u krajnjoj instanci, vodi ka većem nivou resocijalizuje.

2. POJAM RESOCIJALIZACIJE

Poslednjih godina, umesto sticanja određenog znanja, fokus je stavljen na razvoj kompetencija, posebno socijalnih kompetencija i ključnih kompetencija u stručnom i kontinuelnom obrazovanju. Ključne kompetencije su definisane kao skup relevantnih znanja, veština i stavova potrebnih za lični rast i razvoj, te aktivnu ulogu u društvu. Štaviše, ključne kompetencije osiguravaju socijalnu uključenost i zapošljavanje osoba i pomažu im snalaženje u brzo rastućem i globalizovanom okruženju (Habermas, 2012). Imajući u vidu značaj preduzetničkih kompetencija za dalju resocijalizaciju osuđenika nakon izlaska iz penalnih ustanova, doprinos ovog rada je značajan i ukazuje na njegovu aktuelnost.

U psihologiji, termin „resocijalizacija“ uveden je od strane američkih psihologa Kennedija i Kerber-a koji ga definišu kao proces ponovnog uključivanja pojedinca u sociokulturno okruženje usled nemogućnosti njegove socijalizacije ili kao rezultat promene u sociokulturnom okruženju (Kennedy, Kerber, 1973). Giddens definiše resocijalizaciju kao

„vrstu personalne promene gde zrela osoba prihvata ponašanje koje je drugačije od njegovog/njenog prethodnog inherentnog ponašanja” (Giddens, 2006, str. 703). Minev definiše resocijalizaciju kao proces koji pomaže sekundarnom uključivanju pojedinca u socium, nakon što su privremeno isključeni zbog određenih razloga: socijalni, moralni, lični, pravni itd (Minev., 2016). Prema istom autoru, u skladu sa prirodom društvenih adaptera, razlikuju se četiri vrste resocijalizacije:

- Unutarnja resocijalizacija, koja predlaže pružanje socijalnog minimuma, tj. zadovoljstvo osnovnih fizičkih potreba kao što su: sklonište, odeća, hrana, grejanje itd. Adekvatno zadovoljenje osnovnih fizičkih potreba zahteva uključivanje pojedinca u očekivane modele društvene interakcije.
- Radna resocijalizacija sugerise prilagođavanje potencijala pojedinca potrebama i zahtevima koje se odnose na uključivanje u radnu aktivnost - sticanjem adekvatnog obrazovanja, stručnim usavršavanjem i sticanjem profesionalnih znanja, veština i navika; formiranje mentalnih i biheviornalnih stavova za posao – pronalažanjem odgovarajućeg posla i prihvatanjem radnog zakonodavstva.
- Civilna resocijalizacija je integracija u uslove civilnog društva: preuzimanje odgovornosti za sopstveno ponašanje i međusobne odnose; prihvatanje zakonskih uslova i zahteva javnog reda; prihvatanje zahteva moralnih normi; prilagođavanje tradiciji i životnim uslovima, zahtevima određene građanske zajednice, tradiciji, normama i pravilima ponašanja u svakom konkretnom mestu, bilo gradu ili selu, uspostavljanjem društveno-psihološkog kontakta sa okruženjem i aktivnim uključivanjem pojedinca u društvene odnose (Stoykov, 2017).

Ključni problemi koji prate proces resocijalizacije osuđenika koji izdržavaju kaznu u penalnim ustanovama su (Stoykov, 2017, str. 127):

- Nizak obrazovni nivo. Rezultati propusta u ranom detinjstvu i neprikladno porodično i školsko okruženje, upućuju slabo obrazovane osuđunike na stalnu socijalnu izolaciju. Bez adekvatnog obrazovanja, zatvorenici se nakon izlaska iz zatvora, veoma brzo ponovno nađu u zatvoru. Njihov nizak nivo obrazovanja i nedostatak adekvatnih veština i sposobnosti pretvorili su ih u kriminalce. U tom smislu, najvažniji korak po stupanju osuđenika u penalnu ustanovu je poboljšanje njihovog obrazovnog statusa.
- Nedostatak stručne obuke. Drugi najvažniji nedostatak koji zatvorenici trebaju nadoknaditi tokom boravka u zatvoru je manjkavost stručne spreme, a direktan je rezultat nižeg obrazovnog statusa zatvorenika. Poboljšanje obrazovnog statusa i pronalaženje odgovarajućeg posla pružiće zatvorenicima realnu šansu za promenu načina života nakon povratka u društvo.
- Neadekvatno ili nikakvo radno iskustvo. Nedostatak radnog iskustva je jedan od preduslova za tešku resocijalizaciju osuđenika. Radne navike grade svest o zajednici u smislu zajedničkih ciljeva i izazova razvijajući osećaj odgovornosti

prema drugima. Veoma često zatvorenici nemaju takav stav, te se smatra da je njihova stalna izolacija sa tržišta rada važan uzrok da se osećaju marginalizovano i zanemareno. Na treninzima fokusiranim na uspešnu socijalnu inkluziju osuđenika, posebna pažnja mora biti posvećena zatvorenicima koji imaju neadekvatno ili nikakvo radno iskustvo. To se može postići programima kvalifikacije i praktičnim kursovima.

- Nedostatak navika za sistematski rad. Aktivno sprovođenje programa obrazovanja i kvalifikacija treba da stvori mogućnosti za sticanje radnog iskustva i razvijanje radnih navika tokom trajanja kazne. Stručnjaci smatraju da nedostatak radnih navika i motivacije za rad među zatvorenicima je glavni preduslov povratku kriminalnom načinu života nakon odsluženja kazne.

Tokom izdržavanja zatvorske kazne menadžment zatvora u procesu resocijalizacije kroz radno angažovanje kod radno angažovanih osuđenika treba da podstakne i preduzetničku inicijativu. Preduzetnička inicijativa je specifičan skup verovanja, znanja i misaonih procesa koji pokreću preduzetničko ponašanje (Armanurah, A., Syaima, R., Abdul Razak, A., 2017). Lica sa preduzetničkom inicijativom (The Entrepreneurial Learning Initiative, 2020):

- veruju u svoju sposobnost uspeha;
- imaju ubedljive ciljeve koji ih motivišu, podstičući ih da budu usredsređeni, usmereni na sebe, orijentisani na akcije i veoma angažovani;
- imaju optimističnu interpretaciju štetnih događaja i gledaju na probleme kao na potencijalne prilike, postajući veoma otporni, snalažljivi i orijentisani na rešenja, čak i u okruženjima koja su veoma nesigurna i ograničena;
- zagovornici su kontinuelnog znanja, radoznalosti, kreativnosti i kritičkog razmišljanja;
- prikazuju visok nivo pouzdanosti, shvatajući da praćenje jednostavnih rešenja može dovesti do nepredviđenih prilika;
- imaju humanističku crtu, usmerenost na druge i stav da kreiranje vrednosti rešava probleme za druge;
- okružuju se društvom sa pozitivnim uticajem i kritičkim vođenjem.

Resocijalizacija postaje aktuelna uvođenjem kazne lišenja slobode, kada zatvori u odnosu na ranije namene, dobijaju jednu novu i drugačiju funkciju, funkciju prevaspitanja. Ona je u suštini vraćanje iz asocijalnog načina života u prihvatljive načine ponašanja i odnose, odnosno ponovno uključivanje devijantne osobe u redovne tokove života i rada. Pojam resocijalizacije, sa današnjeg teorijskog aspekta, podrazumeva multidisciplinarni prilaz osuđenom licu i saradnju svih subjekata raznih profila i stručne spreme koji su nosioci procesa resocijalizacije (Radoman, 2003).

Resocijalizacija, kao pravna mera kriminalne politike, ima tri faze:

- sudsku (izrečena kazna ili mera),
- institucionalnu (za vreme izdržavanja kazne ili sprovođenja mera bezbednosti),
- postpenalnu (nakon izdržavanja kazne ili sprovođenja mera bezbednosti) (Bobić, 2012).

Ovim postupcima se teži izmeni ličnih osobina i sklonosti osuđenika koje su uzrokovale njihovu delinkventnu orijentaciju s namerom da ih ponovo integriše u društveni život. Posebno se teži izmeni onih dispozicija koje su u osnovi same ličnosti, a čine ih neotpornim na spoljne uticaje.

Brojna istraživanja pokazuju da zatvor različito deluje na ljude koji se u njemu nalaze. Neki od njih nikada više ne vrše krivična dela, drugi postaju još teži delinkventi, a treći se ponašaju isto kao i pre dolaska u zatvor. Tačni razlozi ovakvih ponašanja se ne znaju, ali većina naučnika koji su se bavili ovim ispitivanjima, pretpostavljaju da bi se razlog mogao naći u različitom učešćupojedinih zatvorenika u zatvoreničkom društvenom sistemu. Uticaj Službe za tretman, u tom slučaju, na delinkvente je minimiziran jer po ovakvom zastupanju nije moguće ostvariti cilj prevaspitanja. Mnogi ipak misle drugačije. Iako nije jednostavno ni lako nešto „popravlјati” jer se zna da je uvek lakše nanovo graditi, nego popravlјati staro, u našoj zemlji se ulažu veliki naponi da se koncept resocijalizacije ne samo zadrži, već i da se permanentno usavršava.

3.TRETMAN OSUĐENIH LICA

Pojam tretmana u penologiji označava način postupanja prema osuđenim licima i ujedno predstavlja treću fazu resocijalizacije kao pravna mera kriminalne politike. U širem značenju tretman predstavlja način postupanja prema određenim društvenim pojavama i grupacijama, kao i skup načina postupanja prema osuđenim licima, počev od njihovog prijema u ustanovu, smeštaja, ishrane, radnog angažovanja, ostvarivanja i zaštite njihovih prava, itd. (Bobić, 2012)

Uže značenje pojma tretmana odnosi se na njegovu primenu u institucionalnim i vaninstitucionalnim uslovima i odnosi se na one aspekte koji su u tesnoj vezi sa procesom prevaspitanja. On podrazumeva i način postupanja stručnih službi sa osuđenim licem. U ovom značenju pojam tretmana vezuje se za određeni pristup osuđenom licu, oblik rada sa osuđenikom, primenjenu metodu, vaspitno korektivnu tehniku ili postupanje sa jasno utvrđenim konkretnim zadacima.

Tretman u kazneno-popravnim ustanovama je institucionalne prirode, zasnovan na naučnim osnovama struke i propisan unutrašnjim pravilima ustanove u kojoj se izdržava kazna lišenja slobode. Institucionalni tretman ili kako se u anglosaksonskoj terminologiji naziva – penitensijarni tretman – čine postupci klasifikacije, prevaspitanja i korekcije

vladanja osuđenika s društveno neprilagođenim ponašanjem, koji se izvršavaju u zavodskim uslovima kako bi se kod njega obezbedilo socijalno prihvatljivo ponašanje. Resocijalizacija osuđenih lica postiže se takvim tretmanom koji je u stanju da izmeni njihovu ličnost, kriminalne oblike ponašanja, njihov životni stil, navike, težnje i vrednosne orijentacije. Da bi se to postiglo svaki oblik tretmana treba da je usmeren ka pozitivnim stranama ličnosti osuđenog na kojima je moguće graditi bilo kakve promene (Radoman, M,2003) .

Prvi cilj tretmana je da osuđenik shvati da je odgovoran za svoje ponašanje. U tom smislu, prvim korakom uspeha smatra se spoznaja osuđenog da je učinio nešto što nije u redu i da zatraži pomoć. Ako je ta prepreka savladana tretman može preći u sledeće faze. U kojoj meri će postupak tretmana imati uspeha zavisi od više faktora: 1) adekvatnog prihvata i klasifikacije osuđenika; 2) dužine boravka u kazneno-popravnoj ustanovi; 3) psihičke strukture ličnosti osuđenika; 4) uslova u kojima se kazna izdržava; 5) metoda tretmana; 6) zatvorske atmosfere, ambijenta; 7) motivacije osuđenika; 8) motivacije zaposlenih; 9) kadrovske strukture i stručnosti osoblja zatvora, itd.

Problemi u sprovođenju tretmana su mnogobrojni. Oni proističu iz ličnog osećanja osuđenog i uticaja okoline. Zbog raznovrsne strukture osuđenih lica proizilazi potreba diferenciranog tretmana koji mora dovesti do korekcije u ponašanju i otklanjanja deprivacija u zatvorskoj sredini. Da bi tretman bio uspešan, veoma je važno da celokupan sistem u ustanovi (sve službe i osoblje) funkcioniše planski i jedinstveno (Bobić, A. 2012).

Principi u pristupu prevaspitanja obuhvataju opšta načela koja važe za svaki odabrani oblik i metod tretmana. Pridržavanje principa i korišćenje metoda prevaspitanja je preduslov i oznaka profesionalnog i uspešnog tretmana. Važniji principi su: a) princip poverenja i poštovanja dostojanstva ličnosti; b) princip poznavanja ličnosti; c) princip svestranosti; d) princip jedinstva vaspitnih uticaja; i e) princip aktivnog i svesnog učešća osuđenog u tretmanu (Bošković, M., Bobić, A. 2022).

Princip poverenja i poštovanja dostojanstva ličnosti znači da poverenje mora biti obostrano; tj. uverenje osuđenika u korisnost korekcionih mera, kao i terapeuta u mogućnost da osuđenik može korigovati stavove i ponašanje.

Poštovanje dostojanstva ličnosti je princip koji proističe iz humanosti odnosa i pristupa da je osuđenik čovek, ma kakvo delo da je počinio. Praktično, bez osećanja poštovanja dostojanstva osuđenik će teško iskreno prihvatiti bilo koji oblik tretmana.

Princip poznavanja ličnosti je treća važna činjenica i načelo tretmana. Da bi se tretman mogao individualizirati, neophodno je poznavanje osobene psihološke strukture delikventa i imati njegovu detaljnu socijalnu anamnezu. Samo se na taj način može odabrati najcelishodniji metod i primeniti adekvatan tretman s pozitivnom prognozom ishoda.

Princip svestranosti obuhvata primenu više oblika i metoda tretmana, kako bi ličnost „našla sebe“ i otkrila skrivene vrline, odnosno postala svesna svojih očiglednih mana koje su je navele na delikventnu orijentaciju. Ovaj princip podrazumeva i otkrivanje talenta i sposobnosti za poslove koje neko na slobodi nije realizovao, ili za to nije imao uslova, a za koje ima smisla.

Princip jedinstva vaspitnih uticaja pretpostavlja koherentan, skladan i pouzdan sistem vaspitnih oblika u svim fazama prevaspitanja, kako na radu tako i u slobodnom vremenu, kao i u toku obrazovnog tretmana. To pretpostavlja svrsishodni cilj i sinhronizovanu aktivnost svih stručnih službi kazneno-popravne ustanove gde osuđenik izdržava kaznu lišenja slobode.

Princip svesnog i aktivnog učešća u postupku prevaspitanja je u tesnoj vezi s principom poverenja, a podrazumeva svesnost osuđenog da radi na izgradnji svoje ličnosti. Time ga tretman čini aktivnim subjektom tog procesa a ne samo objektom prevaspitnog tretmana (Bošković, M., Bobić, A. 2022).

Primena pojedinih oblika tretmana zavisi od penitencijarnog sistema, strukture osuđenika na izdržavanju kazne lišenja slobode i tipa kazneno-popravne ustanove u kojoj se ona izvršava. U savremenoj praksi postoji nekoliko oblika prevaspitnih tretmana, kao što su: a) individualni tretman; b) grupni tretman; c) obrazovni tretman; d) okupaciona i radna terapija; e) samoinicijativni oblik i f) tretman stimulacije. Pojedini autori na drugačiji način određuju oblike tretmana osuđenika. Tako se kao posebni oblici tretmana pominju: 1) moralno-pedagoško vaspitanje i obrazovanje osuđenika, 2) rad i profesionalno osposobljavanje, 3) organizovanje slobodnog vremena, 4) učešće osuđenika u svom prevaspitanju, 5) nagrađivanje i kažnjavanje osuđenika, 6) približavanje osuđenika uslovima života na slobodi, 7) primena psihoterapije, 8) primena grupne terapije, grupna psihoterapija i grupno savetovanje (Bobić, 2012).

4. RADNO ANGAŽOVANJE KAO OBLIK TRETMANA

Radno angažovanje u penalnoj ustanovi, tradicionalno se posmatra kao mera podrške resocijalizaciji osuđenika. Rad kao aktivnost tokom izdržavanja kazne, treba da podrži sve tri uključene strane: osuđenika kao lice koje treba da se promeni, zatvor kao instituciju i društvo kao primaoca rezultata rada penalne ustanove. Prema Stewart & Järvelaid (2015), rad u penalnoj ustanovi treba da služi kao: 1) mera individualnog razvoja i obuke osuđenih lica; 2) socijalizacija osuđenika kroz kolektivnu aktivnost; 3) terapija (psihološka, zavisnosti), kreativna aktivnost; 4) reflektor samopoštovanja i samopouzdanja, formirajući uslove za povezivanje sa porodicom (preko prihoda, veština, stavova); 5) aktivnost koja vodi ka povećanju nivoa veština i iskustva buduće radne snage, priprema za zapošljavanje posle puštanja na slobodu i primena odgovarajućeg pojedinačnog programa osuđenika; 6) poveznica ka socijalnoj inkluziji u društvo, obezbeđujući, na taj način, zadovoljstvo zaposlenog i poslodavca ili zaposlenog/vlasnika i klijenta; 7) način ulaska bivših osuđenika kao nove radne snage na tržište rada, umanjujući negativne predrasude društva;

8) aktivnost kojom se umanjuju troškovi zatvora i zatvorskog sistema za društvo; 9) aktivnost kojom se prenosi i primenjuje odgovornost, kako materijalna, tako i kognitivna; 10) kroz sve gore navedeno, mera je za disciplinu, red i ponašanje u penalnoj ustanovi.

Shvatanje o radu kao faktoru prevaspitanja poklapa se sa uvođenjem koncepcije resocijalizacije osuđenih lica, a odnosi se na korisne elemente radne aktivnosti. Pre svega, vaspitni karakter rada ogleda se u sledećem: 1) sve karakterne osobine mogu se upotrebom i vežbanjem, jednom rečju radom, menjati i razvijati, 2) rad je izvor samopregora i energičnosti, 3) rad je izvor urednosti i samodiscipline, 4) rad je izvor pozitivnosti i konstruktivnosti, 5) rad je izvor kritičnosti, 6) rad povećava ličnu moć i ostvarivanje ličnosti, 7) rad poboljšava opšte psihofizičke sposobnosti (Bošković, Bobić, 2022). S druge strane, mogli bismo radu pripisati i druge vaspitne i terapijske efekte, kao na primer: osećanje za zajedničku aktivnost, budući da se radno angažovanje ne odvija izolovano; osećanje solidarnosti; smisao za organizaciju i planiranje, navika da se svakodnevno radi određen broj časova; poštovanje radne discipline, poštovanje autoriteta pretpostavljenih instruktora; želja da se usvoje nova znanja; sklonost da se posao uradi kvalitetno i na vreme, itd. Radno angažovanje treba da izgradi navike, zato ono iziskuje izbegavanje sile kao metoda, ali i principa da ekonomski interes ustanove ne bude iznad interesa prevaspitanja. Radi povećanja efekata primene, ovaj tretman pretpostavlja naknadu za rad, koja mora biti odgovarajuća, što je veoma važno u psihološkom smislu radi potkrepljivanja motiva (Bošković, Bobić, 2022).

U kazneno-popravnim ustanovama Republike Srbije, rad osuđenih lica se organizuje u Privrednim jedinicama, a na poslovima od zajedničkog interesa za život i rad osuđenih lica. Pre uključivanja u sistem rada obavezan je period obuke nakon kojeg osuđeno lice potpisuje izjavu da je obučeno za određeni posao, i kojom potvrđuje svoj pristanak da bude radno angažovan. Radno vreme osuđenih lica iznosi 40 časova sedmično, a osuđena lica imaju pravo za naknadu za svoj rad. Prema vrsti posla, naknada se utvrđuje kategorizacijom svih poslova i radnih zadataka na kojima rade osuđena lica. Prema kategorizaciji poslova i radnih zadataka, utvrđuju se i koeficijenti po osnovu stručne spremlje. Rukovodilac ustanove donosi akt o sistematizaciji radnih mesta za osuđena lica, u kojoj je za svako mesto utvrđena kategorija. Osuđena lica imaju pravo na godišnji odmor, čije je trajanje utvrđeno zakonom, u zavisnosti od dužine kazne i vremena radnog angažovanja. Radno angažovanje osuđenika se vrši na osnovu sistematizacije radnih mesta. Povremeno angažovanje osuđenika se vrši na način da privredna jedinica svoje potrebe za radnom snagom dostavlja službi za tretman. Postoji i mogućnost angažovanja osuđenih lica prema trećim licima, na način da fizičko ili pravno lice sklopi ugovor sa penalnom ustanovom, kojim se reguliše opis poslova, trajanje posla, mere zaštite na radu, i dr. Evropska zatvorska pravila preporučuju da će se radu u zatvoru pristupati kao pozitivnom sistemu zatvorskog režima, i nikada se neće koristiti kao kazna. Koliko god je moguće, radom će se održavati ili povećavati sposobnost osuđenika da zaradi za život po izlasku iz zatvora. Uprava zatvora će omogućiti rad zatvorenika samostalno ili u saradnji sa privatnim ugovaračima, unutar, ili izvan zatvora (Evropska zatvorska pravila). Rad u zatvoru se smatra pozitivnim aspektom zatvorskog režima i nikada se ne sme koristiti kao

kazna. Radno angažovanje osuđenika ujedno predstavlja i sastavni deo tretmana, stim što rad osuđenika mora biti svrsishodan i ne sme biti na bilo koji način ponižavajući. Vrsta posla koju obavlja osuđeno lice mora biti u skladu sa njegovim fizičkim i psihičkim sposobnostima, kao i njegovom kvalifikacijom. Rad u zatvoru treba da održava ili poveća sposobnost osuđenika da zarađuje za život nakon puštanja na slobodu. Za vreme radnog angažovanja i izdržavanja zatvorske kazne ne sme biti diskriminacije na osnovu rada.

5. AKTIVNOSTI MENADŽMENTA ZATVORA U PROCESU RESOCIJALIZACIJE

Iz predhodnog izlaganja jasno se vidi značaj uposlenosti i radnog angažovanja osuđenih lica u procesu resocijalizacije u penalnim uslovima, a to daje veliki zadatak menadžmentu da obezbedi sve neophodne uslove kako bi se taj process realizovao. Međutim, moramo imati na umu da se država još uvek nalazi u procesu tranzicije, da je teško organizovati process proizvodnje u penalnim ustanovama, posebno kada se ima na umu zastarelost sredstava za rad, kao i strukturu osuđeničke populacije, te njihove nedovoljno izražene radne navike. I pored svih navedenih problema u penalnim ustanovama je uz pomoć projekata međunarodnih institucija ipak organizovana proizvodnja i veliki broj osuđenika je radno angažovan. Menadžment zatvora mora da obezbedi tržište za nove proizvode gde će prodajom robe na tržištu doći do stvaranja novonastale vrednosti koja će se koristiti za plaćanje rada osuđenih lica i ulaganje u proizvodnju. Prilikom realizacije tretmana kroz radno angažovanje veliku ulogu imaju i zaposleni u zatvorima, a zadatak menadžmenta jeste da koordinira njihovim radom, da ih na adekvatan način motiviše kako bi efekat resocijalizacije bio što veći.

Na kraju možemo istaći da zadatak menadžmenta jeste da obezbedi veće radno angažovanje osuđenih lica koje bi dopinelo sticanju određenih radnih sposobnosti i navika, a finansijski efekti bi bili usmereni ka poboljšanju uslova izdržavanja kazne. Takođe, neophodno je izvršiti koordinaciju svih privrednih jedinica unutar sistema izvršenja krivičnih sankcija i povezivanja u jednu celinu kako bi se proces potreba proizvodnje i prodaje proizvoda zaokružio unutar sistema. Pored toga, neophodno je ostvariti dobre kontakte na lokalnom nivou sa ciljem da se veći broj osuđenika, kojim omogućava klasifikaciona grupa, uposli van ustanove, a ujedno obezbedi tržište za prodaju proizvoda nastalih u ustanovama. S obzirom da se u današnje vreme na tržištu proizvoda i usluga privredni subjekti pojavljuju putem tendera, sagledati mogućnost učešća na tenderima sa nekom jačom firmom u statusu strateškog partnera za određene proizvode i usluge koje ustanove mogu da pruže. Prateći tržišne zakone ponude i tražnje neophodno menjati unutar sistema vrstu proizvoda i usluga kako bi se obezbedio opstanak na tržištu, a samim tim uposlenost osuđenih lica podigla na viši nivo što bi doprinelo njihovoj uspešnijoj resocijalizaciji. Da bi se sve ovo uspešno sprovedo neophodno je uključiti stručnjaka iz ove oblasti na svim nivoima, a posebno dobre poznavaoce tržišnog poslovanja koji bi na osnovu trenutnog stanja u privredi dali prave smernice za rad i upošljavanje osuđenih lica.

6. ZAKLJUČAK

Resocijalizacija, kao svrha kažnjavanja, postaje aktuelna uvođenjem kazne lišenja slobode, kada zatvori u odnosu na ranije namene, dobijaju jednu novu i drugačiju funkciju, funkciju prevaspitanja. Ona je u suštini vraćanje iz asocijalnog načina života u prihvatljive načine ponašanja i odnose, odnosno ponovno uključivanje devijantne osobe u redovne tokove života i rada. Program postupanja u penalnim uslovima najčešće se primenjuje kroz radno angažovanje osuđenika, organizacije slobodnog vremena, obrazovanja i stručnog usavršavanja, slobode veroispovesti i slično. Radno angažovanje u penalnoj ustanovi, tradicionalno se posmatra kao mera podrške resocijalizaciji osuđenika. Rad kao aktivnost tokom izdržavanja kazne, treba da podrži sve tri uključene strane: osuđenika kao lice koje treba da se promeni, zatvor kao instituciju i društvo kao primaoca rezultata rada penalne ustanove.

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ACTIVITIES OF THE MANAGEMENT OF PENAL INSTITUTIONS IN THE TREATMENT OF CONVICTED PERSONS THROUGH WORK ENGAGEMENT

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ABSTRACT: The community of convicts is an artificially created social environment in which convicted persons serve a term of imprisonment in penal institutions. While serving a prison sentence, the treatment of convicted persons is most often applied through work activities. Work engagement of convicts is one of the essential preconditions for resocialization as a purpose of punishment. The purpose of the work is for the convict to acquire, maintain and increase his work skills, work habits and professional knowledge in order to provide him with the conditions for successful reintegration into the social environment after serving his prison sentence. For this reason, the prison management must take all measures to enable the work engagement of the convict population. The employment of convicted persons is organized in tasks of common interest for the life and work of convicted persons in the penal institution. In addition to the effect of resocialization achieved by employment, it is very important to highlight the economic effect of convict work. During the time of employment, convicted persons also receive a certain monetary compensation, which is provided for by law. The income generated as a result of work engagement of convicted persons while serving a prison sentence belongs to the institution and these funds are invested in improving the standards and conditions of stay of convicted persons in the institution.

Key words: *convict, prison, prison management*

***HUMANISTIČKE NAUKE: FILOZOFIJA, FILOLOGIJA,
ISTORIJA, TEOLOGIJA***

***HUMANITIES: PHILOSOPHY, PHILOLOGY, HISTORY,
THEOLOGY***

AKTIVIZAM STUDENATA U ZAJEDNICI – ULOGA UNIVERZITETA U RAZVOJU GRAĐANSKOG AKTIVIZMA

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SAŽETAK:

Univerziteti su vekovima bili nosioci društvenih promena a danas se repertoar uloga univerziteta proširuje i usložnjava. Društvena zajednica i univerzitet ne smeju egzistirati odvojeno već jedino u koegzistenciji, vodeći računa o dubini i nivoima ostvarenih (ko)relacija. Obazovanje društveno aktivnih građana je jedan od ciljeva visokog obrazovanja u Srbiji. Aktivizam mladih označava kulturu participacije mladih na različitim nivoima i u različitim oblastima društvenog delovanja sa ciljem podizanja nivoa svesti o neophodnom učešću mladih u društvenim zbivanjima i odlučivanju o bitnim društvenim pitanjima. Aktivizam mladih pruža mladima priliku da uzmu aktivno učešće u društvu koje ih okružuje dok razvijajući svoje kompetencije i interesovanja doprinese boljem i humanijem društvu.

Predstavnici humanističke teorije naglašavaju proces ličnog razvoja pojedinca i učenje putem otkrivanja i istraživanja, kroz vlastitu aktivnost u kojoj će pojedinac biti slobodan da razvija veštine i znanja koja su mu neophodna za život i rad. Bitno je naglasiti da studenti kroz aktivizam stiču kognitivne ali i socio-emocionalne veštine koje su u našem formalnom obrazovanju manje zastupljene. Potrebno je pojedinca osnažiti da upravlja svojim procesom obrazovanja razvijajući svoje veštine kako bi sutra bio uspješniji u profesiji kojom želi da se bavi i konkurentniji na tržištu rada.

U radu se navodi pregled istraživanja koja nam mogu poslužiti kao polazna osnova za odgovorniju ulogu naših univerziteta u razvijanju građanskog aktivizma. Neophodna je veća povezanost između formalnog, neformalnog i informalnog obrazovanja, u cilju pružanja holističkog obrazovanja studentima i promocije aktivizma u zajednici.

Ključne riječi: aktivizam, uloga univerziteta, obrazovanje, studenti

1. UVOD

Humanistička psihologija i pedagogija smatraju da je čovek biće koje je u stalnom procesu menjanja i nastajanja, zato je ličnost ne samo ono što jeste i čini, već i ono što će biti, šta može da postane. Humanisti imaju optimističan stav prema razvoju ljudske prirode, smatrajući da čovek može iskoristiti sve svoje mogućnosti i aspiracije kako bi postao ono što jeste i ono što želi da bude. Obrazovanje se posmatra kao proces personalnog rasta, sa ciljem ostvarivanja unutrašnjih potencijala i pomaganja procesa učenja koji vodi do samoaktuelizacije. Bitno je prilagoditi se društvenim promenama i aktivno se uključiti u njih, a to nikako ne možemo ako usvajamo statička znanja (Milutinović 2008, 141).

Pojedinac treba da bude slobodan da izabere ono što želi da nauči, zato humanisti daju prednost učenju putem otkrića, otvorenom obrazovanju, iskustvenom učenju, problemskoj nastavi, angažovanju u grupnim i individualnim projektima (Milutinović, 2008, 142). Poslednjih decenija brojni fakulteti i univerziteti prepoznaju ovu problematiku i svoju obrazovnu misiju šire koncipiraju te iskustvu i angažovanju studenata pristupaju holistički (Astin, 1993 prema Pavlović, 2020). „Sve češće i glasnije se, usled mnogobrojnih promena, govori i promišlja o takozvanoj *Trećoj misiji Univerziteta*. Uz nastavu i istraživanje, dve do sada primarne misije, treća misija se može definisati kao interakcija univerziteta i zajednice koja teži da u sebi pomiri dve dimenzije – društvenu i ekonomsku. Preduslov za razvoj društveno odgovornog univerziteta i njegove treće misije nalazi se pre svega u promeni vrednosnog sistema svih njegovih aktera a zatim i u postavljanju i jačanju institucionalnog okvira za razvoj treće misije univerziteta“ (Marić Jurišin, 2020:158).

2. AKTIVIZAM MLADIH

Aktivizam mladih je nužan u demokratskim društvima i ne možemo govoriti o boljitku društva ako nemamo aktivne mlade koji rade na razvijanju vlastitih demokratskih vrednosti, kao što ne možemo očekivati da sam razvoj demokratskih vrednosti može biti od velike koristi ako ne podstiče mlade da budu odgovorni i konstruktivni akteri u svom društvu.

Demokratizacija obrazovanja ne uključuje samo formalni, institucionalni obrazovni sistem, već i delovanje drugih institucija i različite oblike neformalnog obrazovanja. Bitno je razvijati demokratizaciju i aktivizam kao procese na svim nivoima obrazovanja jer u 21.veku studenti treba da steknu kompetencije za život u neizvesnom društvu, a to mogu ostvariti samo ako su aktivni, ako samostalno donose odluke, ako se njihov glas čuje i ako su u stanju da razvijaju kod sebe demokratske vrednosti kao što su: saradnja, tolerancija, prihvatanje, kritičko mišljenje i dr. Tako shvaćeno obrazovanje za demokratiju i građansko društvo uključuje problematiku koja se obično razmatra u okviru: građanskog vaspitanja (obrazovanja), obrazovanja za ljudska prava, multi ili interkulturnog obrazovanja, obrazovanja za mir i razvoj i globalnog obrazovanja. U

takvom društvu građani moraju biti proaktivni učesnici u svakodnevnom društvenim i političkim procesima. Ujedno ovo predstavlja i preduslov za razvoj zdravog i funkcionlanog civilnog društva. „Civilno društvo predstavlja sastavni deo modernog demokratskog društva koje se temelji na komplementarnim ulogama predstavničke i participativne demokratije, i čine ga organizovani građani koji imaju za cilj da putem svog organizovanja i delovanja utiču na stvaranje kvalitetne promene koja je od opšteg značaja za njihovu zajednicu (na lokanom i na globalnom nivou). U svakodnevnom govoru upravo se na to misli kada se upotrebljava termin lokalna zajednica. Kao primarne uloge koje organizacije civilnog društva imaju u društvenom životu izdvajaju se razvijanje kulture građanskog aktivizma i učešće u društvenim i javnim politikama, te propagiranje filantropskih vrednosti i principa“ (Strategija za stvaranje podsticajnog okruženja za razvoj civilnog društva u RS od 2016.-2020. godine prema Marić Jurišin, 2020:161). *Omladinski aktivizam* može biti definisan kao glas mladih ljudi okupljenih oko zajedničke ideje uključenih u raznolike društvene aktivnosti zarad neke društvene promene. Postoje različiti oblici aktivizma u odnosu na različite društvene promene (studentski protesti, tribine, kampanje). Osnova aktivizma je volonterizam (Vojnić Tunić, 2008) kao i učenje zalaganjem u zajednici (Malčić, 2020).

3. DOPRINOS UNIVERZITETA U GRAĐENJU GRAĐANSKOG AKTIVIZMA – UČENJE ZALAGANJEM U ZAJEDNICI

Univerziteti već odavno nisu mesta na kojima se stiču „samo“ akademska znanja, izvodi nastava i unapređuje nauka, oni su bitni činioci društvenog i ekonomskog razvoja jednog društva, ali i mesto susreta i partnerstava akademske zajednice i lokalne zajednice, nacionalnog i međunarodnog. „Vaspitno-obrazovni sistem u izvesnom smislu predstavlja stožer u prenošenju i utemeljenju vrednosti, koje društvo zastupa, na naraštaje koji se obrazuju i pripremaju za aktivno učešće u zajednici kojoj pripadaju“ (Marić Jurišin, 2020:160). Kao najznačajniji obrazovni centri koji kontinuirano uključuju nove generacije u širu društvenu zajednicu i tržište rada, kao središta stvaranja i diseminacije znanja i kao institucije koje okupljaju najobrazovanije građane različitih naučnih i stručnih profila, univerziteti su dužni da promišljaju o svojoj svrsi i javnoj odgovornosti kao društvene institucije ali i odgovornosti nastavnog kadra koji radi na univerzitetima koji su nosioci pozitivnih promena u zajednici (Čulum, Ledić, 2011; Malčić, 2020; Marić Jurišin, 2020; Pavlović, 2020).

Kada se osvrnemo na dokumenta kao što su Strategija za stvaranje podsticajnog okruženja za razvoj civilnog društva u Republici Srbiji za period od 2016-2020 godine i Strategija za razvoj obrazovanja u Srbiji do 2020.godine, a zatim i do 2030.godine možemo zapaziti saglasnost u ciljevima koji se tiču podsticanja društveno odgovornih i aktivnih građana. U skladu sa navedenim su i principi visokog obrazovanja gde se između ostalog navode: „akademske slobode; autonomija; akademski integritet; otvorenost prema javnosti i građanima; jedinstvo nastave, naučnoistraživačkog rada i inovativne delatnosti, kao i stručan rad; uvažavanje humanističkih i demokratskih vrednosti nacionalne i evropske tendencije i vrednosti kulturnog nasleđa; poštovanje ljudskih prava

i građanskih sloboda, uključujući i zabranu svih vidova diskriminacije; učešće studenata u upravljanju i odlučivanju, posebno u vezi sa pitanjima koja su od značaja za kvalitet nastave“ (Zakon o visokom obrazovanju, 2018 – član 4.).

Postoje različita gledišta o ulozi univerziteta u razvoju građanskog aktivizma. Prema jednim, univerzitet treba da bude u službi zajednici, da svojom stručnošću doprinose zajednici, uz nastavu i istraživanje. Prema drugoj paradigmi, paradigmi zalaganja, univerziteti i zajednica treba da budu u partnerskom odnosu, i postojeća znanja i iskustva iz zajednice treba integrisati u nastavu i istraživanje na univerzitetu (Adams, 2005; Grandić i Bosanc, 2018; Marić Jurišin 2020). Koncept učenja zalaganjem u zajednici – *service learning* ima za cilj integraciju aktivnog angažovanja studenata u zajednici sa kurikulumom univerziteta što rezultira boljim razumevanjem određenih studijskih programa, kao i potreba zajednice i problema koji se u njoj javljaju, što dalje vodi do permanentnog zalaganja studenata i građanskog aktivizma.

Značajno je poimanje razlika koje postoje između vrednosno srodnih pojmova poput volontiranja, praktične nastave i učenja zalaganjem u zajednici (Tabela 1.). Kada studenti uče kroz aktivizam u zajednici, oni pomažu zajednici i na taj način zajednica ima korist a studenti ostvaruju na taj način predviđene ishode određenih studijskih programa, oni za razliku od volontiraju u ovom slučaju moraju promišljati o naučenom i biti u stanju da naučno spajaju sa praksom, da imaju konkretnije ciljeve. Učenja zalaganjem u zajednici je višedimenzionalno iskustvo u kojem studenti učestvuju u organizovanoj aktivnosti u zajednici koja na taj način zadovoljava određene potrebe što onda rezultira dubljim razumevanjem sadržaja studijskog predmeta, uvažavanjem naučne discipline te višim stepenom osećaja građanske odgovornosti (Bringle i Hatcher, 1996 prema Mraović i Pavlović, 2019).

Tabela 1. Razlika između praktičnih aktivnosti studenata (Ćulum i Ledić, 2010:79)

Vrsta aktivnosti iskustvenog učenja	Usmerenost, ishodi učenja i odnos sa zajednicom
Učenje zalaganjem u zajednici	<ul style="list-style-type: none"> - Recipročni saradnički odnosi na relaciji student-zajednica - Profesionalni i lični razvoj studenta i briga za zajednicu su podjednako važni - Ravnoteža između ciljeva studijskog programa i ishoda delovanja u zajednici - Uravnoteženost konteksta nastavnog programa, učenja studenata i dobrobiti zajednice
Praktičan rad u nastavi	<ul style="list-style-type: none"> - U fokusu je dobrobit studenta i njegov profesionalni razvoj uz sticanje specifičnih znanja i veština - Ishodi učenja unapred su definisani nastavnim programom

Volontiranje	<ul style="list-style-type: none"> - Kontekst zajednice je zanemaren - U fokusu je dobrobit zajednice - Akcenat je na raznovrsnim aktivnostima u zajednici - Ishodi učenja nisu povezani sa nastavnim programom - Kontekst učenja je sekundaran
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Angažovanjem u zajednici ostvaruju se brojni benefiti. Proširuje se repertoar sticanja znanja i iskustava svih aktera, što doprinosi kako ličnom i profesionalnom razvoju studenata i nastavnika, tako i razvoju zajednice. Pre nego što se započne sa realizacijom učenja zalaganjem u zajednici potrebno je sagledati okolnosti, omogućiti resurse, uneti izmene u dokumentaciji visokoškolskih ustanova, korigovati silabuse predmeta, uneti neophodne izmene kako u teoriji tako i u praksi koju studenti obavljaju. Neophodno je predstaviti učenje zalaganjem u zajednici kao koncept koji se ostvaruje višedimenzionalno. Potrebno je raditi na podizanju svesti kako studenta tako i nastavnog kadra o značaju i mogućnostima ovakvog načina rada. Studentima takvo učenje može poslužiti kao iskustveno učenje, koje će im sutra lakše omogućiti zapolsenje ili im dati priliku da se oprobaju na različitim poslovima i u različitom okruženju. Isto tako, nastavnici zahvaljujući ovakvom načinu rada imaju priliku da unaprede vlastitu praksu, da steknu nove profesionalne veštine i da idu u korak sa potrebama društva u vremenu brzih promena i tranzicije.

4. PREGLED ISTRAŽIVANJA

U Sjedinjenim Američkim Državama učenje zalaganjem u zajednici je službeno prihvaćeno u visokom obrazovanju već gotovo četvrt veka (Hesser, 1995; Traver i Katz, 2014; Butin i Seider, 2012 prema Mraović i Pavlović, 2019), dok se u europskom prostoru visokog obrazovanja ono tek nameće kao imperativ (Benneworth et al., 2018).

Od 2015. godine Evropski Ekonomski i Socijalni komitet pokrenuo je i sačinio inicijativu pod nazivom “Društveno angažovani univerziteti menjaju Evropu” a građanski aktivizam je prepoznat u brojnim dokumentima. U Zaključcima Veća Evropske unije o obnovljenom programu EU za visoko obrazovanje (2017) u prioritetna područja delovanja navedene su četiri prioritetne aktivnosti: usklađivanje budućih veština i promovisanje izvrsnosti u njihovom razvoju, izgradnja inkluzivnog i povezanog sistema visokog obrazovanja, učestvovanje visokoškolskih ustanova u inovacijama, i podržavanje efikasnih i efektivnih sistema visokog obrazovanja. U dokumentima se navodi da društvene aktivnosti studenata i dobrovoljni rad u zajednici treba da budu sastavni deo studijskih programa. U istom dokumentu, Veće Evrope podržava nameru Evropske komisije da u okviru Erasmus+ programa promiče uključivost i inovacije u visokoškolskom obrazovanju, odnosno jačanje društvene uloge visokoškolskih ustanova i njihovih studenata kroz dobrovoljni i društveni rad (Mraović i Pavlović, 2019).

Ne treba mešati kratke projekte koji su rezultat entuzijazma pojedinih nastavnika ili su nastali zbog donacije i partnerstava sa učenjem zalaganjem u zajednici. Učenje

zalaganjem u zajednici nije samo izolovan projekat ili metoda rada već sistematično učenje zasnovano na povezivanju aktivizma mladih i kurikuluma formalno obrazovnih institucija (Gregorová et.al, 2019).

U istraživanju iz 2008/09 (Ćulum, Ledić, 2011) na Hrvatskim univerzitetima učestvovalo je 570 univerzitetskih nastavnika i saradnika sa ciljem da se utvrde pretpostavke razvoja i integracije civilne misije univerziteta u temeljne akademske delatnosti. Istraživanje je pokazalo da nastavnici i saradnici imaju pozitivne stavove prema civilnom zalaganju i uvažavaju odgovornost univerziteta i univerzitetskog kadra u podsticanju civilnog zalaganja studenata i obrazovanju društveno aktivnih građana.

Ipak, nastavnici najmanje teže razvoju znanja i veština studenata za rešavanje pitanja lokalne zajednice. Na integraciju civilne misije u nastavne i istraživačke delatnosti nastavnike bi prema ovom istraživanju najviše podstaklo sledeće: interes studenata, osigurana administrativna potpora i infrastruktura, fleksibilne mogućnosti opterećenja u radu i vrednovanje različitih akademskih aktivnosti, finansijska potpora za troškove osmišljenih aktivnosti i mogućnost usavršavanja (Ćulum, Ledić, 2011). Tokom 2019.godine u Hrvatskoj (Mraović i Pavlović, 2019) je na prigodnom uzorku od 160 studenata s područja Hrvatske sprovedeno istraživanje koje pokazuje da studenti uglavnom nisu čuli za metodu učenja zalaganjem u zajednici i nemaju iskustva s njom, ali iskazuju želju za upisom takvog predmeta te takvu metoda smatraju veoma korisnom. Istraživanja pokazuju da su koristi učenja zalaganjem u zajednici najviše vidljive u sticanju iskustava studenata i razvoju veština kao što su: kritičko promišljanje, rešavanje problema, samopoštovanje, izgradnja građanske odgovornosti, bogaćenje kontakata, poštovanje različitosti (Hedin i Conrad, 1991; Simons i Cleary, 2006).

U 2013. u Slovačkoj su istraživači identifikovali 4 modela volontiranja ili građanskog aktivizma koji su povezani sa formalnim obrazovanjem. Prvi je individualni kad se pojedinci sami odluče za angažovanje u svojoj lokalnoj zajednici; drugi je angažovanje đaka ili studenata u organizacijama civilnog društva u saradnji sa školama i univerzitetima gde se te aktivnosti vode van kurikuluma tih ustanova; treći je volonteri centri ili njihovi predstavnici koji se nalaze direktno u školama; četvrti je učenje zalaganjem u zajednici odnosno kada se volontersko iskustvo inkorporira u različite školske ili univerzitetske predmete ili kurseve. Što se tiče Slovačke učenje zalaganjem u zajednici je prisutno na univerzitetima od 2005/06. a na ukupno tri univerziteta se takvi programi i danas realizuju (Gregorová et.al, 2019).

Pojedini autori poput Varena (2012), Bernadovski i sar. (2013), Moli i Ilustra (2014) navode u svojim istraživanjima da su benefiniti učenja zalaganjem u zajednici između ostalog: podizanje kulturne svesti studenata; preuzimanje društvene odgovornosti; kognitivni i afektivni aspekti razvoja ličnosti; akademska uspešnost; kritičko mišljenje; praktične veštine poput komunikacije; razvijanje samopoštovanja, samoeфикаsnosti i rastuće socijalne svesti kod studenata... (Warren, 2012; Bernandowski, Perru & Del Greco, 2013; Moely & Ilustre, 2014 prema Pavlović, 2020).

Studenati u Crnoj Gori, kao i u Srbiji imaju priliku za aktivizmom i angažovanjem u zajednici ali su to mahom vannastavne aktivnosti koje nisu sistematski izvođene i povezane sa studijskim programima i predmetima. Takođe, analizom dostupnih

izvora možemo konstatovati da je i broj naučnih istraživanja koja su se bavila ovom tematikom minoran, što bi u budućnosti svakako trebalo promeniti.

5. ZAKLJUČNA RAZMATRANJA

Izvesno je da se tokom vremena, položaj univerziteta menjao u skladu sa aktuelnim društvenim, političkim i ekonomskim potrebama društva. „Brojni autori saglasni su oko sintagme da demokratija ne može da živi bez demokrata, što ukazuje na nužnost razvoja demokratske kulture, pri čemu je upravo civilno zalaganje građana ključno za održanje demokratije, pa je tako i aktivno i proaktivno građanstvo obrazovni ideal prema kome se teži.

Reč je o građanima koji moraju biti svesni problema sa kojima se čovečanstvo danas suočava, ali i spremni i voljni da preuzmu aktivnu ulogu u njihovom rešavanju“ (Elkana, 2009; Ćulum i Ledić, 2010 prema Marić Jurišin, 2020:162). Pregledom dostupnih istraživanja i relevantne naučne literature, možemo konstatovati da se učenje zalaganjem u zajednici i razvoj aktivizma mladih u zajednici i visokoškolskim ustanovama temelji na njihovim uzajamno saradničkim odnosima, uz brojne benefite za sve aktere ovog procesa. Izazovi koji postoje i predstoje u periodu sveobuhvatnih političkih, ekonomskih, društvenih, socijalnih i kulturnih promena zaista su brojni, a ishodi su neizvesni.

U Srbiji je potrebno napraviti jasan koncept i strategiju u kojima će biti predloženo kako univerziteti mogu i treba da se „otvore“ prema lokalnoj zajednici, i na koji način lokalna zajednica može doprineti toj saradnji. Često su reforme koje se dešavaju u našem obrazovanju rezultat pritiska ili podsticaja inostranih trendova a ne naše lične želje, afiniteti, ali još značajnije nisu rezultat spremnosti, osposobljenosti i dostupnih resursa. Potrebno je osvestiti mogućnosti i prednosti učenja zalaganjem u zajednici, ne samo da bismo pratili evropske trendove već i da bismo napredovali na putu demokratizacije obrazovanja. Važno je istovremeno edukovati i senzibilisati nastavnike, studente ali i čelne ljude u lokalnim zajednicama da su partnerski odnosi između univerziteta i zajednice značajan i nužan preduslov napretka ne samo univerziteta i zajednice već društva u celini.

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STUDENT ACTIVISM IN THE COMMUNITY - THE ROLE OF THE UNIVERSITY IN THE DEVELOPMENT OF CIVIC ACTIVISM

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ABSTRACT:

Universities have been carriers of social change for centuries, and today the repertoire of university roles expands and becomes more complex than ever before. The social community and the university must not exist separately, but only in coexistence, considering the depth and levels of (co)relations achieved. Education of socially active citizens is a goal of higher education in Serbia. Youth activism means the culture of youth participation at different levels and in different areas of social activities with the aim of raising the level of awareness on necessary participation of young people in social events and deciding on important social issues. Youth activism offers young people the opportunity to take an active part in the society that surrounds them, as well as to contribute to a better and more humane society developing their competencies and interests.

Representatives of the humanistic theory emphasize the process of personal development of an individual, as well as learning through discovery and research, through one's own activity in which the individual is free to develop skills and knowledge necessary for life and work in general. It is important to emphasize that through activism students acquire both cognitive and socio-emotional skills that are less represented in our formal education. It is necessary to empower individuals to control their education process by developing their skills in order to be more successful tomorrow in the profession they want to pursue and be more competitive in the labor market.

The paper provides an overview of the research that can be used as a starting point for a more responsible role of our universities in the development of civic activism. It is necessary to have a closer connection between formal, non-formal and informal education, in order to provide holistic education to students and promote activism in the community.

Keywords: activism, the role of university, education, students

INTEGRITY ADVISOR IN PUBLIC ADMINISTRATION: HANDLING A REPORTED INCIDENT OF SEXUAL HARRASSMENT

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ABSTRACT:

Sexual harassment in the workplace describes a serious social phenomenon. As an unwanted and oppressive behaviour, sexual harassment constitutes gender discrimination, offends human dignity and can equally affect men and women.

The role of an Integrity Advisor (IA) in public administration is to support employees, to inform the personnel of an organization and to advise managers in relation to cases of ethics and integrity.

The IA must communicate with empathy, seek dialogue to understand the situation of the other, and provide calm and confidence so that the person who reports sees not only the problem but also the solution.

In this sense, the integrity advisor constructs a model human being, equipped with special abilities and skills in order to carry out his/her mission.

This paper approaches the role of the IA in public administration in the case of a reported incident of sexual harassment in the workplace. The paper focuses on the interview, as one of the basic tools available to an IA for exercising his/her duties.

In this context, the necessary preparatory actions for the interview are analyzed, as well as the categories and examples of questions that can be asked in the case of reporting sexual harassment in the workplace.

The aim of the above is to enrich the already existing literature on the subject, as well as to highlight the importance, but also the complexity of the IA's role in its practical dimension.

Keywords: Integrity Advisor, Interview, Sexual Harassment, Skills, Workplace

1. INTRODUCTION

Sexual harassment at work is a term that describes a particularly serious social phenomenon. Testimonies reveal that as a problem it mainly occurs due to power exploitation in the workplace, especially by hierarchically superiors (employers, supervisors) in relation to their subordinates [1].

According to the international and national legislation, sexual harassment at work, as an unwanted and oppressive behavior, constitutes gender discrimination, offends human dignity and can equally affect men and women [2].

At national level, focusing on Greece, Art 22(2)(d) of Law 4604/2019 (Gov. Gaz., A' 50/26.03.2019) on the promoting substantial gender equality, prevention and combating gender violence, provides the definition of sexual harassment in the fields of work and employment, as follows:

sexual harassment: any form of unwanted verbal, psychological or physical conduct of a sexual nature, resulting in an infringement of the personality of a person, in particular by creating an intimidating, hostile, degrading, humiliating or offensive environment around it.

Encouraging employees to speak up or even report relevant behaviours is of great importance, as it gives the organization an early warning that allows prevention. This leads to more effective protection of employees, but also of the organization itself. An important part of the process is the handling of complaints and reports [3].

The Integrity Advisors (IAs) are the central actors of integrity management systems of the administrative organizational structure, whose main task is to promote the implementation of the integrity approach within state administration institutions [4]. According to the Art 24 of Law 4795/2021 (Gov. Gaz. A' 62/17.04.2021) 'Public Sector Internal Audit System, Integrity Advisor in public administration and other provisions for public administration and local government', the responsibilities of an IA are divided into three functional axes:

1. Support.

- a. Provides personalized counseling support for issues of ethics and integrity faced by employees during the exercise of their official duties, including such as sexual harassment, discrimination, bullying, harassment and conflict of interests.
- b. Receives reports from employees of the organization, for incidents of integrity violation or corruption and mediates in order to the organization's bodies or external bodies take over their investigation.
- c. Monitors the process of investigation and informs the employee who submitted a report.

2. Information.

- a. Provides information to the organization's staff about ethics and integrity issues, as well as for the mission and responsibilities of the IA.
- b. Plans and coordinates training actions and capacity building for employees and the employees of the supervised entities in collaboration with the relevant

unit that is responsible for education matters, as well as with external providers of education services, such as the National Center for Public Administration and Local Government.

c. Participates in the formulation of internal policies and in the development of tools to strengthen the fairness and transparency, such as Codes of Ethics, Regulations on Management of Conflict of Interests, Protocols on Management of Incidents of Fraud and Corruption.

3. Advice.

a. Informs and cooperates with the management body, the Internal Audit Unit and the unit responsible for administrative matters, support and human resources, for the development and implementation of policies and standards of integrity within the organization.

b. Formulates proposals to the head of the organization in order to improve the mechanisms of prevention, deterrence and detection, when incidents of integrity violations are detected.

c. Draws up an Annual Report and submits it to the head of the organization and the National Transparency Authority on the effectiveness of integrity policies and procedures applied, the results, as well as on the course of relevant cases handled.

The central mission of an IA in national public administration is to ensure a coherent framework for the effective protection of employees who discover, suffer the consequences or wish to report integrity violations, as well as providing support, information and advice to them regarding issues of ethics and integrity in the workplace [5].

In order the above responsibilities to be carried out effectively, a specific profile of the IA is required that includes special knowledge, abilities and skills. This applies especially to the case of reporting sexual harassment, due to the special 'ethical' content of the relevant human behavior. At the same time, given the confidentiality of the mentioned data, the skill of conducting an interview is considered to be particularly critical for creating a climate of trust between the participants [6]. Communication, in this context, should be studied both in its interpersonal and organizational dimension [7]. The interview conducted by an IA is an administrative interview of an exploratory and advisory nature [8]. With reference to its type of structure, it is characterized as semi-structured, as it contains both specific and general questions, giving the IA the scope to search for and collect further useful data for the specific case [9].

2. REPORTING SEXUAL HARASSMENT IN THE WORKPLACE: INTEGRITY ADVISOR'S SKILLS THAT CONTRIBUTE TO CREATING A CLIMATE OF TRUST DURING THE INTERVIEW

Conducting effective interviews is an essential part of an IA's job description. An effective interview is one that manages to collect accurate, useful and, above all, true information. In order to do this, the 'right' questions should be asked in the appropriate

way, so that the 'right' answers are drawn in turn [10]. Something like this in practice does not concern the grammatical formulation as much as the persuasion of the interviewer [11].

In any case, it is the duty of the IA to create a climate of trust and cooperation [12] by acting in an ethical manner, in order to ensure on the one hand the successful outcome of the interview by obtaining the necessary information for making the right decisions, and on the other hand the protection of the interviewee, as well as safeguarding the reputation of the organization [13].

Acquiring the necessary skills to conduct an effective interview is a challenge that involves both training and experience. The interviewer must be able to understand and methodically manage complex behaviors and procedures [14], such as reports of sexual harassment, where the interviewees may be in a state of psychological vulnerability, moral weakness and fear.

Following the above, among the basic skills of an IA as interviewer [15], the following character components and skills are distinguished as of decisive importance, in case of a report of sexual harassment:

a. Impartiality.

An IA must be free from stereotypes and personal bias, in order to treat the interviewee consistently, to process the information correctly and in the context of the conducted interview, as a discussion and not as a prosecutorial investigation [16].

b. Composure.

An IA should be distinguished by self-control, lack of uncertainty and anxiety. The above requires at least three other skills: the ability to be attentive, the ability to identify ambiguity, and the ability to calm down [17].

c. Active listening. Key components of this are the active presence during a conversation (eye contact, body posture that shows readiness to receive a message and attention to the speaker) [18], the encouragement by the IA to the speaker to express himself/herself freely and to be perceived [19], the recognition of emotions and the response to them. The latter is one of the dimensions of emotional intelligence. Its basic condition is empathy, which pays attention not only to what the interviewee says, but how he/she says it, thus looking for the essence behind the details [20]. It is recognized that body language is the unspoken part of communication through which individuals use to reveal their true feelings and give their message more impact. An IA must pay special attention to the thoughts and emotional reactions perceived during the interview and be able to recognize the symptoms and effects of moral and sexual harassment.

d. Flexibility [21] both mental and behavioral, which is also related to the level of personal self-awareness of an IA, that allows him/her to adapt his/her behavior and adopt new approaches, when necessary.

3. INTERVIEW IN THE FRAMEWORK OF A REPORT ON SEXUAL HARASSMENT IN THE WORKPLACE

3.1 Preparatory activities

In order to better prepare and plan an interview, it is necessary to hold a meeting to plan the tasks to be followed, through which all available information will be taken into account and the main issues and objectives of the interview will be determined [22].

The initial evaluation of the complaint/report is important, as it will also indicate the correct way to handle the claim and the examination process. The issue of sexual harassment concerns acts of employees that directly violate the law and have an impact on the relationships between them, but also on the organization itself [23]. The initial evaluation of the IA concerns the above effects.

Especially in the case of harassment, due to the sensitive nature of the issue, it is preferable initially to communicate personally with the alleged victim [24] at the IA's office, so that the latter can investigate whether he/she will consult or further examine the matter. Through this practice, and given that each person is different and unique, the interviewee's characteristics (professional and personal) will significantly facilitate communication in the context of the interview that will follow [25].

The next actions of the IA until the realization of the main interview at a time to be determined, concerns the creation of a plan regarding the most efficient conduct of the interview, which should at least include [26]:

- a. Gathering the necessary data/information for the case. This will lead to the identification of both missing data and confidential information, as well as the special circumstances of confidentiality and protection of sensitive personal data that must be addressed in the case.
- b. Gathering and study of the regulatory framework and the relevant laws, and other supporting legal documents for the specific case. The IA must have knowledge of international, European and national legislation on equal treatment and know in detail the legal remedies in case of moral and sexual harassment [27].
- c. Determining the negotiation style and techniques to be used. In the case of sexual harassment, a consultative approach is indicated, taking into account the prescribed procedure and the role of the IA. The creation of a positive and supportive climate is the driving force of the IA's effort with simultaneous adaptation depending on the case [28].
- d. Defining the type of questions and drawing up an indicative (not lengthy) list in the context of a semi-structured interview [29].

3.2 Question categories and examples

During the interview, not only the type of questions to be asked, but also their style is of utmost importance, in order to gain respect and trust and achieve the basic purpose of seeking the truth. Openness, simplicity and comprehensibility in speech, precision, clarity and closeness are generally indicated on the part of the IA -characteristics that generally encourage conversation [30].

According to the typology of questions based on their content [31], due to the specificity of the case, it is considered adequate to use open questions in principle, so that the person reporting can be helped to explain. Open questions are very productive, because

they require the interviewee to think clearly and, although they may cause difficulty, they can provide a large amount of information and help the flow of the interview [32]. In addition, the use of neutral and non-directed questions, so that the respondent does not feel that he/she is being guided, are also indicated in counseling, as they do not cause the respondent to either defend or attack [33].

Due to the case under consideration, which may involve extremely personal and sensitive experiences accompanied by deep inner opinions, concerns and feelings, the use of indirect questions encourages the interviewee to express himself/herself honestly and unhindered. In addition, such type of questions can serve as a distraction [34] with the aim of changing the subject in order to feel comfortable.

Clarifying questions will be posed in case that what was said has not been clear or obvious, and it is necessary to clarify whether the information quoted by the respondent is indeed real facts or just opinions [35].

Utilization of probing/reflective questions is also adequate, on the one hand, to make sure that the IA has understood correctly, so that there is no doubt about the facts and controversial points in the interview, on the other hand, to help the interviewee to find the solution and gradually lead to the choice he/she will make [36].

Moving on to more 'sensitive' questions, the interviewer should be particularly careful with his/her style and the way of asking the question, as long as a sufficient period of time has passed since the start of the interview and the appropriate climate of trust has been achieved [37].

At the end, hypothetical/self-evaluation questions can be used [38], as well as direct questions concerning the last clarifications on the issue, the summary of what has been said and the confirmation of a cooperation agreement between the interviewers [39]. Listed below are five examples of questions, according to the above typology, that could be asked by the IA in case of a report on sexual harassment in the workplace:

- a. Open question: 'Why do you think this incident took place?', 'What do you think is the reason for this behavior of...?'
- b. Indirect/distraction question: 'Did you talk about this incident to other people close to you, friends or family?', 'How did they react?', 'What advice did they give you?' [40]
- c. Probing/reflective question: 'Based on what you said, do you mean that the work environment favors this kind of behavior?', 'Could you clarify what you just said?'
- d. Sensitive question: 'What do you think were the reasons for your own reaction to the incident?', 'Did you feel safe to share it with others within your workplace?', 'Did you have physical and psychological effects, because of the incident?'
- e. Hypothetical/self-evaluation question: 'What do you think should be done to deal properly with this situation?', 'What would you like to be improved in your organization, in order to better be dealt similar incidents in the future?'

4. CONCLUSION

The IA, as a confidential point of contact in its three axes of competence (supporting the victim, informing the personnel, advice to the head), contributes decisively to the prevention and establishment of a culture of integrity in public administration.

In order to handle reported incidents of violence and harassment in the workplace, an IA should have developed appropriate skills and techniques to recognize, prevent and deal with cases involving sexual harassment.

By establishing a relationship of trust, asking questions skilfully and listening actively, the IA creates the right conditions for the interviewee to express himself/herself freely. An IA must communicate with empathy, seek dialogue to understand the situation of the other, and provide calm and confidence so that the person who reports sees not only the problem but also the solution. In this sense, the IA constructs a model human being, equipped with special abilities and skills in order to carry out his/her mission [41].

Proper communication with whistleblowers can in turn strengthen employees' sense of trust in the organization and create a culture that will lead other employees to use the internal mediation channel. People who feel they have been listened to often also strengthen their commitment to the organization to which they belong.

The applied contribution of the IA, inextricably linked to the fundamental concept of ethics at work, aims to serve alongside the latter as a cornerstone of the national integrity system.

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A (POTENTIAL) LIFESPAN OF A METAPHOR: THE CASE OF A BANK

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ABSTRACT:

The paper examines the possibility of certain metaphoric expressions starting out as interpretative use of language and becoming a descriptively used unit by means of reutilization and routinization. The aim is to illustrate this process by using one example – lexeme bank – and elaborating how a certain metaphorical mapping can become routinized within a group or a community. Theoretical framework used in this paper is Relevance Theory, a cognitive-inferential model of pragmatics. Two approaches to metaphoric expressions are taken into consideration – explicature analysis (descriptive approach) and modified explicature analysis (interpretative approach). The main idea is to illustrate the process of utterance interpretation when the lexeme bank is used metaphorically, both as a case of descriptive and interpretative language use.

Keywords: *metaphor, ad hoc concept, interpretative use of language, descriptive use of language, truth-conditional contribution*

1. INTRODUCTION

In this paper we shall briefly present the relevant-theoretic account of production and interpretation of metaphoric expressions in the light of the recent research in cognitive-pragmatic treatment of metaphor. There has been a considerable number of research attempting to compare or reconcile the cognitive-linguistic and the cognitive-pragmatic approach to metaphor (Tendahl and Gibbs 2008, Tendahl 2009, Carston 2010, Wilson 2011, Rasulić and Mišković-Luković 2021, Manojlović 2022 etc.). In this paper, however, the focus is on the cognitive-inferential approach and the hypothesis that metaphoric expressions can be examples of both descriptive and interpretative use of language, depending on the number of factors, the most important one being the routinization of a certain expression within a certain community.

Following the conclusions made by Manojlović (in print) we shall examine the validity and applicability of relevance-theoretic approach by providing a hypothetical example of one expression that can cover every phase of the proposed process – from descriptively

used non-metaphoric expression, via interpretatively used metaphoric expression to the descriptively used metaphoric expression. We shall not focus here separately on the demarcation between explicit and implicit content. However, the very fact that the implicit content remains unchanged in all the instances presented in this paper supports the claim that metaphoric expressions constitute part of the explicit content of an utterance.

2. THEORETICAL CONSIDERATIONS

The framework used in this paper is the relevance theory (Sperber and Wilson 1986/95, Carston 2002b) – the cognitive-inferential, post-Gricean approach to communication. According to this approach human cognition tends to be geared towards the maximization of relevance (the cognitive principle of relevance) and every ostensive act of communication carries the presumption of its own optimal relevance (the communicative principle of relevance). Relevance itself is not a calculable phenomenon, but it is rather a function of cognitive effect achieved and cognitive effort exerted. The greater the cognitive effect the greater the relevance and vice versa. The opposite relation holds for cognitive effort since it is inversely proportional to relevance. Following the path of least effort, the hearer tests the interpretive hypotheses in order of their accessibility and stops when the interpretation that satisfies the expectation of relevance is reached (or abandoned). Both explicitly and implicitly communicated assumptions are at play when it comes to expectation of relevance. Moreover, pragmatic intrusion is important and pervasive not only in the recovery of implicit content but explicit as well. For the sake of the analysis conducted in this paper we shall define explicature as a proposition resulting from the development (pragmatic) of the logical form (the semantic representation of a sentence) and implicature as a proposition that does not result from the said development.

When it comes to metaphoric expressions there are two main approaches within this framework – explicature analysis (henceforth EA) and modified explicature analysis (henceforth MEA). According to EA (Carston 2002a, Wilson and Carston 2006, Carston 2010, Wilson 2011) metaphor represents a part of a continuum of cases of loose use of language which includes approximation and hyperbole as well. On the said continuum metaphoric expressions depart the most from the encoded meaning of a given expression. No special mechanisms are needed for arriving at the intended interpretation of an utterance containing a metaphorically used expression since interpretation is contextually conditioned (Wilson 2011: 202). The encoded concept is narrowed (strengthened) and/or broadened (loosened) in order to yield the communicated – ad hoc – concept. The pragmatic processes of narrowing and broadening of meaning are treated in the same way – as pragmatic enrichment of the basic proposition of an utterance (Mišković-Luković 2013: 50). The resulting concept is a descriptively used constituent of the explicature.

On the other hand, MEA (Mišković-Luković 2013, 2015) proposes that metaphoric expressions represent interpretative use of language. This (in the same way as the cases of

irony) relieves it from truth-conditional constraints (Mišković-Luković 2013: 54). Unlike descriptively used expressions (e.g., metaphoric expressions within EA) interpretatively used expressions do not contribute to the truth conditions of the proposition expressed. MEA treats metaphoric expressions as attributive concepts in that the speaker is not committed to the descriptive content of the lexical concept. This attributively used concept can be modulated in the same manner as is the case within EA approach, however, it remains an interpretatively used propositional constituent and does not contribute to the truth-conditional content of the utterance (Rasulić and Mišković-Luković 2021: 29). The implicatures within EA and MEA are generated in the same way, depending on the context.

Within the next chapter we shall put to the test the hypothesis that metaphoric expressions can be treated both as descriptive and interpretative language use by exemplifying a potential process of routinization of a lexeme *bank* when used metaphorically.

3. DESCRIPTIVE VS INTERPRETATIVE USE OF METAPHORIC EXPRESSION BANK

In this chapter we shall start with non-metaphorical descriptive use of the lexeme *bank* and provide a conversational framework (hence the context) which will be used to exemplify its potential metaphorical use. Consider the following exchange:

- (1) A: Do you have the money you owe me?
B: I haven't been to the bank.

Firstly, B's response will be optimally relevant by virtue of answering the question raised (standard expectation created by the asking of a question). In order to arrive at the fully propositional form of B's utterance the following pragmatic processes take place: disambiguation (*bank*), reference assignment (*I*) and free enrichment (the present perfect tense). The explicature would then be *B has not been to the BANK*[recently/since the last time A asked for money, etc.]*.¹ The first highly accessible assumption (implicated premise) which might help to answer A's question is *If a person has not been to the BANK* it is not likely that one can pay the money back*. This (together with the explicature) yields another strong implicature – implicated conclusion *B does not have the money he owes A (because B has not been to the BANK*)*.

¹The asterisk with the concept BANK signals that the communicated concept has been modulated – narrowed to refer to the bank in which the speaker has the account, and (possibly) broadened to include ATM machines as well.

Let us now presume that the lexeme *bank* could be used metaphorically by the speaker to refer to the speaker's mother. In a context where both participants share the common knowledge that the addressee does not have a bank account and is financially dependent on his/her parents, the speaker could use the said lexeme interpretatively to form a propositional constituent which does not contribute to the truth conditions of the proposition expressed. The search for relevance would trigger the pragmatic processes needed for the arriving at the intended interpretation. The explication of B's answer would be:

(1a): 'The speaker hasn't been to „the bank”[as one would say or think]'

It is important to note here that the strong implicatures – implicated premise (1b) and implicated conclusion (1c) – remain the same:

(1b) 'If a person hasn't been to „the bank”[as one would say or think] it is not likely that one could pay the money back'

(1c) 'The speaker does not have the money he owes A (because B hasn't been to „the bank”[as one would say or think])'

Confronted for the first time with the lexeme *bank* being used metaphorically in the described manner, the hearer might need to exert additional cognitive effort to arrive at the interpretation that would satisfy the expectation of relevance created by the asking of the question. This could be linked to the findings made by deliberate metaphor theory (Steen 2008, 2011, 2015, Reijnierse et al. 2019) which puts forward the communicative dimension as relevant and recognizes that not all metaphoric expressions are produced/perceived metaphorically. An interesting parallel can be drawn between the relevance/theoretic approach to metaphor and deliberate metaphor theory – deliberate metaphors can be said to be instances of interpretative language use, and due to repetitive use in a certain language, culture, or community these expressions can become routinised and cease to be attributively used (Manojlović 2022: 224-225). Frequent use of certain metaphoric expressions leads to routinization since it contributes to their cognitive entrenchment, which in turn contributes to decrease in the cognitive effort needed for their interpretation (Mišković-Luković 2014: 353). Having become instances of descriptive use of language these expressions might lose the status of deliberate metaphor. So, there is a continuum between the expressions that are distinctly metaphorical (and used with that intent) and those that are not perceived as being metaphorical (either by the speaker or by the hearer, or both).

In our example it is possible to imagine that referring to B's mother by the use of the lexeme *bank* can become common or frequent within a small community (even if it is only for A and B). This process of routinization would lead to decrease in cognitive effort

needed for interpretation and metaphorically used concept would become descriptively used. The explicature of B's answer in (1) would be:

(1d): The speaker hasn't been to the BANK**.

The communicated ad hoc concept BANK** (that still refers to the speaker's mother) has undergone pragmatic processes of narrowing and broadening so that it now shares very little with the encoded concept bank (presumably the emergent property of being the source of financial funds). This concept is a constituent of the proposition expressed and contributes to the truth conditions of the overall proposition. Again, the implicit content follows the same line of inference as was the case with descriptive non-metaphoric use of the lexeme *bank* (example (1)) and interpretative metaphoric use (in (1b) and (1c)):

(1e): If a person hasn't been to the BANK** it is not likely that one could pay the money back.

(1f): The speaker does not have the money he owes A (because the speaker hasn't been to the BANK**)

This could be taken even further, beyond our constructed context, provided that the routinization of the said metaphoric use persists. Any number of different situations could be imagined where the lexeme *bank* is used metaphorically to refer to a female parent and present a descriptive use of language (EA framework).

(2) A: Do you want to go for a walk after school?

B: I can't, the bank is making casserole.

In example (2) the communicated ad hoc concept BANK** could be used descriptively given that the expression is routinized enough within a given community, i.e., for the given language users.

The importance of routinization has been pointed out within cognitive-pragmatic framework (Mišković-Luković 2013, 2015, Rasulić and Mišković-Luković 2021). However, in what way and to what extent this frequent and prolonged use of an expression can affect its interpretation is a much more difficult question. The search for a definite delimitation between descriptive and interpretative use of language is not only (nearly?) impossible but might also be unnecessary (Manojlović in print). While the same expression can be perceived as metaphorically used and hence an attributive concept by one participant in communication, for someone else it will be an instance of descriptive use of language (or, to put it in cognitive-linguistic terminology, will not require the activation of the source domain). This very important question was raised by deliberate metaphor theory – whether all metaphoric expressions can be equally metaphorical to everyone (Steen 2011). Certain expressions are not problematic in this respect, as is the

case with prepositions that are widely considered non-metaphoric (Steen 2015: 67, Bach 1994: 148). On the other end of this spectrum we would find expressions that are strikingly metaphorical, as is the case with our example (1) taken to mean (1a). Manojlović (in print) proposes that certain expressions present potentially both descriptive and interpretative use of language, depending on the speaker's and hearer's abilities and preferences. Namely, for example, if a hearer is exposed to a novel metaphor or expression, one could assume that the said expression will be treated as an attributive concept whose interpretation will depend on the context and search for relevance (as is the case with all inference). The hearer can then continue to use the said concept without fully developing the descriptive concept. By subsequent use the conceptual address can become filled with information (linguistic, logical and encyclopedic entry) and the said concept can be used descriptively.

4. CONCLUSION

Although the cross-domain mappings between HUMAN and MACHINE or OBJECT are quite frequent, the example of metaphoric use of the lexeme *bank* in this paper was not selected to that end. Even though there is the tendency in recent research of metaphoric expressions to develop a unified and explanatorily adequate approach (since the cognitive pragmatic and the cognitive linguistic approach are considered to be compatible)¹ the aim in this paper was quite different. Examples of non-metaphoric and metaphoric use of the said lexeme here were analyzed with the goal to exemplify the adequacy and applicability of relevance-theoretic approach to metaphor – both the explicature analysis and the modified explicature analysis. Additional analysis of implicit content was conducted with the secondary goal to demonstrate the inadequacy of implicature approach to metaphor.

Examples given illustrate the potential path of any expression used metaphorically – from the first instance of usage (as a novel metaphor so to speak) where it would represent an attributive concept, to the descriptive use of the same expression where it represents a propositional constituent that contributes to the truth conditions (similar to other instances of loose use of language). Further corpus-based research would undeniably contribute to cognitive-pragmatic approach to metaphor production and interpretation.

¹ Namely, according to cognitive linguistics a conceptual metaphor is a cross-domain mapping, i.e., mapping of certain elements of the conceptual structure of the source domain (which is commonly more concrete) onto the target domain (which is commonly more abstract). These mappings are usually grounded in our bodily experience, but not necessarily. For instance, the use of lexeme *bank* to refer to a human being would be an example of a conceptual metaphor PEOPLE ARE OBJECTS/MACHINES, which is grounded in our socio-cultural experience within the metaphoric system GREAT CHAIN OF BEING (Rasulić and Mišković-Luković 2021: 32).

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PERCEPCIJA STUDENATA/STUDENTKINJA O PROFESIJSKIM IMENICAMA ŽENSKOG RODA

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Sažetak:

U radu se ispituje percepcija studenata i studentkinja društvenih nauka Univerziteta Crne Gore o neophodnosti postojanja i upotrebe imenica ženskog roda za zanimanja i zvanja. Nakon kritičkog pregleda dosadašnjih lingvističkih tumačenja spornih tvorbenih modela imenica ženskog roda za označavanje vršiteljki radnji, odnosno nositeljki zanimanja i zvanja, autorke analiziraju stav studenata i studentkinja po ovom pitanju, odnosno izvode zaključke percepcije upotrebe socijalnih femininativa na osnovu anketiranja ispitanika/ispitanica, te njihovog opredjeljenja za formu muškog ili ženskog roda u neutralnoj i konkretnoj upotrebnoj situaciji. U ovom radu podaci će se analizirati metodom deskriptivne statistike, a koristeće se i Pirsonov χ^2 (hi-kvadrat) test, kojim će se ispitati veza između pojedinih posmatranih varijabli.

Ključne riječi: imenice ženskog roda, percepcija, Pirsonov χ^2 test, studenti, Crna Gora

1. UVOD

Javnost, koju bismo mogli nazvati lingvistički laičkom, nije jedinstvena po pitanju upotrebe imenica ženskog roda saznačenjem zvanja i zanimanja, a slično je i sa naučno-stručnim djelatnicima. Dok ih jedni podržavaju i smatraju da izbjegavanje ženskih formi predstavlja vid polne diskriminacije, drugi ih smatraju bespotrebnim i problematizuju im gramatičku pravilnost. Budući da je njihova upotreba u Crnoj Gori regulisana Zakonom o rodnoj ravnopravnosti, ovim radom želimo da ispitamo koliko su studenti upoznati s pravnom regulativom, ali i lingvističkom kodifikacijom ove pojave, te šta najviše utiče na njihovu percepciju odabrane teme. Stoga ćemo u prvom dijelu rada ukazati na stavove referentnih proučavalaca tvorbe i značenja profesijskih imenica ženskog roda, kao i na ključne pravne normative koji obuhvataju njihovu upotrebu. Drugi dio rada predstavlja analizu rezultata ankete, koja će nam dati odgovore na istraživačka pitanja koja se dominantno odnose na percepciju i stav ispitanika po pitanju rodne ravnopravnosti i polne diskriminacije s aspekta upotrebe imenica ženskog roda, a i pokazati da li određeni demografski faktori imaju statistički značajnog uticaja na njihovu percepciju o primjeni rodno senzitivnog jezika.

U nauci o jeziku profesijske imenice ženskog roda izučavaju se i pod drugačijim nazivima, npr. socijalni femininativi, movirani feminini ili femininumi, imenice ženskog roda kategorije nomina agentis et professionis i sl. Svaki od ovih termina podrazumijeva

sufiksne imeničke izvedenice ženskog roda koje imaju značenje profesionalnog statusa (Piper-Klajn 2013, 54), odnosno imenice ženskog roda izvedene pomoću odgovarajućih sufiksa, koje označavaju žensko lice – vršioca radnje ili imaoca zanimanja (Stanojčić-Popović 2002, 139). Sufiksi kojima se izvode feminini od maskulina, tj. imenice ženskog od imenica muškog roda, nazivaju se mocioni, a sam proces derivacije moviranje (Barić 1987, 9–18; Ćorić 1982, 3–17). Jedan od najplodnijih sufiksa ove vrste u posljednje vrijeme je sufiks *-kinja* (Nenezić 2008, 377–385; Burić 2021, 198), te ćemo upravo istraživanje percepcije studenata o odabranoj temi temeljiti na njegovim derivatima.

S obzirom na to da se lingvističko pitanje kojim se u radu bavimo tiče i teme ravnopravnosti polova u društvu, odnosno polne diskriminacije, njegovo rješenje ponuđeno je pravnom regulativom. Naime, prema Zakonu o rodnoj ravnopravnosti, diskriminacija po osnovu pola je svako neposredno ili posredno pravljenje razlike ili nejednako postupanje prema licu ili grupi lica jednog pola u odnosu na lica drugog pola. Tu je uključeno ograničavanje ili davanje prvenstva nekom licu u odnosu na lica drugog pola, što implicira uskraćivanje ljudskih prava i sloboda u građanskom i političkom, ekonomskom, socijalnom, kulturnom i drugim oblastima javnog i privatnog života. Svako seksualno uznemiravanje, podsticanje drugih lica na diskriminisanje po osnovu pola, te i “korišćenje riječi u muškom rodu kao generički neutralne forme za muški i ženski rod”, takođe se smatra polnom diskriminacijom (Član4). Ovim Zakonom rodna ravnopravnost definisana je kao “ravnopravno učešće žena i muškaraca, kao i lica drukčijih rodnih identiteta u svim oblastima javnog i privatnog sektora, jednak položaj i jednake mogućnosti za ostvarivanje svih prava i sloboda i korišćenje ličnih znanja i sposobnosti za razvoj društva, kao i ostvarivanje jednake koristi od rezultata rada” (Član 3). Takođe se, u cilju ostvarivanja rodne ravnopravnosti, Članom 13a propisuje korišćenje rodno osjetljivog jezika u javnoj komunikaciji, odnosno mediji, privredna društva, preduzetnici/ce, sva pravna lica obavezuju se na upotrebu naziva radnih mjesta, zanimanja, zvanja i funkcija u prirodnom rodu (muškom ili ženskom) lica na koje se akti (o izboru, imenovanju i sl.) odnose.

Pravni propisi su, za razliku od lingvističkih, strogi i predviđaju čak novčane kazne za pravna lica, kao i odgovorna lica u pravnom licu, odnosno državnom ili organu lokalne samouprave (Član 33a), koja u svom radu ne koriste rodno osjetljivi jezik na način na koji su obavezni po referentnom Zakonu, tj. kada za zanimanja, zvanja i funkcije koje obavljaju konkretna ženska lica ne koriste odgovarajuće imenice ženskog roda.

Nije nam poznato da je neko kažnjen zato što nije postupao u skladu sa Zakonom o rodnoj ravnopravnosti, ali sudeći po jeziku publicistike, administracije, medijskih portala i društvenih mreža – njihovi korisnici, odnosno stanovništvo Crne Gore slabo je upoznato sa njegovim sadržajem, pogotovo u segmentu koji se tiče profesijskih imenica ženskog roda. Imajući u vidu da je upravo omladina najveći konzument elektronskih medija i društvenih mreža, istraživanje smo usmjerili na informisanost i percepciju mlađe populacije, tj. onog njenog dijela koji studira fakultete društvenih nauka.

Ovim radom testiraće se sledeće hipoteze:

H1: Da li demografski faktori poput pola, sredine i regije imaju statistički značajnog uticaja na percepciju studenata/kinja o profesijskim imenicama ženskog roda i polnoj diskriminaciji u jeziku?

H2: Da li vrsta studija ima statistički značajnog uticaja na percepciju studenata/kinja o profesijskim imenicama ženskog roda i polnoj diskriminaciji u jeziku?

Takođe, analizom anketnih podataka, daće se i odgovori na sledeća istraživačka pitanja:

IP1: Koji su ključni izvori informisanja o rodnoj ravnopravnosti i polnoj diskriminaciji?

IP2: U kojoj mjeri su ispitanici upoznati sa zakonskom regulativom pitanja jezičkog seksizma i osnovnim

pojmovima poput rodne ravnopravnosti i polne diskriminacije?

IP3: Kakav je stav ispitanika o neophodnosti postojanja i upotrebe imenica ženskog roda za zanimanja i zvanja? IP4: Za koje forme se ispitanici opredjeljuju u neutralnoj, tj. apstraktnoj upotrebnoj situaciji (muška i/ili ženskaforma, npr. u konkursima) i iz kojih razloga?

IP5: Za koje forme se ispitanici opredjeljuju u konkretnoj upotrebnoj situaciji (muška ili ženska forma, npr. kada se referiše na određeno žensko lice) i iz kojih razloga ?

IP6: Koje forme ispitanici smatraju neuobičajenim?

Odabrana tema je posebno relevantna jer se odnosi na jezičku praksu i društvenu jednakost, a samo istraživanje pruža novi pogled o tome kako različiti faktori mogu uticati na percepciju jezičke diskriminacije. U tom smislu, naučni doprinos ovog istraživanja nalazi se u činjenici da se ovo pitanje, iz ugla koji smo odabrali, po prvi put istražuje u sredini koja tradicionalno ima čvrste patrijarhalne obrasce, kao što je Crna Gora. Taj kontekst dodaje poseban značaj istraživanju, jer omogućava da se ispita percepcija studenata/kinja u okruženju u kojem su rodne uloge još uvijek strogo podijeljene, a time i jezička diskriminacija potencijalno prisutnija. Budući da je ovo prvi rad ove vrste u Crnoj Gori, samo istraživanje značajno dopunjuje literaturu u referentnim oblastima. Rezultati istraživanja mogu pomoći u boljem razumijevanju kako društveni kontekst i obrazovanje mogu oblikovati percepciju jezičke diskriminacije, te pružiti osnovu za razvoj ciljanih intervencija ili politika koje bi mogle smanjiti ili prevazići polnu diskriminaciju u jeziku.

2. PREGLED LITERATURE

Najveći dio normativne, ali i ostale referentne naučne literature, nedvosmisleno upućuje na neophodnost postojanja profesijskih imenica koje označavaju lica ženskog pola i afirmiše njihovu upotrebu. Tako se u gramatici grupe autora na čijem čelu je hrvatska lingvistkinja Eugenija Barić, paralelno sa imenicama kategorije nomina agentis et professionis koje znače mušku osobu, navode i imenice koje znače žensku osobu, odnosno kako tamo stoji: “vršiteljicu radnje” (Barić i dr. 1979, 243–247). Tvrdi se takođe da su ove posljednje motivisane najčešće imenicama koje znače muško lice (*car – carica*), ali

mogu biti izvedene i od drugih vrsta riječi, za šta se u pomenutoj gramatici navodi pomalo bizaran primjer *tumarača*, što je tvorenica od glagola *tumarati* (Barić i dr. 1979, 246). Kao najplodniji sufiks kojim se izvode imenice ženskog roda navodi se *-ica*, dok se sufiks *-kinja* u vrijeme kada je gramatika objavljena, tj. prije četrdesetak godina, smatrao slabije plodnim (Barić i dr. 1979, 246–247), što je suprotno sadašnjem stanju u Crnoj Gori (Nenezić 2008, 377–385).

Sličnog je stava i Živojin Stanojčić prema čijoj klasifikaciji ove imenice pripadaju potkategoriji “izvedene imenice sa značenjem ženskog lica – vršioca radnje, imaoca zanimanja i sl.” (Stanojčić-Popović 2002, 139). On navodi da referentne imenice mogu biti motivisane glagolima (što egzemplifikuje brojnim formama poput *pralja*, *vračara*, *čitateljka*), kao i imenicama muškog roda (što, takođe, ilustruje brojnim primjerima među kojima su i *profesorka*, *profesorica*, *stomatološkinja*). Za poslednje navedene imenice pomenuti autor kaže da “imaju isto značenje kao i imenice m.r. koje su im motivne reči, uz informaciju da je reč o ženi – vršiocu radnje, odnosno imaocu zanimanja” (Stanojčić-Popović 2002, 140).

Autori “Gramatike crnogorskog jezika” iz 2010. godine drže se slične semantičke podjele, koju su, kada je riječ o ženskim licima, oprimjerili brojnim formama od kojih izdvajamo *asistentica*, *poslanica*, *lingvistkinja*, *psihologica*, *psihološkinja*, *doktorica*, *doktorka* (Čirgić-Pranjeković-Silić 2010, 141–42).

Pomenućemo i čuvenu Stevanovićevu gramatiku kojom su profesijske imenice ženskog roda implicitno normirane još prije šest decenija. Stevanović, naime, objašnjava da se imenice poput *blagajnica*, *sekretarica*, *ministarka*, tj. “novi oblici za označavanje prirodnog roda uvode posle promene socijalnog položaja žene, posle njenog izjednačenja s čovekom – muškarcem, kada je stupila na dužnosti čiji se nosioci označavaju napred navedenim imenicama”, tj. imenicama *blagajnik*, *sekretar*, *ministar*. On eksplicitno tvrdi da pomenute imenice gramatičkog muškog roda označavaju lica oba pola, ali i da je uzrok njihove upotrebe za označavanje ženskih lica – “doskorašnji položaj žene kod nas”, odnosno njeno doskorašnje odsustvo iz pojedinih profesija i društveno-političkog angažmana, te da su u upotrebi i imenice ženskog roda (Stevanović 1962, 80; Stevanović 1964, 174).

Autori jedne od recentnih normativnih gramatika generalno nijesu protiv upotrebe socijalnih femininativa, međutim, smatraju da bi “insistiranje na polu bilo neumesno” onda “kada je pol nebitan” i objašnjavaju da se u rečenici *Studenti su dužni da dolaze na predavanja* imenica *studenti* odnosi na lica oba pola (Piper-Klajn 2013, 54). Tvrde da imenice muškog roda mogu referisati na lice muškog, ali i ženskog pola, za šta navode primjer Milica je *student*, uz napomenu da je ispravno i Milica je *studentkinja*. Socijalni femininativi poput *učiteljica*, *plivačica*, *pjevačica* po njima su u širokoj upotrebi i stilski neutralni, dok su *doktorka*, *profesorka*, *šefica* prisutni u razgovornom, ali se izbjegavaju u ostalim stilovima, kada se umjesto njih “upotrebljavaju odgovarajuće imenice muškog

roda u kontekstu koji pokazuje da se te imenice odnose na osobe ženskog pola, npr. *Ona je odličan profesor*” (Piper-Klajn 2013, 54–55). Dakle, neophodnost upotrebe profesijskih imenica dovedena je u pitanje i u neutralnim i u konkretnim situacijama, s tim što ostaje nejasno zašto se izbjegava socijalni femininativ u rečenici *Ona je odlična profesorka*, kada je već konstatovano da je ispravno reći *Milica je studentkinja*. S druge strane, sasvim je jasno da autori ove gramatike ne podržavaju tzv. nove socijalne femininative poput *borkinja*, *meteorološkinja*, *knjigovotkinja* jer kažu da ih “upotrebljavaju oni koji smatraju politički nužnim da za svaki društveni status postoji imenica ženskog roda, a ako je u jeziku nema, da takvu imenicu treba napraviti” (Piper-Klajn 2013, 55). Takođe zastupaju mišljenje da procesi uzualizacije “spornih” formi variraju u zavisnosti od vrste funkcionalnog stila, te da takve procese ne treba vještački ni ubrzavati ni usporavati (Piper-Klajn 2013, 55–56), sa čim smo saglasni.

Suprotno njima, najvatrenije pristalice ženskih formi profesijskih imenica smatraju da ih treba normirati, jer ukoliko se referentnom literaturom propiše korišćenje muških formi i za ženska lica, žena će ostati nediljiva u društveno- političkoj sferi, što predstavlja jedan vid verbalnog seksizma, odnosno polne diskriminacije putem jezika (Savić 1999, 4; Savić 2006, 72–87). Istraživanja sprovedena na jeziku medija pokazala su da se forme muškog roda koriste kada se odnose na ženu čije ponašanje se afirmiše, dok se profesijskim imenicama ženskog roda nerijetko upućuje na ženska lica čije ponašanje se osuđuje ili je društveno neprihvatljivo. Da bi se izbjegla ovakva vrsta manipulacije na štetu žena, lingvistkinja Svenka Savić zalaže se za obavezivanje korisnika jezika na upotrebu ženskih formi kod pisanja naziva titula i zvanja žena (*docentkinja*, *doktorka*), a u tzv. apstraktnim situacijama predlaže princip simetrije, tj. paralelnu upotrebu muških i ženskih formi (*profesor/profesorka*) ili neutralizacije (iskazivanje funkcije neutralnom formom *profesura* umjesto polno markiranih *profesor* i *profesorka/profesorka*) (Savić 1999, 20). Nešto drugačije rješenje nudi već pominjana hrvatska naučnica Eugenija Barić, koja za opšte ili neutralne upotrebne situacije, poput konkursa i formulara, dopušta muški lik imenice kao vid ekonomisanja jezičkim sredstvima, dok za pojedinačne ili konkretne upotrebne situacije predlaže ženski lik profesijske imenice (npr. uz žensko lično ime) (Barić 1987, 15–16). Istina je da imenice muškog roda sa semantikom zanimanja i zvanja imaju širi semantički opseg od imenica ženskog roda (Ćorić 2008, 205), ali uzrok ove pojave nije u “prirodi” jezika, već ga treba tražiti u nekadašnjoj inferiornosti žene u društvu pa i porodici, kada je njena uloga bila marginalizovana i kada su muškarci obavljali većinu zanimanja, pa nije ni postojala mogućnost formiranja ženskih likova imenica. Kada žene počnu da obavljaju iste poslove kao i muškarci, javlja se i potreba za odgovarajućim nazivima u ženskom rodu. Oni u početku zvuče neobično, a dok se ustale, naporedo se upotrebljavaju već postojeće muške, odnosno tzv. generičke forme koje referišu na lica oba pola. Premda se tzv. novim socijalnim femininativima (npr. *psihološkinja*, *psihologica*, *stomatološkinja*, *borkinja*, *sutkinja*, *vodičkinja*) prigovara da su movirani po neobičnom modelu, da su rogobatni, dvosmisleni (npr. *ministarka*, *poslanica*), teško izgovorljivi ili da zvuče neumjesno (Ćorić 2008, 202–208), tvorbeno-semantička analiza konkretnih derivata pokazala je da primjedbe nijesu naučno fundirane,

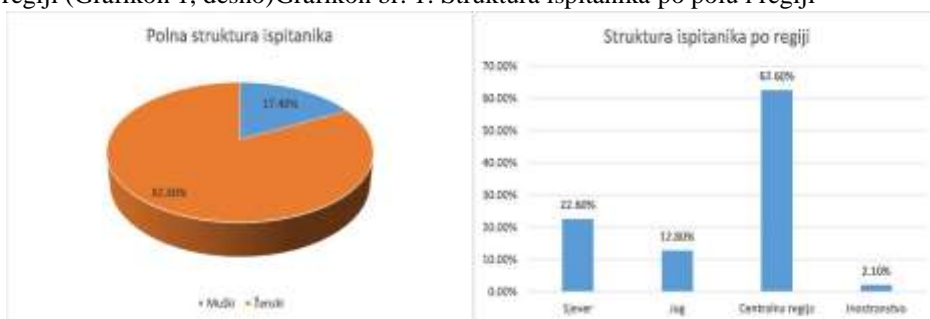
već motivisane individualnom percepcijom i stečenim navikama (Burić 2022, 480–487; Burić 2021, 197–213; Stanojčić-Popović 2002, 140–141; Babić 1986: 253; Klajn 2003, 106).

3. METODOLOGIJA ISTRAŽIVANJA I PODACI

Istraživanje percepcije studenata o profesijskim imenicama ženskog roda, urađeno je anketiranjem studenata društvenih nauka Univerziteta Crne Gore, putem vibera i mejla, u martu i aprilu 2023. godine. Ispitano je ukupno 390 studenata od kojih je 82,6% ženskog, odnosno 17,4% muškog pola. Ispitanici dominantno dolaze iz centralne regije Crne Gore (62,6%), zatim sjeverne (22,6%), a najmanje ih je sa juga Crne Gore (12,8%), odnosno inostranstva (2,1%). U strukturi ukupnog broja ispitanika najviše je onih koji studiraju Filološki fakultet (55,9%), dok su ostali ispitanici sa Filozofskog fakulteta (15,9%), Fakulteta za političke nauke (11,8%), Ekonomskog fakulteta (10,3%) i ostalih fakulteta za društvene nauke (6,1%).

Činjenica da je najviše ispitanika sa Filološkog fakulteta, koji dominantno upisuju lica ženskog pola, upravo i objašnjava njihovo značajno učešće u uzorku. Najviše ispitanika dolazi iz centralne regije, zatim sjeverne, a najmanje sa juga Crne Gore. Ovakav odnos približno odgovara zatupljenosti stanovništva po regijama. Naime, centralna Crna Gora zauzima 35% državne teritorije, sa oko 45% ukupnog stanovništva. Na sjeveru Crne Gore, na nešto više od polovine državne teritorije, živi manje od jedne trećine stanovništva Crne Gore. Na Crnogorskom primorju, na približno jednoj desetini državne teritorije, živi oko jedne četvrtine stanovništva Crne Gore.

Na narednom grafikonu prikazana je strukura ispitanika po polu (Grafikon 1, lijevo) i regiji (Grafikon 1, desno)Grafikon br. 1: Struktura ispitanika po polu i regiji



Izvor: Obrada autora

4. REZULTATI ISTRAŽIVANJA

Anketa je koncipirana na način da se, pored segmentacije ispitanika prema demografskim karakteristikama, ispita i njihova informisanost i percepcija po pitanju polne diskriminacije i rodne ravnopravnosti u jeziku.

Ključni izvori informisanja ispitanika o rodnoj ravnopravnosti prikazani su u Tabeli 1 iz koje se može uočiti da je najveći broj studenata o rodnoj ravnopravnosti informisan putem društvenih mreža 38,5%, a zatim iz štampanih i elektronskih medija 32,8%. Ovakav rezultat je očekivan s obzirom na to da se radi o onom dijelu populacije koja je najveći korisnik društvenih mreža i elektronskih medija.

Tabela br.1 : Izvori informisanja ispitanika

Izvori informisanja	Broj	%
mediji (štampani, elektronski)	128	32,8
pravni propisi	4	1,0
društvene mreže	150	38,5
porodica	30	7,7
škola/fakultet	42	10,8
nisam informisan/a	6	1,5
ostalo	30	7,7
Ukupno	390	100,0

Izvor: Obrada autora

Rezultati istraživanja pokazuju da su ispitanici u velikoj mjeri upoznati s konceptima rodna ravnopravnost i polna diskriminacija, ali da suštinsko razumijevanje ovih pojmova većina ispitanika ipak nema. Takođe, samo 40% ispitanika zna da postoji Zakon o rodnoj ravnopravnosti, dok samo 21% njih smatra da postoji zakon koji korisnike jezika obavezuje na upotrebu rodno senzitivnog, tj. rodno nediskriminatornog jezika.

Čak 92,8% ispitanika odgovorilo je da rodna ravnopravnost podrazumijeva ravnopravno učešće žena i muškaraca, kao i lica drukčijih rodni identiteta u svim oblastima javnog i privatnog sektora, jednak položaj i jednake mogućnosti za ostvarivanje svih prava i sloboda kako u privatnom tako i u profesionalnom životu, dok 6,2% ispitanika rodnu ravnopravnost doživljava kao jednakost muškaraca i žena isključivo u društvenom i političkom životu. Samo 4 ispitanika, ili 1% ukupnog broja, naveli su da ne znaju šta ovaj pojam znači. Takođe, 91,3% ispitanika smatra da je diskriminacija po osnovu pola (seksizam) nejednako postupanje prema licu (ili licima) jednog pola u odnosu na lica drugog pola, odnosno ograničavanje prava i sloboda jednom licu (ili licima) u odnosu na lica drugog pola, u oblastima javnog i privatnog života, kao i seksualno uznemiravanje.

Grafikon br. 2: Razumijevanje pojma diskriminacija po osnovu pola

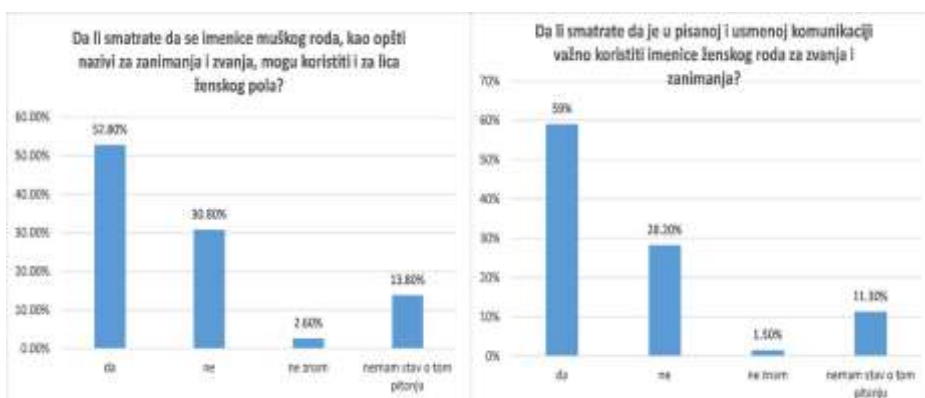


Izvor: Obrada autora

Da suštinsko razumijevanje pojma diskriminacije po osnovu pola većina ispitanika ipak nema, jasno pokazuju odgovori na pitanja prikazana Grafikonom br. 2.

Većina ispitanika (59%) je stava da je u pisanoj i usmenoj komunikaciji važno koristiti imenice ženskog roda za zvanja i zanimanja, dok takođe većina njih (52,8%) smatra da se imenice muškog roda, kao opšti nazivi za zanimanja i zvanja, mogu koristiti i za lica ženskog pola (Grafikon br.3.)

Grafikon br.3: Stav ispitanika o upotrebi imenica ženskog roda za zanimanja i zvanja



Izvor: Obrada autora

Takođe stav većine ispitanika je da ženska lica nisu diskriminisana ukoliko se za njihova zanimanja i zvanja koriste imenice muškog roda, što pokazuje i Tabela br. 2.

Tabela br. 2: Stav ispitanika po pitanju diskriminacije ženskih lica

Diskriminacija postoji ukoliko se za zanimanja i zvanja koriste imenice muškog roda	Broj	%
da	132	33,8
ne	218	55,9
ne znam	18	4,6
nemam stav o tom pitanju	22	5,6
Total	390	100,0

Izvor: Obrada autora

Za koje forme se ispitanici opredjeljuju u neutralnoj, tj. apstraktnoj upotrebnoj situaciji (muška i/ili ženska forma, npr. u konkursima) pokazuje Tabela br. 3, a koji su razlozi za takvo opredjeljenje, Grafikon br. 4.

Tabela br. 3: Izbor forme u neutralnoj, tj. apstraktnoj upotrebnoj situaciji

Ukoliko neka ustanova raspisuje konkurs za zaposlenje osobe koja je diplomirala na fakultetu za psihologiju, tekst treba da glasi:	Broj	%
raspisuje se Konkurs za psihologa	100	25,6
raspisuje se Konkurs za psihologa/psihologicu	46	11,8
raspisuje se Konkurs za psihologa/psihološkinju	244	62,6
Ukupno	390	100,0

Izvor: Obrada autora

Tabela br. 3 jasno pokazuje da većina ispitanika (62,6%) bira formu koja glasi: „Raspisuje se Konkurs za psihologa/psihološkinju“, dok su razlozi izbora različiti što pokazuje Grafikon br. 4. Zanimljivo je i to da je prednost data formi *psihološkinja* (koju pojedini lingvisti smatraju spornom sa stanovišta derivacije) nad dubletom *psihologica* (čija se ispravnost takođe dovodi u pitanje).

Grafikon br. 4: Razlozi izbora forme u apstraktnoj upotrebnoj situaciji



Izvor: Obrada autora

Forme za koje se ispitanici opredjeljuju u konkretnoj upotrebnoj situaciji (muška ili ženska forma, npr. kada se referiše na određeno žensko lice) prikazani su u Tabeli br. 4, dok se razlozi za takvo opredeljenje mogu uočiti u Grafikonu br. 5.

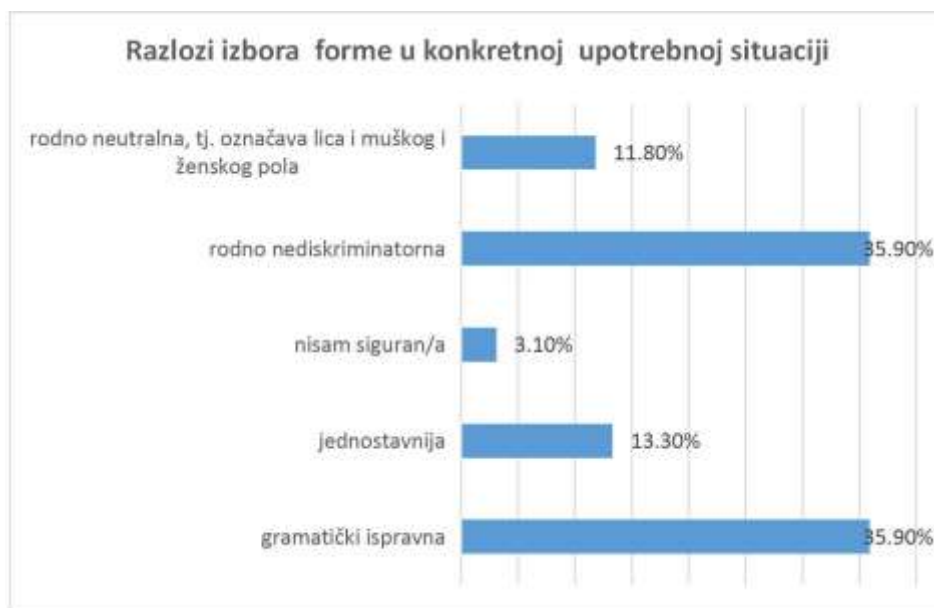
Tabela br. 4: Izbor forme u konkretnoj upotrebnoj situaciji

Ukoliko nas je o odlaganju nekog ispita obavijestila žena koja asistira na predavanjima, reći ćemo:	Broj	%
asistent nas je obavijestila o odlaganju ispita	32	8,2
asistent nas je obavijestio o odlaganju ispita	30	7,7
asistentkinja nas je obavijestila o odlaganju ispita	328	84,1
Ukupno	390	100,0

Izvor: Obrada autora

Tabela br. 4 jasno pokazuje da većina ispitanika (84,1%) bira formu koja glasi: „Asistentkinja nas je obavijestila o odlaganju ispita“, dok su razlozi izbora različiti, što pokazuje Grafikon br.5.

Grafikon br. 5: Razlozi izbora forme u konkretnoj upotrebnoj situaciji



Izvor: Obrada autora

Interesantno je naglasiti da je na pitanje koju formu treba koristiti za ženu koja se bavi lovom, 44,6% ispitanika odgovorilo „lovac“, 27,7% „lovkinja“, a 27,7% je dalo odgovor „ne znam“.

Poslednje istraživačko pitanje odnosilo se na jezičku formu koja ispitanicima zvuči najneobičnije (Tabela br. 5). Najveći broj njih (218 ispitanika) odgovorilo je da je to riječ „vodičkinja“, dok je najmanji broj ispitanika, njih 16, navelo riječ „arhitektica“.

Tabela br. 5: Neobična jezička forma

Najneobičnija jezička forma	Broj	%
arhitektica	16	4,1
arhitektkinja	20	5,1
borkinja (za ljudska prava)	86	22,1
nijedna od navedenih	50	12,8

vodičkinja	218	55,9
Total	390	100,0

Izvor: Obrada autora

Da bi se odgovorilo na hipoteze postavljenje u radu, potrebno je sprovesti hi-kvadrat test kojim se utvrđuje da li postoji povezanost između demografskih faktora i vrste studija sa percepcijom studenata o profesijskim imenicama ženskog roda.

Kroz odgovore na pitanja “Da li smatrate da je u pisanoj i usmenoj komunikaciji važno koristiti imenice ženskog roda za zvanja i zanimanja?”, te “Da li smatrate da su ženska lica diskriminisana ukoliko se za njihova zanimanja i zvanja koriste imenice muškog roda?”, hi-kvadrat testom ispitana je povezanost između pola i percepcije koju ispitanici imaju po ovom pitanju.

Tabela br. 6: Povezanost pola i stava o diskriminaciji prilikom korišćenja profesijskih imenica za žene

		Da li smatrate da je u pisanoj i usmenoj komunikaciji važno koristiti imenice ženskog roda za zvanja i zanimanja?				Ukupno
		da	ne	ne znam	nemam stav o tom pitanju	
Vaš pol je:	muški	24	30	2	12	68
	ženski	206	80	4	32	322
Ukupno		230	110	6	44	390

Izvor: Obrada autora Tabela br. 7: Hi-kvadrat test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.236	3	.000
Likelihood Ratio	18.934	3	.000

Izvor: Obrada autora

Iz Tabele br. 6 nedvosmisleno se uočava da je učešće ispitanika muškog pola koji ne smatraju da je u pisanoj i usmenoj komunikaciji važno koristiti imenice ženskog roda (44%) mnogo veće od pripadnika ženskog pola (24%).

Rezultati hi kvadrat testa (hi-kvadrat statistika – 19,236) potvrđuju da postoji statistički značajna povezanost između pola i stava ispitanika po pitanju potrebe za korišćenjem imenica ženskog roda. Očigledno, veću potrebu za korišćenjem imenica ženskog roda imaju pripadnice ženskog pola u odnosu na pripadnike muškog pola.

Tabela br. 8: Povezanost pola i stava o diskriminaciji prilikom korišćenja profesijskih imenica za žene

		Da li smatrate da su ženska lica diskriminisana ukoliko se za njihova zanimanja i zvanja koriste imenice muškog roda?				Total
		da	ne	ne znam	nemam stav otom pitanju	
Vaš pol je:	muški	14	46	8	0	68
	ženski	118	172	10	22	322
Ukupno		132	218	18	22	390

Izvor: Obrada autora

Učešće osoba ženskog pola koje smatraju da su ženska lica diskriminisana ukoliko se za njihova zanimanja i zvanja koriste imenice muškog roda je veće nego kod osoba muškog pola. Naime, oko 48% lica ženskog pola smatra da je ovakvo ponašanje diskriminatorsno, dok oko 32% lica muškog pola dijeli to mišljenje.

Tabela br. 9: Hi-kvadrat test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.078	3	.000
Likelihood Ratio	22.248	3	.000

Izvor: Obrada autora

U Tabeli br. 9 prikazani su rezultati hi-kvadrat testa koji potvrđuju statistički značajnu razliku u percepciji između osoba različitog pola.

S druge strane, hi-kvadrat testom ne možemo potvrditi da postoji povezanost percepcije i regije (sredine) iz koje ispitanici dolaze.

Tabela br. 10: Povezanost regije i stava o diskriminaciji prilikom korišćenja profesijskih imenica za žene

		Da li smatrate da je u pisanoj i usmenoj komunikaciji važno koristiti imenice ženskog roda za zvanja i zanimanja?				Ukupno
		da	ne	ne znam	nemam stav o tom pitanju	
Na studije dolazim iz:	centralne regije Crne Gore	146	68	4	26	244
	inostranstva	6	2	0	0	8
	južne regije Crne Gore	26	16	0	8	50
	sjeverne regije Crne Gore	52	24	2	10	88
Ukupno		230	110	6	44	390

Izvor: Obrada autora

Posmatrajući rezultate u Tabeli br. 10, odgovori ispitanika na pitanje o važnosti korišćenja imenica ženskog roda u pisanoj i usmenoj komunikaciji pokazuju približno ujednačeno učešće u stavovima kroz različite regije.

Tabela br. 11: Hi-kvadrat test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.304	9	.890
Likelihood Ratio	5.926	9	.747

Izvor: Obrada autora

Prema Tabeli br. 11, kroz rezultat hi-kvadrat testa, ne možemo da tvrdimo da postoji statistički značajna povezanost između regije i percepcije ispitanika po ovom pitanju, dok je takva povezanost prethodno potvrđena među ispitanicima različitog pola.

Tabela br. 12: Povezanost regije i stava o diskriminaciji prilikom korišćenja profesijskih imenica za žene

		Da li smatrate da su ženska lica diskriminisana ukoliko se za njihova zanimanja i zvanja koriste imenice muškog roda?				Ukupno
		da	ne	ne znam	nemam stav o tom pitanju	
Na studije dolazim iz:	centralne regije Crne Gore	84	132	12	16	244
	inostranstva	2	6	0	0	8
	južne regije Crne Gore	16	30	4	0	50
	sjeverne regije Crne Gore	30	50	2	6	88
Ukupno		132	218	18	22	390

Izvor: Obrada autora

Slični su odgovori na pitanje “Da li smatrate da su ženska lica diskriminisana ukoliko se za njihova zanimanja i zvanja koriste imenice muškog roda?”. Učešće odgovora “NE” kojim ispitanici iskazuju stav da ne postoji diskriminacija ukoliko se za ženska lica koriste imenice muškog roda za njihova zanimanja i zvanja, prilično je ujednačeno po regijama.

Nepostojanje statističke povezanosti između regije i percepcije potvrđeno je upotrebom hi-kvadrat testa (Tabela br. 13). Test statistika u vrijednosti od 7,645 upućuje na zaključak da ne možemo odbaciti nultu hipotezu o nepostojanju statistički značajne veze između dvije posmatrane pojave.

Tabela br. 13: Hi-kvadrat test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.645	9	.570
Likelihood Ratio	11.237	9	.260

Izvor: Obrada autora

Ako se percepcija, kroz odgovore na prethodna pitanja, posmatra iz ugla studija koje studenti pohađaju, hi kvadrat testom možemo potvrditi da postoji značajna povezanost, tj. da ta percepcija zavisi od studija koje izučavaju.

Tabela br. 14: Povezanost studija i stava o diskriminaciji prilikom korišćenja profesijskih imenica za žene

		Da li smatrate da je u pisanoj i usmenoj komunikaciji važno koristiti imenice ženskog roda za zvanja i zanimanja?				Ukupno
		da	ne	ne znam	nemam stav o tom pitanju	
Oblast studija:	Ekonomski fakultet	16	18	0	6	40
	Filološki fakultet	138	58	4	18	218
	Filozofski fakultet	36	18	0	8	62
	Ostalo	4	4	0	6	14
	Političke nauke	32	8	2	4	46
	Pravni fakultet	4	4	0	2	10
Ukupno		230	110	6	44	390

Izvor: Obrada autora

Stavovi po pitanju važnosti korišćenja imenica ženskog roda za zvanja i zanimanja variraju među studentima različitih studija. Tako npr. studenti Filološkog fakulteta i Fakulteta političkih nauka u mnogo većem procentu smatraju da je važno koristiti imenice ženskog roda, nego što to misle studenti ostalih fakulteta.

Tabela br. 15: Hi-kvadrat test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	33.581	15	.004
Likelihood Ratio	30.036	15	.012

Izvor: Obrada autora

U Tabeli br. 15 hi-kvadrat testom potvrđeno je postojanje statističke povezanosti između studija koji studenti izučavaju i stava po pitanju važnosti korišćenja imenica ženskog roda. Ipak, treba biti obazriv u interpretaciji ovog istraživačkog pitanja zato što na prezentovani stav može više uticati činjenica da neke od studija dominantno upisuju lica ženskog pola, pa bi odgovor mogao biti nedovoljno pouzdan.

Tabela br. 16: Povezanost studija i stava o diskriminaciji prilikom korišćenja profesijskih imenica za žene

		Da li smatrate da su ženska lica diskriminisana ukoliko se za njihova zanimanja i zvanja koriste imenice muškog roda?				Ukupno
		da	ne	ne znam	nemam stav o tom pitanju	
Oblast studija:	Ekonomski fakultet	10	26	0	4	40
	Filološki fakultet	70	126	12	10	218
	Filozofski fakultet	24	34	4	0	62
	Ostalo	2	10	0	2	14
	Političke nauke	24	16	0	6	46
	Pravni fakultet	2	6	2	0	10
Ukupno		132	218	18	22	390

Izvor: Obrada autora

Odgovori po pitanju stava da li je diskriminatorno ukoliko se za zanimanja i zvanja koriste imenice muškog roda, slični su odgovorima na prethodno pitanje. Razlike su potvrđene i hi-kvadrat testom kojim se pokazuje da postoji statistički značajna povezanost između vrste studija i stava po pitanju diskriminacije prilikom upotrebe imenica muškog roda za zvanja i zanimanja ženskih lica.

Tabela br. 17: Hi-kvadrat test

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	36.047	15	.002
Likelihood Ratio	40.769	15	.000

Izvor: Obrada autora

5. ZAKLJUČAK

Pitanja rodne ravnopravnosti i verbalnog seksizma globalno su značajna i aktuelna budući da se tiču čovječijih prava. Činjenica da se regulišu ne samo pravnim već i lingvističkim

propisima, ukazuje na kompleksnost pronalaženja srećnog i primjenjivog rješenja. Dodatnu komplikaciju predstavlja neupućenost jezičkih korisnika u postojeću regulativu.

Naše istraživanje pokazalo je da je studentska populacija u najvećoj mjeri o rodnoj ravnopravnosti i seksizmu informisana preko društvenih mreža i medija (više od 70%), a najmanje iz pravnih propisa (svega 1%). Ispitanici razumiju šta generalno podrazumijevaju pomenuti pojmovi, ali svega 21% njih zna da se referentnim zakonskim normama obuhvata i rodna ravnopravnost u jeziku, a čak više od polovine ispitanika smatra da se imenice muškog roda, kao opšti nazivi za zanimanja mogu koristiti i za lica ženskog pola (što pravna regulativa jednim svojim dijelom isključuje, za razliku od lingvističke koja toleriše, odnosno ne zabranjuje). Visok je procenat (55,9%) i onih koji smatraju da žene nijesu diskriminisane ako se za njihova zanimanja i zvanja koriste imenice muškog roda. S druge strane, skoro tri četvrtine anketiranih opredijelilo se za tzv. princip simetrije, tj. paralelnu upotrebu muških i ženskih formi u neutralnoj upotrebnoj situaciji, kakva je tekst konkursa za zaposlenje. U konkretnoj upotrebnoj situaciji, tj. kada se referiše na određeno žensko lice, dominira opredjeljenje za profesijsku imenicu u ženskom rodu (čak 84,1%). Kada je riječ o percepciji formi za koje jedan dio lingvističkih proučavalaca smatra da su sporne, studenti najneobičnijim smatraju imenice izvedene od domaćih riječi, dok su njihovom jezičkom osjećanju derivati od stranih osnova bliži.

Hi-kvadrat testom potvrđeno je da postoji statistički značajna povezanost između pola i stava ispitanika o neophodnosti korišćenja imenica ženskog roda, jer se pokazalo da u većoj mjeri žene smatraju da je u komunikaciji važno koristiti ženske forme. Ženski pol je značajno procentualno zastupljeniji i kada je u pitanju stav o postojanju diskriminacije ukoliko se za žene koriste muške forme. Test, s druge strane, nije potvrdio da regionalna pripadnost ima uticaj na percepciju pripadnika i pripadnica studentske populacije po ovim pitanjima.

Hi-kvadrat test je potvrdio da vrsta studija utiče na stavove o neophodnosti korišćenja referentnih naziva ženskog roda i postojanju verbalnog seksizma ukoliko se oni ne koriste. Naime, studenti i studentkinje Filološkog i Fakulteta političkih nauka, u većoj mjeri od onih koji studiraju na ostalim fakultetima, naglašavaju važnost upotrebe ženskih formi kao i diskriminatoran odnos prema ženama ako se na njih upućuje muškim formama, s tim što valja imati u vidu da oba navedena fakulteta upisuju pretežno lica ženskog pola.

Opšti je zaključak da, iako nešto više od polovine anketiranih smatra da žene nijesu diskriminisane ako se za njihovo zvanje i zanimanje upotrebljavaju imenice muškog roda, ipak su se u mnogo većem procentu opredijelili za ženske likove profesijskih imenica u praktičnoj primjeni (i u konkretnim i u neutralnim upotrebnim situacijama), zato što ih smatraju gramatički ispravnim i rodno nediskriminatornim.

Ova studija pruža mogućnost da se otvore nove diskusije o rodnoj ravnopravnosti, jezičkoj praksi i društvenim promjenama u Crnoj Gori. Kroz istraživanje ove teme može se

podstaći osvješćivanje važnosti uklanjanja polne diskriminacije u jeziku i kreiranja ambijenta jednakih mogućnosti za sve.

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STUDENTS' PERCEPTION ON FEMININE NOUNS DENOTING PROFESSION

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ABSTRACT:

The paper examines perception of students of social studies of the University of Montenegro on necessity of existence and use of feminine nouns for professions and professional titles. Upon critical review of former linguistic interpretations of disputed formative models of feminine nouns denoting female performers of actions, that is holders of professions and professional titles, authors analyze standpoints of students on this matter, and conclude perception of use of referential social feminines pursuant to determination of respondents regarding the form of masculine and feminine gender in neutral and specific usage situation. Data in this paper will be processed by the methods of descriptive statistics, and in certain instances Pirson's χ^2 (hi-square) test will be used, by which examination on statistically important connection between two observed variables will be examined.

Keywords: *feminine nouns, perception, students, Montenegro*

WAY OF THINKING AND SKILLS AS CHALLENGES IN A TURBULENT BUSINESS ENVIRONMENT

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ABSTRACT:

Earthquakes caused by functioning in a turbulent environment require organizations to respond promptly, become resilient, and build tools that will help them go through the process of transformation, survive and even flourish in what we call the permacrisis. How to reinvent business, processes, business model, and brand, if we take into account that a lot of changes in the environment? How to respond to the demands of consumers, employees, suppliers, business partners, the community, and the growing competition? How to create a blue ocean of creating additional value for new consumers? We hear more and more terms like resilience, re-innovation, agile leadership, co-creation, collaboration, and lifelong learning which rely on new models and skills necessary for managing a team and organization in the first half of the 21st century. The paper analyzes the way of thinking and skills needed to progress in a world of insecurity that should assist employees and leaders in solving modern and everyday challenges.

Keywords: re-innovate, business model, added value, co-creation, lifelong learning

1. INTRODUCTION

Exponentially changing technology and new market situations have forced businesses to be more innovative and apply the strategy of change with continuous re-innovations of their products and services. In the period of the VUCA world (volatility, uncertainty, complexity, and ambiguity), business modeling needs to evolve from traditional static models for static environments to radically new business models that are chosen and applied at a unit level rather than the full company. [1]

The basic skills needed to advance in the world of insecurity, VUCA world (Volatility, Uncertainty, Complexity, Ambiguity) are:

- the ability to understand existing assumptions and situations that need to be examined and analyzed to create new insights - to explore trends and needs of all market participants;
- considering alternatives for finding new business models and practices that are relevant and sustainable - includes the four pillars of sustainability of the United Nations -

contribution to the community, environmental awareness, and proactivity, caring for people, and economic development;

- self-confidence to take risks to achieve results that bring greater value to users and the community - entrepreneurial agility and accepting the possibility to make mistakes;
- generating challenging experiences and connections to develop new relationships - openness to options and new experiences. [2]

Management in companies that do not adopt or even disrupt and challenge their models are not in a favorable position. [3] Today, the issue is how to keep the unique position to stay relevant and sustainable.

Tseng and Lin [4] consider that agile companies are making use of different key drivers. These refer to the internal capabilities of a company such as technology, personnel, innovation, and processes. According to Kleinschmidt and Peters [5] development of business model design is interdisciplinary, by leveraging information and communications technology business models improve human-centered service systems, improving production and delivering better results. Business is no longer a rational process in which decisions are made only based on exact facts, knowledge, and information. Innovative leadership believes in the power of human creativity, lateral thinking, reframing, and coaching.

A successful structural transformation of the Western Balkan economies, driven by innovation, needs to be based on a deep understanding of the existing economic fabric as well as the challenges and interrelations between traditional and emerging sectors. Innovation is one of the main factors driving territorial transformations and as these vary between territories, taking account of place-based diversity is essential. The Western Balkan region has significantly improved in terms of innovation performance in the last ten years. However, in catching up with other European regions, the focus of innovation efforts should be enhanced. [6]

2. WHY IS RE-INNOVATION IMPORTANT

We are in a period of constant change and turbulence, a tsunami world. While a large number of people and organizations expect us to return to normal, i.e., to the state that existed before the COVID-19 virus pandemic, as well as migration and armed conflicts in Eastern Europe, what is evident is that the existence of a tsunami world poses ahead of us new challenges and it makes us think continuously about what we expect from ourselves and our environment.

The data say that we will see more changes in the next 5 years than in the last 250 years.

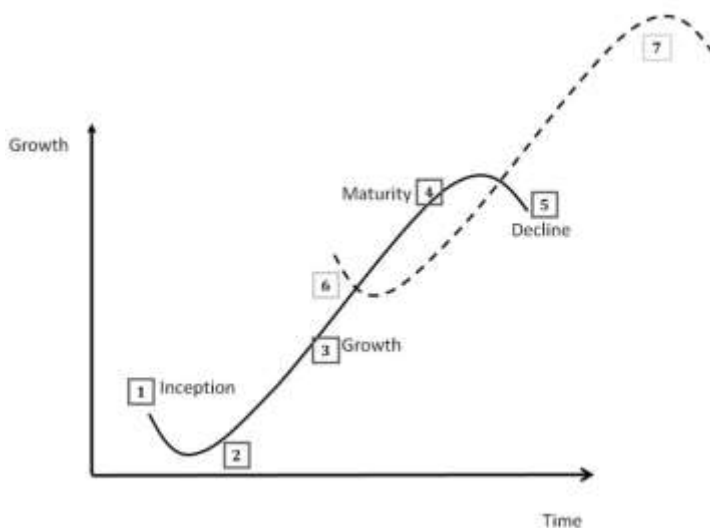
- Markets are accelerating - product life cycle is reducing and the number of transformations, renovations, and innovations is increasing.
- Consumers are more educated and connected - with access to education, unlimited knowledge, and digital platforms, they are increasingly informed and their map of decision-making paths gets increasingly personalized.
- Consumer attitudes and experiences are changing - the vast majority of new generation members choose brands that are sustainable, socially responsible, and environmentally

proactive, they are less receptive to corporate business and they have the initiative to start their organizations.

- Leaders are under pressure, by changing themselves they change business models and ways of thinking.
- Employees change employers but also careers in the process of lifelong learning.
- In the re-innovation culture, today the formula that gives results: out of 100%, let 60% remain unchanged, 60% improved, and only 10% completely new.
- Research says that the average life expectancy of organizations has decreased from 75 years in the 1950s to 15 years at the beginning of the 21st century, and 6 years in 2022, in cases when companies do not reinvent themselves. [7]

The Curve S by Charles Handy [8] is shown in illustration 1.

Illustration 1. Curve S and the beginning of the new curve S by Chares Handy



The intensity of changes caused by digitalization, globalization, financial crises, and the COVID-19 pandemic opens space for new ways of thinking aimed at long-term business development and sustainable growth of the company. The era of knowledge is passing into the age of design thinking, entrepreneurship, and re-innovation. Critical thinking, communication, creative thinking, and collaboration are of vital importance in the workplace, at home, and in every interaction, as four skills that act as necessary wheels in the exciting journey of the 21st century. Business re-innovations are the creation of essentially new value for users by applying dimensions such as co-creation, participation, collaboration, and perceived opportunities that contribute to the improvement of ecosystems. [9]

It is of the utmost importance for companies today to respond to challenges in a turbulent environment, “to listen” in a focused way, to have “the eyes wide open” and to act proactively. Nadya Zhexembayeva, an educator, consultant, and author of books on business re-innovation, believes that only those companies whose leaders and teams can creatively respond to everyday unexpected situations in the future can survive. [10] There is no progress without crisis and innovation, and they are the basis of a modern economy and entrepreneurship, confirmed the New Schumpeterians, professors Peter Howitt and Philippe Aghion, winners of the 2019 Frontier of Knowledge Award. [11]

3. HOW TO RESPOND TO CHANGE

Establishing the right innovation management process enables organizations not only to think continuously about changes and ways to welcome them and adapt quickly but also to create changes that others need to adapt to and thus to be ahead of the competition. However, the introduction of the innovation management process represents a kind of transformation of the organization, and many organizations do not fully achieve the goals they set for such a transformation. The reason usually lies in the fact that any significant change is a serious process that requires expertise, resources, and time, and is usually much larger than what leaders and management initially anticipate and what companies have at their disposal at a given moment. Such a change can also be very personal for employees, it can cause fear and consequently reduce productivity and create serious resistance from employees when approached improperly.

The role of final customers in the VUCA world is imminent for agencies and companies. Finally, customers play the game by changing rules and demanding more discounts, sharing opinions on products or services on the Internet, and asking for participation in the co-creation of new product or service development process. [12] [13] During the Covid-19 pandemic, online shopping increased, but shopping will continue to take place in stores. Retailers should review the layout of products on store shelves as well as working hours to make purchases safe and fast. They should also optimize sales space for a different type of customer, especially for those who buy less often and spend less, but buy more, and keep the focus on the assortment because the household need for basic and health products is increasing, and for non-priority categories is declining. More and more people are buying domestic brands. [14]

How to re-innovate business, processes, business model, and brands, if we take into account that a lot of changes in the environment? How to respond to the demands of consumers, employees, suppliers, business partners, the community, and the growing competition? How to do business in the blue ocean of creating additional value for consumers? Unlike designing technological innovations (such as a new technology or a patent), this way of thinking can enable using a different approach to the process of re-innovation in business, so that the organization separates from the red ocean full of competitors into the blue ocean of additional new values for customers, users, and consumers.

Earthquakes caused by functioning in a tsunami environment require organizations to respond promptly, become resilient, and build tools that will help them go through the process of transformation, survive and even flourish in what we can now call the new normal, in a word, to apply organizational Darwinism:

- How do organizations develop?
- How do they adapt to pressures from the environment?
- What resources and capabilities determine their survival in the dynamics of competition?

4. IMPORTANT TOOLS TO UNDERSTAND CONSUMERS AS STAKEHOLDERS

Unlike technological innovations (such as new technology or a patent), this way of thinking can enable incremental re-innovations in business for a company to stand out from the red ocean full of competitors to the blue ocean of new values. It is first necessary to identify the underlying problem or user need to find a solution. Only then is it possible to devise several different approaches to problem-solving and conduct several different tests with users to find the best possible solution. Some of the most common methodologies in designing re-innovations in organizations today are MVP (minimum viable product), "design thinking", "lean startup" and "jobs to be done", "persona", and "empathy map" which share a common approach to problem-solving and design of new business models with added value for the user. [15] Virtual reality, augmented reality, Metaverse EnEfTi, new forms of gaming, virtual property, and Web3, open up a marketing and business opportunities, especially for generation Z. [16]

In his book *Black Swan*, Taleb believes that the human mind is subject to many blind spots, illusions, and biases and that: "The right strategy for inventors and entrepreneurs is to rely less on detailed plans and to focus as much as possible on creative thinking and recognizing opportunities when they arise. Excessive attention to what we know results in yet another similar weakness: we tend to learn the details instead of adopting general laws." Resistance to change has long been cited as one of the key reasons why companies do not adapt to change on time. One of the approaches is the exercise "How to destroy a company". [17] Employees and stakeholders can be divided into groups to find the most effective ways to destroy a company. Lisa Bodell, founder and CEO of the company "Futurethink", uses simple techniques to help organizations embrace change and increase their ability to innovate, such as Google, Novartis, and HBO: "The first time the HBO team performed this exercise, it created three tactics that a top competitor could use to destroy HBO. The American mining company regularly conducts this exercise to protect itself from both competitive and market forces." Modern management has always existed for "best practices". In training, managers use role models to encourage and direct change. New research suggests a method better than the previous one. Scientists from the Kellogg School of Management in the USA conducted a series of experiments, and in one such experiment managers were gathered in small teams to create unusual creative purposes for

a cardboard box. Before the brainstorming, half of the group was given the task to share the unpleasant stories from the past six months, and the other half was given the task to share the stories they are proud of. According to the results of the experiment, the teams that shared unpleasant stories generated 26 percent more ideas than the groups that shared proud stories.

5. CONCLUSION

The COVID-19 pandemic reminded business leaders of the brutal reality: that all assumptions and practices must be constantly re-examined and that existential threats can come at any time, from any direction. As consumer preferences change rapidly, consumer-oriented companies should accelerate market feedback by regularly collecting information from consumers and anticipating changing trends. For companies to succeed in turbulent times, the re-innovation of the way of thinking and doing business requires a constant re-examination of their weaknesses and vulnerabilities. Therefore, business diagnosis is increasingly important in leadership, because as in medicine, issuing a prescription without a diagnosis is the wrong treatment. With the changes in the environment caused by the COVID-19 pandemic and the 4.0 SMART revolution (Social, Mobile, Analytics, Robots, Transformation), there arises the question of how to approach consumers who decide on the survival of companies, valorize the work of companies and brands by buying them. Open questions that can help re-innovate a business when the employer is in the shoes of customers, clients, and consumers can be:

- what elements should I focus on to increase value for consumers; whether my value offer is current and relevant from the aspect of user needs shortly,
- how to include new generations (Y, Z, Alpha) in our map of travel through digital experiences.

Leaders have to be aware of a lot of things, even beyond the range of the industry where they operate. This is a way to widen their horizons, keep their minds awake, to be more open to finding opportunities around them. We hear more and more terms like resilience, re-innovation, agile leadership, co-creation, collaboration, and many others, which rely on new skills necessary for managing a team and organization in the first half of the 21st century. Therefore, the approach to modern challenges also requires from everyone different tools, experiences, and readiness to learn and be a lifelong learner.

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NAČIN RAZMIŠLJANJA I VEŠTINE KAO IZAZOVI U TURBULENTNOM POSLOVNOM OKRUŽENJU

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SAŽETAK:

Potresi nastali kao posledica funkcionisanja u turbulentnom okruženju, zahtevaju od organizacija da blagovremeno reaguju, postanu otporne i izgrade alate koji će im pomoći da prođu kroz proces transformacije, prežive i čak procvetaju u onome što sada možemo nazvati permanentnom krizom. Kako reinovirati poslovanje, procese, poslovni model, brend, ako uzmemo u obzir da se mnogo toga menja u okruženju? Kako odgovoriti na zahteve potrošača, zaposlenih, dobavljača, poslovnih partnera, zajednice i sve veće konkurencije? Kako dizajnirati plavi okean stvaranja dodatnih vrednosti za nove potrošače? Sve više čujemo termine kao što su otpornost, reinovacija, agilno liderstvo, ko-kreacija, saradnja, celoživotno učenje, a koji se oslanjaju na nove modele i veštine neophodne za upravljanje timom i organizacijom u prvoj polovini 21. veka. U radu se analiziraju način razmišljanja i veštine potrebne za napredovanje u svetu nesigurnosti koji bi trebalo da pomognu zaposlenima i liderima u rešavanju savremenih i svakodnevnih izazova.

Ključne reči: reinovacija, poslovni model, dodatna vrednost, ko-kreacija, celoživotno učenje

AN ETHICS FOR EMERGING TECHNOLOGIES

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ABSTRACT:

In a world of rapid development of technology innovations the concept of ethics plays a key role in determining how to avoid undesirable outcomes of technology dissemination. It becomes increasingly difficult to understand the ethical implications of our use of technology. This creates problems both for practitioners and regulators. The increased use of digital technologies in almost every field of human activities worldwide indicates complexity of the research problem. Paper discusses tech ethics and deals with relatively unexplored field. To fill this gap in the literature, besides tech ethics paper indicates problematic of the proliferation of tech ethics. First part of the paper introduces ethics as general object of study. In the second part of the paper are shown different types of ethics. The rest of the paper deals with the ethical challenges and opposite views. This study could provide valuable insights for a debate on the tech ethics. It is important for furthering scientific progress.

Keywords: *ethics, technology, ethical challenges*

1. INTRODUCTION

Technology innovations are able to influence future conditions in a way that is not easy to predict. Contemporary society faces ethical challenges in every aspect of human lives. Technology is an indispensable part of everyday routine. Here we face the problem of responsibility and safe use of technology. "Technology is not neutral in the sense that it can be applied to every chosen proposal and produce non-neutral collateral effects" [1, p.12] Responsible use of emerging technologies implies the relationship to ethics. Traditionally, a concern with ethics in technology is viewed as a late historical development that grew out of an expansion of advanced technologies which encourage ethical concern for humanity.

Various authors have explored ethics in technology [2, 3, p.66, 4-6]. Ethics have a key role of balancing creativity and responsibility. We need to pay our attention in the redesign of the essential elements of ethics in accordance with technological development. To be of any use ethics guidelines of technologies must deal successfully with the moral problems which are related to technology.

Paper deals with current and important topic, that should be debated freely and may help to achieve greater understanding of ethical issues in contemporary science and technology. At a minimum, exploring these questions provide material that may assist in the creation of policies designed to ensure safety uses of emerging technology within the bounds of ethical standards.

2. ETHICS

Ethics are not easy to define. They direct human action and defining what is good manner in which one should act. They are closely related with values. There are numerous types of values with varying degrees of importance. Each value expresses goal or motivation that distinguishes one value from another. Values can be basic, individual, group or universal. Universal values “are grounded in one or more of three universal requirements of human existence with which they help to cope. These requirements are: needs of individuals as biological organisms, requisites of coordinated social interaction, and survival and welfare needs of groups“ [7, p.4] Universal values have strong cross-cultural support and they are global in their nature. They operate within a complex, multipolar organized system. Many factors influence individual values, such are: socio-economic status [8], gender [9], religion [10], cohort and age [11]. Above mentioned factors have the potential to produce contradictory effect and values may conflict as individuals develop multiple role identities.

Technology development like never before brings urgency for the emergence of global values, universal and shared by almost everyone. They “imply ethics of individual and collective responsibility, which (as value claims) are able to override divisions of interest.” [12, p.21]. Ethics draw people toward desired social outcomes. Their power comes from their unquestionable goodness and correctness rather than extensive reflection. They are connected to ideal human behavior. However, ethical directives are not always obvious. People sometimes disagree about what is correct and incorrect behave in a certain situation. Ethics are related to ideal ways of being. Acceptance of ethical sensitives in a society implies that “we need to develop our hearts as well as our minds“ [13, p.6] Doing ethics is active process. Ethical guidelines are applied through the use of principles and theories, such as those that are developed for professions and religions. Humans justify their actions through logical, theoretically based arguments. When people are doing ethics, they need to support their actions with reasoning and emotions. Emotions can play legitimate role in doing ethics. However, sometimes emotions overtake good reasoning. A balance of emotion and reason is a good foundation for ethics-related behavior.

Merrill defines ethics as “the study of what we ought to do” [14, p.3]. The approaches of ethics have varied over time. There are three dominant approaches of understanding the ethics: 1. deontological, 2. teleological and 3. virtue approach.

1. Deontological approach – Juristic ideas are the original frame for deontological approach. It derives from idea about universal divine law. The ideal society in the deontologists view is that where humans are living in fellowship, equal with

others under the rule of law. So, to act ethical means to act in accordance of duties, rules, and policies. Break this rules mean to act unethically.

2. Teleological approach is focused on the consequences of human behavior. So, ethics should lead people to act most good in a situation, social group or society. The ancient Greeks, Plato and Aristotle founded major system of ethics. This approach is associated with utilitarian philosophy and pragmatism. Accordingly, rational intuitionism theory „standards of right and wrong are an object of the intellect, and one's knowledge of it comes from directly perceiving its elements and structure through the exercise of the intuitive powers of reason“ [15, p.135]. People face situations in which it is hard to know what is the right action. Kant wrote about human action guided through reason. “Everything in nature”, Kant wrote, “works in accordance with laws. Only a rational being has the power to act in accordance with his idea of laws – that is, in accordance with principles – and only so has he a will. Since reason is required in order to derive actions from laws, the will is nothing but practical reason.” [16, p.412]. Kant identified moral laws with categorical imperative. He wrote that moral law also reinforces the judgments of ordinary people about right and wrong behavior. Deight criticized Cant’s categorical imperative: “It does not contain the idea of the rule's having the purpose of helping to sustain human society by either restraining people from doing things that, if done too often, would threaten the society's stability or requiring people to do things that, if not done often enough, would also threaten the society's stability” [15, p.154].
3. The virtue approach – Human beings have emotions, passions, desires originate in animal instinct. In the absence of clear rules human focus is on the subjective, nonrational impulses that influence human behave [17]. Human often act on those emotions and desires. In these cases, individual acts on poor judgment, but not necessarily against reason.

Ethics and moral are often used interchangeably in common speech. However, “ethics means the theory of right and wrong conduct; morals, its practice.” [18, p.18] Further, “ethics involves the values that a person seeks to express in a certain situation; morals, the way he sets about achieving this“ [18, p.18]. Main features of morals and ethics that distinguish nature of this concepts from others:

1. Inevitability - “Nobody can avoid them “[18, p.19]. Get through life all of us every day consciously or unconsciously make decisions and deal with ethics and moral.
2. Collective character – The moral and ethical decisions that people make always involve others, or they are related to others.

3. Causal significance - Moral and ethical are matter as they affect others. “Everything we do matters because everything we do is capable of affecting other people’s lives” [18, p.21]
4. Fluidity- Ethical debate can’t offer final conclusions, as “there can never be a final solution in this field” [18, p.21];
5. Choice – Both in ethics and morals, choice is essential and unavoidable. „Where no choice exists, no moral judgment can be made, and where it does exist, it cannot be escaped from“ [18, p.23];
6. Moral reasoning as tool for solving the dilemma and discover right action.

3. TYPES OF ETHICS

Ethics is one of the main branch of philosophy. It is also known as moral philosophy. Philosophers mentioned various ethics that can be classified in four types: 1. normative, 2. meta-ethics, 3. descriptive and 4. applied ethics.

1. Normative ethics derived from asking normative questions. It is “an attempt to decide or prescribe values, behaviors, and ways of being that are right or wrong, good or bad, admirable or deplorable.” [19, p.6] Also, there are three types of normative ethics:
 - a. utilitarian or consequentialist ethics, ethics based on outcome
 - b. deontological ethics -“Deontology literally “means the science of duty“, but in ethical theory it has a more specific meaning. It begins with the idea that good and evil reside in the individual's intentions rather than in the consequences of the act.“ [20, p.7]
 - c. Aristotelian ethics, also known as virtue ethics – “The idea is that someone who doesn’t have correct virtue, internal disposition might attain it gradually through practice.“ [21, p.19]
2. Meta-ethics “is concerned with understanding the language of morality through an analysis of the meaning of ethically related concepts and theories, such as the meaning of good, happiness, and virtuous character. “ [19, p.6]
3. Descriptive ethics –They are used to describe how people behave regarding their morals. It evaluates human behavior from aspect of moral and compare it during time.
4. Applied ethics- These ethics refer to the concrete subjects such as: profession, state, politics, family etc. „There are six domains of applied ethics: decision ethics, professional ethics, clinical ethics, business ethics, organizational ethics and social Ethics which primarily deal with rightness of social, economical, cultural, religious aspects like child labour, abortion euthanasia, cloning, surrogacy etc.“ [21, p.20-21]

4. TECHNOLOGY AND ETHICAL CHALLENGES

Technology changed the world. Dealing with the ethics for technology is not easy task. Technology “encompasses the sphere of making or contriving, and it includes purposes, material results, tools or instruments, and processes, as well as invention.” [6, p.19] As technological developments occur, world become unstable and unclear. Nowadays scholars focus is to resolve dilemmas. As Kress observed traditional system characterize stability and “education for stability: stability of values and ethics; stability of knowledge; for a stable economy, with stable jobs and professions; for stable futures, with stable structures, and stable life journey” [22, p.7].

Technology bring changes. As Gee mentioned technology “discourse reproducing institutionalized power relations.” [23]. Contemporary society is center on design, creativity rather than on replication. Emerging technologies “fragmenting contemporary society, yet uniting it; they are destroying education or remaking it; they are transforming culture and communication or merely conferring privilege on a few” [24, p.2].

Technological innovation implies also a social activity, with psychological and political impact. Society is created and recreated through actions among social structures and individuals. There are a variety of possibilities for action, but they differ. Some of them represent more or less desirable available options. Values and ethics guide individuals to desirable options both within certain situations and across the humanity course related to emerging technologies.

Noticed that “technology reflects the ethics and beliefs of those with whom it has contact. If technology provides a means of control, how it is employed depends on its users values.” [6, p.19]. Modern technology has a double face. In the name of safe use it restricts basic human rights. Is really necessary to provide access to our location, camera and other private information in order to be users of certain app? Where are the limits?

Ethic guidelines have a potential of achieving greater liberty – at the individual, national and global levels. Thinking to the ethics of technology is a hard task. It is very young field that has reached prominence because new technologies. There is no doubt that emerging technology will have widespread ramifications that revolutionize the contemporary society (Table 1).

Table 1. New technology trends 2023 [25]

Technologies	Key Benefits	Use Cases	Level of Maturity
Artificial Intelligence (AI) and Machine Learning (ML)	Automate and optimize processes, provide insights	Chatbots, fraud detection, image recognition, predictive maintenance, personalization, recommendation engines, etc.	Mature

Robotic Process Automation (RPA)	Automation of repetitive and rule-based tasks	Data entry, invoicing, HR onboarding, financial reporting, etc.	Mature
Edge Computing	Reduced latency, improved performance	Autonomous vehicles, real-time analytics, video streaming, IoT, etc.	Emerging
Quantum Computing	Solve complex problems traditional computers cannot	Cryptography, drug discovery, optimization, machine learning, etc.	Emerging
Virtual Reality (VR) and Augmented Reality (AR)	Immersive experiences, user interaction with digital environments	Gaming, education, training, marketing, tourism, etc.	Mature
Block chain	Secure and transparent transactions	Supply chain tracking, digital identity, voting, payment processing, etc.	Emerging
Internet of Things (IoT)	Improved efficiency, automation, and monitoring	Smart homes, industrial automation, healthcare monitoring, energy management, etc.	Mature
5G	Increased speed, reduced latency	Enhanced mobile broadband, autonomous vehicles, smart cities, etc.	Emerging
Cybersecurity	Protection of data, networks, and systems	Network security, threat intelligence, identity management, encryption, etc.	Mature
Full Stack Development	End-to-end development of software applications	Web development, mobile app development, e-commerce, etc.	Mature
Computing Power	Increased computing power for complex calculations	Scientific research, weather forecasting, financial modeling, artificial intelligence, etc.	Mature
Datafication	Collection, analysis, and use of data	Marketing analytics, customer insights, operational efficiency, personalized experiences, etc.	Mature
Digital Trust	Building trust in digital interactions	Online banking, e-commerce, social media, digital identity, etc.	Mature

Internet Behaviors	Analysis and use of data from human behavior	Retail analytics, healthcare monitoring, smart cities, etc.	Emerging
Predictive analytics	Analysis and use of data to predict outcomes	Customer retention, fraud detection, supply chain optimization, risk management, etc.	Mature
DevOps	Integration of development and operations processes	Continuous integration/continuous deployment (CI/CD), software testing, infrastructure as code, etc.	Mature
3D Printing	Printing of physical objects from digital designs	Prototyping, product design, medical implants, customized manufacturing, etc.	Mature
AI-as-a-Service	Access to AI technology through cloud computing	Chatbots, predictive analytics, natural language processing, image recognition, etc.	Emerging
Genomics	Study of genes and their functions	Precision medicine, genetic engineering, disease diagnosis, personalized	Mature

There is benefit to swiftly integrating advanced technology, as they poses the opportunity to improve the efficiency and quality of provided service. However, there is a need to minimize ethical risks of emerging technology implementation. The ethical problems related to emerging technologies shouldn't be solved by limiting the technologies, but rather by limiting the risks and their possible abuses. "Technology ethics emerges from a mix of institutionalized codes, professional cultures, technological capabilities, social practices, and individual decision making." [5, p.96] They are characterized by complexity.

The European Commission published guidelines on AI ethics in April 2019. "Based on fundamental rights and ethical principles, the Guidelines list **seven key requirements** that AI systems should meet in order to be trustworthy:

1. Human agency and oversight
2. Technical robustness and safety
3. Privacy and Data governance
4. Transparency
5. Diversity, non-discrimination and fairness
6. Societal and environmental well-being
7. Accountability" [26]

This **requirements** can be implemented to other emerging technologies. About ethics, there are different opinions, because advanced technology covers wide field. While, some authors insist for specifics ethics related to area in which technology is applied [27, p.37, 28-29], other „argue that while all technologies are ethically relevant, there is no need to create a separate ‘ethics of X’ or ‘X ethics’ for each and every subtype of technology or technological property“ [30, p.1]

The ethics for humane technology framework that provides creating a reliable environment promotes six principles:

1. wellbeing,
2. inclusion,
3. 3. privacy,
4. 4. security,
5. Accountability
6. trust. [31]

5. RECOMMENDATIONS

1. Elastic regulation - Failure to conform ethics in technology to the appropriate standards may lead to a violation of the laws and rules governing current the practice. On the other hand, above mentioned standards should present a source of trust and acting to protect the public, state and human well in general. States are forced to have a regulatory system which is elastic and capable to embrace the changes in technology and will bring the welfare to humans.
2. Equality- Worldwide ethical guidelines consensus attempt to define equality primarily in terms of opportunity. Policy makers must act to ensure that the provided tech service is equitable and not influenced by bias based on race, ethnicity or other forms of discrimination.
3. Knowledge and familiarity with ethics in technologies -Humans should be aware of risks and must embody the ethical guidelines in their everyday routine. Engineers, policy makers and technology inventions should strive to apply highest ethical behavior related to technology. It will lead to a fundamental obligation, knowledge and appreciation of the ethics principles related to technology.
4. Commitment and proactive approach - As technology rapidly advances (and perhaps exceeds) the limits of human, there may be no easy to reexamine existing technology ethics and standards, to identify vulnerabilities and make improvements. A more active approach is needed to address this issue more effectively.
5. Continuous monitoring and evaluation – We need public and private bodies that will deal with monitoring and evaluation of emerging technologies actively and transparent.

6. Global initiative – People should apply universal values to global tech policy. “Global governance is best described as a set of prescriptions and conventions that nations agree to be bound by” [32, p.17]
7. Awake ethics through practice - The old model of teaching ethics through education in a class of students, no longer seems either productive or valuable. Ethics cannot be taught. They derive and develop with practice. Most people construct their definitions of the good, i.e., their ethics, “in everyday shared activities and the evaluations of alternatives that those activities impose” [33, p.136]. Global community should introduce procedures and practices related to technology. Each state should to guarantee their application and punishment for non-fulfilment.
8. Conscientiousness - Breakdown of moral standards open space for economic individualism. Ethical guidelines are in contrast to economic individualism and may have a positive effect on technological development. Positive ethical component related to technology is key aspect to achieve conscientious use of technology.

6. CONCLUSION

Technology is powerful contingent that shapes our lives and reflect us and our values, ethics and our society in general. Some advanced technology innovations are already in use, while policy related to them late. That situation makes the understanding of ethics related to technology of primary importance.

It is necessary to regulate a technological development according to human rights tradition. Universal relevance of ethical guidelines in technology from the beginning is unquestionable. Contemporary world need consensus on certain universal ethics in technology. These ethics are important step to establish guidelines and limits for technology innovations which require a global dimension of governance. Nonetheless, there is much work to do in order to lay down the proper ethical foundation for using emerging technologies safely and effectively. A productive future society should continue to proactively confront the risks related to emerging technologies.

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THE INTERWEAVING AND CROSSINGS OF HISTORY AND FICTION IN POSTMODERN LITERATURE: FOWLES'S *THE FRENCH LIEUTENANT'S WOMAN* AS A REVISIONARY HISTORICAL NOVEL

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ABSTRACT:

*The aim of this article is to underline the relationship of history and fiction in the postmodern revisionist historical novel, with particular reference to John Fowles's *The French Lieutenant's Woman*. The starting hypothesis, by contrast with Fowles's claim that this novel does not belong to the genre of historical novel, is that history and its entanglement with fiction is one of the major motifs of *The French Lieutenant's Woman*. The first part of the paper offers a brief overview of the interweaving and crossings of history in fiction from Aristotle to the present moment. However, the article argues that the interrelationship of history and fiction becomes problematic in postmodern literature, especially with the creation of the revisionist historical novel in the 1960s. This kind of historical fiction brings to the fore blurring of genres and crossings of limits, which is a prominent feature of postmodern literature. Starting from the observation that the wide scope of the revisionist historical novel should not be reduced only to the genre of historiographic metafiction, the article offers evidence that Fowles's novel rather falls under the category of metahistorical novel. This kind of novel deals with the redefinition of historical consciousness in contemporary time and aims at linking the past not only with the present, but with all time periods. In doing so, it deals with eternal, universal topics that are interesting both in the past and in the present, which is one of fundamental concerns of *The French Lieutenant's Woman*.*

Keywords: *history, fiction, revisionist historical novel, metahistorical novel*

1. INTRODUCTION

This paper will focus on the relationship between history and fiction in postmodern literature, with special reference to Fowles's *The French Lieutenant's Woman* (1969). The aim of both history and fiction is to encompass the entire human experience and improve the human spirit. However, whether history and fiction do this in the same way, that is, by means of the same devices and strategies, is the topic of our research. In his *Poetics*, Aristotle made the distinction between history and fiction. History deals with events that

actually happened. Aristotle proclaims poetry graver and more important than history (1984: 2333) due to its engagement with events that may happen, since in that manner poetry represents a source of knowledge that pushes our limits of cognition. However, we should not neglect the fact that both history and fiction are based upon real-world facts. Dorothy Van Ghent correctly notes that both history and fiction start from the empirical data (1953: 14). This critic claims that the novel starts from a hypothesis, and interprets the empirical data so as to obey the laws of causality and probability. However, Van Ghent does not realize that historical narrative also reflects the hypothesis of the historian.

Until the nineteenth century, history was considered a branch of literature. Its use of narrative form and devices was widely recognized. After the French Revolution, there was a need to define history as an objective scientific discipline in order to avoid its linking to any kind of myth. Therefore, history was defined as an impartial presentation of facts about past events. The emphasis was on its representation of true events, whereas fiction was associated with the representation of the untrue, invented, and fictitious. As a consequence, a gap was created between history and fiction. Still, critics such as Northrop Frye and R. G. Collingwood challenged the notion of history as an objective and impartial scientific discipline. In the view of Hayden White, the significance of these critics is in their recognition that historical discourse is not only a collection of data, of facts related to bygone events. The work of a historian includes both discarding the facts which are considered irrelevant and filling in the gaps by means of imagination and speculation (White 1978: 51). Furthermore, White recognizes that historical discourse, in order to be found interesting by the reader, adopts the form of a story. In addition, every story depends on a plot, which means that both story and plot are recognized as integral elements of historical discourse. White points to the fact that histories depend on the view of the historian (1978: 125), similarly to fiction which depends on the hypothesis of the writer. Therefore, it may be argued that history is also a hypothetical structure that depends on laws of causality and probability.

In the view of postmodernism, the intent of history is to master, to control the past. Additionally, White argues that both the historian and the author of fiction intend to assign meaning to the chaotic and fragmented world (1978: 125). Both attempt to create a plausible discourse out of events which they select and interpret. However, we have to oppose this White's claim. He does not make a distinction between the author and the narrator of fiction. This means that the attitudes of the narrator cannot be identified with the views of the author. For example, in *The French Lieutenant's Woman*, Fowles attempts to create a world which is free of his influence. He does so by creating worlds within worlds, that of the author, the narrator, the impresario, and the fictional characters. All these worlds are supposedly independent. Fowles goes beyond the alleged assignment of meaning. He claims that he does not interfere with the course which the characters' actions will take. According to Fowles, the novel is the ultimate free form. The only boundary to the novel is language (1998: 21). The fact that the novel is written in the form of a language, which is the mediator between reality and the reader, means that: "One cannot

describe reality, but only give metaphors that indicate it” (1998: 16). This Fowles’s claim explains that although story is the primary form of knowledge (Liotar 1988: 37), its meditative nature suggests that this knowledge is doomed to be aporetic and unable to convey the truth of an unnarratable experience. In that manner, Fowles’s novel confirms White’s thesis that “every discourse can be shown to be distorted” (White 1978: 3). Nonetheless, Fowles further complicates this claim by introducing the reader in the process of mimesis. He intentionally chooses to finish his novel with three instead of one ending. In doing so, he does not indicate that mimesis does not exist, but emphasizes that the novel achieves its effect only in the reader’s consciousness. The reader is the one who decides upon the meaning of the novel and assigns it its value. Chatman persuasively argues that the narrator of a fictional work (contrary to the historian) deliberately omits some important facts of his plot so as to make it more tense (Chatman 1978: 212). These gaps have to be filled in by the reader. Fowles creates a rather unconventional story in order to instruct the reader not to follow his/her internalized views and attitudes. In doing so, he attempts to motivate the evolution of the reader. According to Booth, the narrator of fiction (in contrast with the author), has insight into the thoughts of his characters, unlike the historian (But 1976: 180). Still, Fowles’s novel opposes such a claim, at least partially. Whereas the reader learns the thoughts of Charles Smithson and some other characters, he/she is not given admission to the thoughts of the mysterious Sarah.

Various similarities between fiction and history do not imply that these disciplines are of the same kind. Paul Ricoeur coined the term “the interweaving reference” to suggest that although these disciplines have some common features, they represent independent and different kinds of discourse. The most important difference is their subject matter. History is aiming at representing the true events which did take place, whereas fiction refers to the fictional worlds of fictional characters. Still, as Ricoeur persuasively argues, the experience of fictional characters is based upon reality. Therefore, history and fiction get more similar in contact with the reader (Riker 1993: 102). Only in this contact with the reader history and fiction achieve their primary goal – the advancement of human spirit through dealing with problematic areas of human experience. Second, in contrast with history, the author of a work of fiction is not the narrator. In addition, the reader of fiction is expected to believe the narrator, to suspend disbelief, whereas the reader of history is expected to adopt a critical position towards the discourse. As we are going to demonstrate, these distinctive features of history and fiction are played upon in the revisionist historical novel. The revisionist historical novel, postmodernist in its essence, adopts the position that doubt and disbelief are crucial features of the contemporary reader. Therefore, Fowles expects the reader to be suspicious. We should not be deceived by Fowles’s refusal to call the novel historical. This refusal is part of his game with the reader, his attempt to challenge the conventional reader and lead him/her astray. One of the fundamental implications of *The French Lieutenant’s Woman* is that disbelief and questioning are among the most important features of the modern, evolved reader.

2. POSTMODERN HISTORICAL NOVEL

Postmodern theory and literature are aimed at redefining the established grand narratives such as past, reality, and history. Some theorists are radical in their claims. For example, Jean Baudrillard proposes that there is no reality and bases this thesis on his theory of simulacra. However, Linda Hutcheon adopts the position that the real does not exist outside of its representations. Furthermore, this critic underlines the distinction between history as it is and history for us. In its essence, history is non-narrative and non-representational (Jameson 1981: 82), but we can get to know it through its representations (Hutcheon 1991: 58). Similarly, the implication of *The French Lieutenant's Woman* is that the past exists, but that we can learn about and from the past only through its traces whose objective status is problematic. After the non-existence of history in modernist literature, history re-enters fiction in postmodernism. However, we have to bear in mind the fact that historical consciousness, although it becomes important again, is fundamentally critical. This means that we are both aware that the past did happen and that our ability to know the past is limited. In postmodernism, the past, reality, and fact are given the status of constructs. This is not something to be afraid of. Such a condition, according to Vukotić, implies that the truth is no longer unique and irrevocable (2016: 34). As Hutcheon puts it, this is a typical “postmodern strategy, and here leads to the acknowledgement, not of truth, but of truths in the plural, truths that are socially, ideologically, and historically conditioned (2004: 18-19). Challenging concepts that have not been questioned so far is a fundamental feature of postmodernism, a feature which is the precondition of knowledge. For Hutcheon, doubt and disbelief are some of the most distinctive qualities of postmodernism. In that manner, the reader of fiction takes on qualities of a reader of history. Hutcheon specifically refers to the genre of historiographic metafiction due to its simultaneous dealing with historical events and self-consciousness. However, Hayden White claims that every discourse is both interpretation of its subject matter and a meditative narrative which deals with the nature of interpretation (White 1978: 4).

The revisionist historical novel, whose origin may be traced to the 1960s, the post-war period, is postmodernist in its essence. It adopts most of the features of postmodernist literature, such as fragmentation, discontinuity, self-consciousness and self-reflexivity. Furthermore, the revisionist historical novel may be defined as an ambiguous type of fiction which is the epitome of “the crossing of boundaries and the blurring of genres” (Nünning 1997: 218), which is also typical of postmodernism. This blurring of genres, according to Nünning, “opens up new possibilities for representing the past” (1997: 218). These possibilities do not refer only to the emphasis on the fact that our ability to know the past is limited. As this critic suggests, historical consciousness in the revisionist historical novel is not conceptualized as dealing with important historical events. These events, although they are sometimes mentioned, are overshadowed by the individual experience of history by the common man. Revisionist historical novels are revisionist both in terms of correcting or supplementing the official history and in terms of redefining

the conventions of a typical historical novel. However, Nünning claims that the scope of this genre is so broad that Linda Hutcheon is wrong when she attempts to encompass all revisionist historical novels under the term “historiographic metafiction” (1997: 219). This critic proposes that this genre should be given more attention and offers a classification of postmodern historical novels. According to him, a distinction should be made between metahistorical novels, moderate types of the revisionist novel, and historiographic metafiction, which can be explicit or implicit. Starting from this classification, it may be argued that Fowles’s *The French Lieutenant’s Woman* falls under the category of metahistorical novels. The focus of these novels, as Barbara Foley states, is not the “accurate representation of the past” (Foley 1978: 96). Its emphasis is rather on the link between the past and the present. Its aim is to underline the ways in which the past and the present overlap and influence each other. According to Raymond Williams, this is the main difference between the “classic” historical novel and its contemporary, revisionist version. In his view, the main drawback of a typical historical novel is that it remains enclosed within a certain period and in the fact that it uses history as a mere background (Williams 1987: 3). These novels are named by Williams period novels. He suggests that a “true” historical novel should connect the past not only to the present, but that it should stand in “dialectical connection” (Widdowson 2006: 495) with all the periods. This is exactly the intent of Fowles’s *The French Lieutenant’s Woman*. This novel is preoccupied with not only the past, but also with the present and the manner in which they influence each other. What is more, Sarah may be viewed as a character attempting to transcend the particular historical conditions of her time. In doing so, her experience may be interpreted as universal and it can be applied to all the periods. Connecting the past and the present, the author implies that there are timeless issues that torment all people regardless of time and place.

As Dorrit Cohn states, the historical novel conflates two “ontological realms” – the real characters and events and the fictional ones (Cohn 1999: 153). Aleksandra Vukotić asserts that the primacy of fiction over history lies in the fact that fiction can combine factual and fictional (Vukotić 2016: 32). Brian McGale cites the historical novel as an instance of the transgression between the real and the fictional world (McHale 1987: 90). This transgression consists of mixing the fictional events and characters with the real-world individuals and events (so-called “realms”). However, McHale underlines that there are three major constraints that limit the appearance of realms. First, representation of historical figures should not be at odds with official history. This problem is often solved by representing what is usually left out of the official historical accounts. McHale calls these blanks “dark areas” and suggests that dark areas refer to different domains of experience for authors of historical fiction. Whereas some authors deal with the interior life of historical figures, implying that interior life is a “dark area”, other writers perceive the interior life as inaccessible (McHale 1987: 87). Second, the whole background of the historical novel should go in line with the official history. This constraint is characterized by McHale as the constraint on anachronism. According to him, it is difficult for writers to write about events that are distant in time. Even writers such as Scott do not succeed to

write about the past without including the attitudes of their present. Third, the logic of the fictional world of the historical novel has to be in accordance with the logic of reality (McHale 1997: 87).

We have to bear in mind that these constraints refer to a “classic” historical novel. As a revisionist historical novel, Fowles’s *The French Lieutenant’s Woman* both follows and challenges these constraints. For example, since this novel deals with the Victorian era, it involves the representation of its cultural material. These data are in accordance with that of official history. For example, the narrator describes Victorian attitudes, manners, clothes, furniture, and these descriptions confirm the general view of the era. Furthermore, Fowles introduces a historical figure, Dante Gabriel Rossetti, and deals with the “dark area” of his life, his private life. Still, although the plot superficially reflects the plot of the Victorian novel, it is implicitly aimed at correcting the Victorian history. As McHale suggests, official history is the history of the winners and of the male sex. *The French Lieutenant’s Woman* attempts to correct the official history by offering the story of the marginalized members of Victorian society, both in terms of class and gender. Looking at life in the Victorian age from the perspective of a woman who is pushed to the margin due to her humble origins enables us to broaden our horizons and get a more comprehensive knowledge of this era. When it comes to the second constraint, the novel also violates it. *The French Lieutenant’s Woman* abounds in anachronism. Obviously, Fowles’s implication is that our living in the present inevitably shapes our view of the past. He over and again compares the 1960s with the 1860s in order to bridge the temporal gap between the bygone period and the contemporary reader. Finally, whereas in the “classic” historical novel the transgression between the real and the fictional world should be as discreet as possible, in the revisionist historical novel this transgression is obvious and conspicuous (McHale 1987: 90). Fowles reminds the reader from time to time that his writing about the events which “took place” in 1867 is given from the present perspective, that he describes these events in 1967. He deliberately dispels the illusions of the reader because it does not make sense to him to pretend that he is situated in the past. As Fowles comments in “Notes on an unfinished novel”, “A novel is something new. It must have relevance to the world’s now” (1998, 15). However, the link Fowles creates between the past and the present is an uneasy one. He adopts a certain half-ironic, half-parodic perspective towards the past. Such an attitude provides a simultaneous view of the past as a potential source of our modern attitudes and age of hypocrisy and conformism. Starting from Hutcheon’s statement that historians’ most important goal is to “establish a relationship between the past and the present” (1991: 70), we may conclude that Fowles’s acts in the very same way in *The French Lieutenant’s Woman*.

3. CONCLUSION

This article represents an attempt to demonstrate that the relationship between history and fiction has always been problematic. Although their subject matter differs, it has always been recognized that history and fiction employ similar narrative strategies and devices.

After unsuccessful attempts to create a gap between these two kinds of discourse, their interweaving and crossings are widely studied in postmodernism. History becomes important again in postmodern literature, although it should be mentioned that contemporary historical consciousness is highly critical. The complex relationship between history and fiction is particularly evident in the revisionist historical novel, which is aimed at crossing boundaries and blurring genres. One such novel is John Fowles's *The French Lieutenant's Woman*.

The reader should not be deluded by Fowles's claim that this novel is not historical. Actually, history is one of major motifs in *The French Lieutenant's Woman*. In this novel, Fowles plays with the conventions of historical and narrative discourse. The author intends to instruct the reader not to interpret the novel according to his internalized expectations. The implication is that the reader should approach the fictional discourse with mistrust and disbelief, that is, critically, which is actually the perspective of the reader of historical discourse.

Starting from the classification of the revisionist historical novel offered by Nünning, the paper proposes that *The French Lieutenant's Woman* is a metahistorical novel. As this critic explains, in metahistorical novels representation of history is not limited to a certain period, but it is aimed at establishing a link not only with the past, but with all periods of time. Such an intention of the author of the metahistorical novel is almost identical to the main intention of the historian to make a connection between past events and the contemporary reader. The goal of history and fiction to improve human spirit and to expand experience are realized only in the mind of the reader. In Fowles's novel, the reader actually participates in the creation of the novel since he/she has to choose between the offered endings and to fill in the gaps by imagination and speculation. These devices, commonly used by historians in order to turn the historical data into a plausible and interesting story, once again underline the “interweaving reference” of history and fiction, which is the subject of heated debate both in contemporary historical and literary circles.

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MULTI-FACETED IRONY IN KAZUO ISHIGURO'S NOCTURNES¹

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ABSTRACT:

In this paper, Kazuo Ishiguro's collection of short stories Nocturnes (2009) is interpreted via a methodology sourced from theories of irony as a multi-faceted literary (meta)trope. Poststructuralist and psychoanalyst literary theories ground the elaboration of irony. Ironic discontinuities present in Ishiguro's short prose involve levels of narrative discourse, characterization, as well as cultural ideology and its structural implications. Results expose a relativist worldview based in affect, methods of consoling self-delusion, and a (tragic) conformism to an increasingly commodified social reality. The significance of this research lies both in the formulation of an operative interpretative framework and in the analysis of Ishiguro's rarely explored genre of short stories.

Keywords: Kazuo Ishiguro, Nocturnes, irony, poststructuralism, psychoanalysis

1. INTRODUCTION

Rarely have Kazuo Ishiguro's short stories been the focus of literary criticism, even following his winning of the Nobel Prize in Literature in 2017. The Swedish Academy likewise stressed his novels as the focal point of his literary career, disregarding his short prose. Ishiguro's short stories have generally been interpreted as a transitioning form, valid only inasmuch they could potentially evolve into a novel, which is why they have only occasionally been afforded literary merit in their own right. The case is somewhat different with his only collection of short stories, *Nocturnes: Five Stories of Music and Nightfall*, published in 2009, since the stories are both structurally and thematically connected via music, which demands diverse interpretative approaches. However, secondary literature on the collection is still rather sparse (see Mazullo 2012, Wang 2012, Mathews 2017, Whitehead 2021), which leaves a substantial niche to be filled.

In this paper, theories of irony as a literary trope, particularly those sourced from poststructuralist and psychoanalyst frameworks, are applied to the interpretation of

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Ishiguro's stories from *Nocturnes*. In his eight novels published to date, Ishiguro has employed irony often, particularly in representing the operative modes of memory and trauma (see Matović 2020). In *Nocturnes*, his use of irony can, as in his novels, be tracked alongside discursive, situational, and structural pathways. In the next section, theoretical approaches to irony as a multi-faceted (meta)trope are elaborated, especially in the context of (post)modernist writing. While the following section provides an exploration of Ishiguro's *Nocturnes* in the context of presented theories of irony and their relevance for characterization, narrative world building, and the structure of ideology integrated within the short stories.

2. IRONY AS A MULTI-FACETED LITERARY TROPE

Wayne Booth states that, aside from irony, “[n]o other term used by critics, except possibly ‘rhetoric’ itself, has produced so many tracts about the nature of man or the universe or all literature or all good literature” (1974: x). Irony has been studied across various disciplines, from linguistics and literature to psychology and philosophy, while contemporary research aims toward interdisciplinary approaches (see Živković 2019: 197–198). The levels of irony relevant for the literary interpretation in this paper concern those generally established within these approaches: conditions of its production and perception (level of characterization), situational irony (level of narrative plot and story), and its structural propositions related to ideology (level of genre/worldview). Theories especially pertinent for the analysis of irony in Ishiguro's *Nocturnes* stem from the poststructuralist era in literary theory and criticism, which tackled irony as indicative of the neuralgic points in the contemporary (Western) philosophical and cultural paradigm.

Following the linguistic turn, symbolic practices of structuring reality gained privilege in discourses within and in relation to the humanities. Poststructuralism further problematized both the given nature of symbolic practices and the given nature of reality because, in a paradigmatic shift, it focused on the lack within and not the “fullness” of structure as the condition of all symbolic and, in continuation, “real” action. Since its elementary function is to stress the contradiction between *what is said* and *what is meant* (regardless of whether such contradiction is intentional or not, discursive or situational, meant to mock or to express disillusionment etc.), irony is the poststructuralist trope *par excellence*. It prevents complacency in terms of convention, tradition, metanarratives (of presence), and overall destabilizes the idea of straightforward signification. In its most revolutionary form, it leaves us detached from all essentialisms by dissolving structural/symbolic pretensions to definitive meaning.

Hayden White (1973: 137–138) labels irony as *metatropological*, in the sense that it is the trope most aware of itself, of the contradictions inherent in the figurations of language which propose to ground meaning. According to White, irony is also *transideological*, since it “tends to dissolve all belief in the possibility of positive political actions” (1973: 138). Similarly, Paul de Man previously contended that irony cannot be reduced to a rhetorical device or to one among other literary tropes, but that it exemplifies a

fundamental aspect of language itself. The Swedish Academy's remark that Ishiguro's writing "has uncovered the abyss beneath our illusory sense of connection with the world" highlights the connection it has with de Man's view of irony as indicative of the indeterminacy and instability of meaning in language. Poststructuralist theorists in general stress irony's potential to reveal the arbitrary and contingent nature of meaning, and therefore uncover the power dynamics that underlie language and communication. "Curiously enough," writes de Man, "it seems to be only in describing a mode of language which does not mean what it says that one can actually say what one means" (1983: 211). Furthermore, irony necessarily involves *duration*, the dimension of temporality, because it demands of the addressees – be they characters in the story, readers, or speakers themselves (in the case of unconscious irony) – that they invest time to *realize* (in the sense of understand *and* produce) the ironic discontinuity. Duration is a vital component of "what one means" in de Man's conception of irony.

Jacques Derrida's (see 1982: 3–27) term *différance* points to the postponement of stable signification upon which language is based in discourse. Such an operative principle creates only the illusion of the symbol's presence, while its functioning depends on its virtuality and relationality. The irony of the process of signification lies in the unbreachable gulf between the symbolic idealizations which claim direct referentiality and Derridean *trace*, which the Real – as unsymbolized and impossible to be symbolized – leaves as a rupture in metaphysics, as a pattern of incongruities within the text. The realization of the desire for presence is, ironically and indefinitely, postponed on account of the very nature of that desire, which is symbolically structured and conditioned by the lack in the Symbolic. The encounter with the Real of desire is always "missed" (see Lacan 1978: 55) since we can think it only belatedly and retrospectively, when we are reintegrated into the Symbolic, from which point the Real is a gap, an emptiness.

The operative mechanism of trauma in psychoanalysis coincides with the ironic discontinuities of the process of signification. The symptom emerges as an emissary of the Real directed at the big Other (see Žižek 2006: 11), but only belatedly, following the traumatic experience, which is, by definition, too extreme for the experiencing subject to be symbolized with available resources. The post-traumatic nature of trauma makes poignantly overt the irony which structures our psychic worlds – every experience is indirect for the symbolizing mind and the symbol will never grasp the *thing* (see Žižek 1989: 148). The illusion of presence masks that fact, but trauma makes it palpable symptomatically. Traumatized subjects can no longer act as if the meaning-making structures of the Imaginary-Symbolic planes map onto the experiencing reality in a direct way. They are instead forced to compulsively repeat their traumas in order to gain a modicum of a sense of reality, since traumas stand for their "missed encounter" with the Real, regardless of how uncanny (*unheimlich*) that sense of reality may be. Dolar transposes this narrative of the uncanny of (post)traumatic repetition to a wider ideological and culturological level when he stresses that the uncanny is "closely linked with the advent of modernity and [that it] constantly haunts it from the inside" (1991: 7). Such a worldview almost exclusively makes up the background of Ishiguro's narratives.

Georg Lukács, in his study *The Theory of the Novel*, remarked that “self-recognition and, with it, self-abolition of subjectivity was called irony by the first theoreticians of the novel, the aesthetic philosophers of early Romanticism” (1971: 74). From the period of Romanticism, subjectivity was no longer thought of as normatively creative, ascribing meaning through art to a dissonant fragility of the world, but recognized as an interiority, which makes dissonance the form of art, abolishing itself in the process. Lukács noted that “the immanence of meaning required by the form is attained precisely when the author goes all the way, ruthlessly, towards exposing its absence. Art always says ‘And yet!’ to life” (1971: 72). Romantic irony implies a sense of detachment and suspended judgement necessitated by a world which is no longer experienced as external to the subject, but as dependent on the perspective of the subject’s interiority. Such a stance is only further deepened in (post)modern literature, which exponentially complicates the ontological unreliability of the subject in literature (see McHale 1987: 39–40). Ontological unreliability implies the lack of a stable referential point or context in reference to which one could determine levels of reliability of the narrative speaker. It posits a relational point of reference, which depends on other points it can relate to, but without recourse to an overarching system or an immovable center. Ishiguro’s authorial choice has consistently been ontological unreliability since he places his narrators within worlds which are increasingly anxiety-inducing in denying individuals a stable, operative social and cultural paradigm that they could rely and depend on. Agamben’s notion of the “destruction of experience” (see Mathews 2017) and Bauman’s “liquid modernity” (see Wang 2012) both point to the displacement of fear so characteristic of Ishiguro’s characters.

3. LEVELS OF IRONY IN NOCTURNES

Despite focusing his analysis on Ishiguro’s formal modes of integrating suspicion into his narratives, Battersby still points out that “Ishiguro criticism has understandably tended to be less interested in the author’s formal endeavors than his ethically freighted narrative explorations of personal and cultural memory and collective historical guilt in the aftermath of the twentieth century’s catastrophic political events” (2021: 69). While understandable, such criticism disregards that it is precisely in the communication between form and content that Ishiguro’s prose can be interpreted most authentically. Form structures the experience of reading; it is not an envelope into which content is placed. Rather, in literature which aims at structural complexity, both enter a motivated relationship (see Brooks 2001). When Battersby writes that the motivation of Ishiguro’s “characterizations is the sense of there being a disparity, tension, or dissonance between a narrator’s account and its emotional and ethical impact” (2021: 68), he highlights the formal trait of Ishiguro’s prose under examination in this paper – irony as it structures Ishiguro’s short stories on different narrative levels.

The multi-faceted quality of irony explored in this paper involves three levels. The first sheds light on the types of characters Ishiguro most frequently places at the center of his narratives. Those characters generally suppress the emotions which they are incapable of confronting. They express themselves through language which continually ironically

undermines itself, in that it never purports to fully stand behind the speaker's emotional state or attitude. From a psychoanalytic perspective, this type of behavior can be interpreted as a defense mechanism, intent on avoiding facing one's inability to bridge the gap between the idealistic illusions one has of themselves and the lack of realization of those ideals, especially pertinent to the contemporary, increasingly globalized, fast-paced, and commodified world.

The more overarching level of irony in *Nocturnes* coincides with definitions of Romantic irony. Whereas the characters in Ishiguro's stories are rarely, if at all, aware of the irony which permeates what they do and say, the narrative plot reveals the irony in the disjunction between the surface level of action and dialogue, and the implied disturbance of that surface. Romantic irony questions the straightforwardness of choice, the binary conception of fact and truth, and it highlights the inherent contradictions, aporias, and paradoxes which structure our symbolic worlds. White stresses that the "rhetorical figure of *aporia* (literally 'doubt'), in which the author signals in advance a real or feigned disbelief in the truth of his own statements, could be considered the favored stylistic device of Ironic language" (1973: 37). What is being suppressed in the stories of *Nocturnes* need not be understood as the truth whose revelation will bring about *anagnorisis* and resolution. That which is continually kept at bay is an emptiness, a sense of loss, a lack that structures modern subjectivity. The protagonists of Ishiguro's short stories are all *flâneurs*, wandering around, detached from the fabric of society which would ground them and provide them with a stability at least rooted in tradition or a collective identity. They make sporadic attempts at genuine communication and connection, but Ishiguro does not allow constellations of that kind. The world he portrays is one where cultures, historical periods, sensibilities, and ideologies clash without recourse to a language which would foster meaningful and purposeful communication. Most often, his narratives leave the reader uncomfortable in intentionally failing to provide an ordered, coherent, and comforting conclusion to questions of how to authentically live one's life.

The final level of irony concerns the structural paradigm employed in the stories to signal the ideological presuppositions upon which they are based. In *Nocturnes*, that paradigm is closely aligned with music, especially sentimental ("crooner") music, jazz, soul, classical, and ethnic music, all of which have associations with the romantic and the sublime. Structural irony only appears not to be dominant in Ishiguro's short stories since he does not overtly deconstruct conventions of genre. However, he does employ music and its formal qualities as the connecting strands of the stories. What is crucial to note is that music in *Nocturnes* is not just a permeating motif, but primarily a structural paradigm. The aspect of music which is conventionally implied and throughout the stories undermined is its unmediated, and in conjunction, essentialist emotional impact, which further involves its almost divine, opaque nature. This undermining complements Ishiguro's previously mentioned technique of ironically juxtaposing the build-up of expectations of the characters, the plot, and the ideology of the fictional world, on the one hand, and their continual and culminative betrayal, on the other. In addition to this binary interpretation, stands the tentative affirmation of music as a configuring, creative operative paradigm for

identity construction, strengthening affiliation, and making sense of the contingent, complex social reality.

In “Come Rain or Come Shine”, Ray, a 47-year-old ESL teacher, who wanders through European countries, disengaged from any community which might provide him with a grounded sense of identity, is used by his university friend Charlie “[t]o be Mr Perspective” (2009: 51) for Charlie’s wife Emily, to help her realize that her husband is superior to the likes of Ray. While Charlie and Emily project the issues they are unable to face in their marriage onto Ray, Ray apparently plays his part without almost any sense of ego. The way he portrays his relationship with Emily and Charles reveals his desire to be considered relevant, a part of their family, even expressing disappointment over their not having children to whom he could be godfather. His desire for belonging implicitly permeates his supposedly nonchalant comments about how Emily and he share an other-worldly connection through music, how he experiences particular pride in being welcomed to his friends’ house with a room prepared especially for him, how he feels restless when alone at his own home, but at peace when alone at other people’s homes. However, his loneliness and the depletion of his ego are never stated explicitly. When he tears a page from Emily’s journal where she describes him as the “Prince of Whiners” (2009: 56), Ray considers explaining himself honestly and expressing his hurt, but concludes: “I could sense something there – something near the bottom of it, something I didn’t care to examine too closely – that I knew would make it an impossibility for me” (2009: 62). Emotional suppression functions as a defense mechanism against the realization of the ironic discrepancy between Ray’s imagined ideal of belonging and that ideal’s reduction to pragmatic insignificance, its basis in lack. Ultimately, he humiliates himself before Emily in a grotesque tableau, but even that scene is inconsequential. The only moment of recognition regarding what implications his visit might have had for his sense of identity is the typically Ishigurian traumatic moment of detached realization that the protagonist is crying. “I realized my eyes had filled with tears” (2009: 85), Ray remarks symptomatically. Duration, which is required for realizing *what is meant* in this ironic discontinuity, for Ray marks the distance between his ideal self and that which leaves his already unstable identity without any grounding. The vacuum of consoling wish-fulfillment while dancing with Emily on the terrace to the music of Sarah Vaughan ends the story, but the tragic irony of the casserole in the kitchen and with it the world in which Ray’s role is barely peripheral to those who for him are some of the last pillars of meaning and sense, inescapably await him.

Not only the *metatropological*, but also the *transideological* nature of irony is exemplified in the first story in the collection, “Crooner”. The 27-year-long marriage between an American “crooner” singer Tony Gardner and his wife Lindy is gradually revealed in its complexity (and simplicity) in the shifting perspective of the narrator, guitarist Jan, who used to live in one of the communist countries behind the Iron Curtain, but is now in Venice, playing for whichever café orchestra has an opening slot. Music is right from the beginning of “Crooner” portrayed as reduced to an atmospheric supplement, a commercialized, repetitive repertoire which serves the non-specific tastes of the

globalized stream of tourists (see Ishiguro 2009: 4–5). Whitehead notices that: “If music can, at its best, offer a momentary glimpse of a better world it is, it seems, only a fleeting escape from the pressures and constraints of the market” (2021: 28). The music of Tony Gardner is, for Jan at least, supposed to represent both a fond memory of his mother and their relationship, and a linear movement toward progress, from communism to a liberal democracy. Jan’s mother used to listen to Tony Gardner whenever her relationships would fall apart, projecting herself into the sentimentally romantic sensibility of the songs, and later, Jan would hunt down Gardner’s records from the black market in Warsaw, to replace his mother’s worn-out ones, bringing back home a taste of the West. However, the imminent dissolution of Tony and Lindy’s marriage demonstrates to Jan the irony behind ideals of romantic love when faced with the demands of the capitalist market, and behind liberal democracies when they betray opportunism and calculation as even the basis of most intimate relationships (see Ishiguro 2009: 31–32). The power dynamic between the West and the East qualifies the exchange between Tony and Jan, who accepts to accompany him in serenading Lindy, only to ultimately realize that the serenade is not an expression of Tony’s devotion, but a farewell. Divorce is accepted by both Tony and Lindy as the inevitable outcome of the market forces dominating the sphere of intimacy. He will find a younger wife to complement his comeback to the music scene, and she can likewise move on, as if a contract of mutual benefit had arrived at its natural conclusion. No ideology appears as dominant in this story and genuine personal affiliation seems to only emerge in circumstances which allow it as the only recourse for stability, as in the case of Jan’s mother. The disillusionment which strikes Jan following this ironic turn of events does not initiate a reframing of what he considers to be reality. Alongside other Ishiguro’s protagonists, he silently accepts the circumstances of a relativist worldview, comments that “Mr Gardner had seemed a pretty decent guy” (Ishiguro 2009: 33) and carries on trying to survive by making a living in Venice.

Lindy Gardner appears again as a character in “Nocturne”, only now following her divorce and from the perspective of Steve, a middle-aged saxophonist who confesses that only in his “innermost dreams [is he] still a jazz player”; otherwise, he is “just a jobbing tenor man, in reasonable demand for studio work, or when a band’s lost their regular guy” (Ishiguro 2009: 127). Steve would like the option of having his music appreciated for its quality and not having to participate in the “game” of “image, marketability, being in magazines and on TV shows, [caring] about parties and who you ate lunch with” (Ishiguro 2009: 131). The relentless market, however, pushes him into accepting his soon-to-be ex-wife Helen’s offer of her new partner covering Steve’s facial plastic surgery, as a recompense for leaving him. Like in “Crooner”, (tragic) conformism to the increasingly commodifying capitalist market emerges as an unavoidable choice if one desires to participate in the world at large. And not just in a professional sense, but in the private sphere, as well, since Steve clings to his manager’s idea that Helen had concocted this elaborate scheme of leaving him only for him to have the surgery that will make his music marketable and ultimately bring her back to him.

Even though Lindy epitomizes for Steve “everything that was shallow and sickening about the world” (Ishiguro 2009: 137), once he gets to know her in the hotel where they are both recovering from plastic operations, with their faces bandaged up, he can no longer project a simplistic image onto her. In the limbo of facelessness, they reveal to each other what is usually hidden behind presentable social masks. Lindy lives in a fantasy world of her own making, but one that caters to the demands of the social reality they both belong to. She performs “talent”, even though she has little of it, while Steve has talent, but does not possess the means of platforming it for the public. In discussing hard work versus talent and entertainment industry demands versus moral idealism and professional integrity, no side prevails as the indisputable truth. It is only momentarily that the inherent contradictions of the symbolic world both Lindy and Steve inhabit are brought to light. Irony is present on all three levels in “Nocturne”, which are interwoven throughout the story: the discrepancy between idealistic notions of inherent value and their reduction to pragmatic realism; the aporias of irreducible binaries which demand a sense of detachment to stave off the realization of the lack which structures subjectivity; and the structural dethroning of the essentialism ascribed to music and its romantic sublimity, which fails to definitively save humanity. However, irony does not close off the process of signification. Precisely because it is procedural, it collides Lindy’s “life’s so much bigger than just loving someone” (Ishiguro 2009: 182) with Steve’s five interspersed maybe’s which close the story in reference to his and Helen’s routine I-love-you’s on the phone (Ishiguro 2009: 184–185).

The dynamic between Steve and Lindy is further explored in “Cellists”, between Tibor, a young Hungarian cellist with an enviable education in music, but currently out of a job, and Eloise McCormack, an American woman in her 40’s who takes Tibor under her wing and claims to be a “distinguished musician” (Ishiguro 2009: 197), but eventually confesses that she had never learned to play the cello. Eloise proposes to tutor Tibor while they are both on the Adriatic coast in Italy, in a town neither considers home. Both participate in a virtual space where they employ music to express their desires in a relational sense. Tibor’s playing and Eloise’s verbal guidance translate the field of music into the emotional playground, where they both display vulnerability, at least following Eloise’s covert confession regarding her self-destructive perfectionism. However, she ultimately leaves for America with her suitor Peter from Oregon, renouncing the relationship in which her idealism would continually be ironized, but also one in which she could genuinely act in accordance with her desire, exchanging it for a marriage in which she can be safe, as an object. “He’s found me, so I guess he deserves me,” (Ishiguro 2009: 218), Eloise says of Peter. All the planes collide in this final story of the collection. The West and the East, performative/symbolic aura of worth and unrecognized talent in the commodified market, capitalist notions of economic exchange and romantic notions of emotional sublimity. But even though music is ironized as an ephemeral, transient embodiment of personal utopian projections, it remains the affective fabric of memories, yearnings, and structures of feeling. Irony does not resolve aporias; it reveals them, belatedly and traumatically, but also loyally to the human condition, especially in the contemporary Western world.

4. CONCLUSION

The different layers of irony explored in Ishiguro's only collection of short stories *Nocturnes* reveal a worldview conditioned by inherent structural contradictions, defense mechanisms which aim at metaphysical consolation, and a dynamic conformism to the demands which idealism and integrity face by the ruthless drives of the capitalist market. Poststructuralist and psychoanalyst frameworks for the theoretical elaboration of irony formed an especially generative model for the analysis of Ishiguro's short prose since they stress the destabilization of supposedly straightforward meaning-making processes, the belated trauma of realizing the lack which structures subjectivity, the haunted state of modernity, and the perspectivism which underlies textual incongruities that are not meant to be solved, but to signify. The analyzed short stories demonstrate levels of irony which encompass characterization, narrative emplotment, and the ideological presuppositions of the narrative structure. Ironic discontinuities emerge in the gap between sublime idealism and performative pragmatism, in the indeterminacy of either ideological or affiliative practice, and in the structural inadequacies of music to embody an essentialist paradigm of aesthetic and ethical value, alongside its role in continuing to generate meaning, regardless of how ephemeral it may be.

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ROMKINJE U SVETU PREDUZETNIŠTVA: MOGUĆNOSTI I IZAZOVI ZA AKTIVNU PARTICIPACIJU I JAČANJE SOCIO- EKONOMSKE RESURSNE BAZE

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SAŽETAK:

Rad stavlja u fokus dinamičan i kompleksan odnos između položaja žena preduzetnica pripadnica marginalizovanih društvenih slojeva i mogućnosti za jačanje njihove socio-ekonomske resursne baze. Imajući u vidu da je njihov društveni, ali i položaj na tržištu ograničeni brojnim faktorima, predrasudama i stereotipa, rad otvara pitanje samopercepcije sopstvenog položaja od strane žena koje su se odlučile da otvore i vode sopstvene biznise. Odnosno, u radu je korištena fokus grupa, kao oblik grupnog intervjua, koja je okupila šest učesnica iz romske populacije koje su preduzetnice. Cilj fokus grupe bio je usmeren na razmeni ideja o različitim teškoćama kada su u pitanju gorenavedeni problem. U zaključnim razmatranjima, ostavljen je prostor za diskusiju o praktičnijim strategijama za uključivanje Romkinja na tržište rada, što će imati pozitivne implikacije i na uključivanje u društvene tokove.

Ključne riječi: *preduzetništvo, Romkinje, tržište rada, diskriminacija i predrasude.*

1. UVOD

Pregled vodećih teorijskih stavova podrazumeva kratko strukturisanje najvažnijih pogleda na pitanje ženskog preduzetništva i sumiranje njegovih osnovnih karakteristika. Široka ekonomska i društvena dobrobit preduzetništva predstavlja saznanje koje je opšteprihvaćeno u svetskim i domaćim izvorima (Drucker, 1985; Bolčić, 2008; Babović, 2012), a posebno pitanje jeste kategorija ženskog preduzetništva. Autori navode da postoje brojna ograničenja za razvoj ženskog preduzetništva na teritoriji Republike Srbije, poput pitanja njegove održivosti, manjka prosebnih razvojnih programa ženskog preduzetništva

i slabe ekonomske snage ženskih preduzeća (Popović & Pantić, 2014). Međutim, ono što ide na ruku ženama preduzetnicama jeste „*snažno izražena želja za autonomijom u radu, za samostalnim poslovnim poduhvatima, i rešenost da se ne odustaje lako (nakon prvog pokušaja)*“ (Babović, 2012: 9). Sa druge strane, neki izvori govore da se preduzetništvo često stereotipizovano shvata kao mesto muške dominacije i njihovo prirodno polje (Heilman, 2001; Powell et al., 2002; Marlow and Carter, 2004). Uz to se navodi da postoji i disproporcija između žena i muškaraca na rukovodećim položajima u domenu preduzetništva i ličnog vlasništva, kao i različitim motivima da se postane samozaposlen (Stanković & Marković, 2011, Blagojević & Hjuson, 2012). Smatra se da su žene više fokusirane na motive samopostignuća i samostalnosti, a manje na isključivo ekonomski/profitni aspekt. Sa druge strane, Romi predstavljaju najbrojniju i najugroženiju etničku grupu u Srbiji, uz činjenicu da u određenim istraživanjima „*nije bilo moguće utvrditi broj registrovanih preduzetnika u Republici Srbiji koji su pripadnici romske etničke zajednice*“, pošto se „*pri registraciji preduzetnika ne vodi se evidencija o njihovoj etničkoj pripadnosti, te ne postoje zvanični podaci o broju romskih preduzetnika*“ (Žarković, Sovrlić, Kražić Živković & Mijačić, 2016: 2). Pošto se, generalno smatra da se romsko preduzetništvo nalazi u nepovoljnijem položaju od ostalih njegovih formi (Žarković, Sovrlić, Kražić Živković & Mijačić 2016), tako, u ovom trenutku možemo da postavimo pitanje da li uz sva navedena ograničenja postoje i onda dodatna kada je reč o ženama preduzetnicama pripadnicama marginalizovanih društvenih slojeva, poput romske populacije?

2. PREDMET I CILJ ISTRAŽIVANJA

Predmet istraživanja jesu karakteristike i samopercepcija položaja, mogućnosti i ograničenja žena preduzetnica, koje su ne samo opterećene rodnim i klasičnim poslovnim stegama, nego su istovremeno i pripadnice nacionalne manjine.

Rad ima za cilj da postavi nekoliko ključnih istraživačkih pitanja u pogledu višeslojne relacije koja postoji između položaja i uloga pripadnica romske populacije u sferi preduzetništva/samozapošljavanja, kako bi se detektovale njihove percepcije o sopstvenim mogućnostima, preprekama i izazovima u radu i svakodnevici.

Kao što je već istaknuto u apstraktu, ključna pitanja i okosnica empirijskog dela rada bili su usmereni ka:

1. detektovanju osnovnih karakteristika položaja na tržištu rada društveno osetljivih grupa - žena pripadnica romske populacije i potencijalnih prednosti/problema sa kojima se svakodnevno suočavaju,

2. mogućnostima i potencijalu ovog društvenog i ekonomskog podsloja i grupacije (Romkinje - preduzetnice) da aktivno participiraju u percepciji i promenama sopstvenog položaja,

3. percepciji opšte društvene i ekonomske klime za razvoj poslovanja i preduzetničkih kapaciteta Romkinja,

4. analizi potencijalnih kanala komunikacije, digitalnog marketinga i alata za promenu društvenog položaja u kontekstu jačanja preduzetničkih kapaciteta i socijalnog kapitala,

5. ulozi i značaju ličnog iskustva, primera dobre prakse, solidarnosti, socijalnog preduzetništva i savremenih tržišnih tendencija,

6. značaju i ulozi negovanja autentičnosti i ličnog pečata u poslu,

7. podizanju stepena informisanosti opšte populacije po gorenavedenim problemima - koliko se poznajemo?

3. METODOLOGIJA ISTRAŽIVANJA

Sprovedeno istraživanje bazirano je na primeni kvalitativnog metoda¹ putem realizacije razgovora baziranih na protokolu karakterističnom za fokus grupe. Metod fokus grupa odabran je u skladu sa obeležjima predmeta istraživanja i potrebom da se dublje istraže stavovi, uverenja i percepcije pripadnica romske populacije u svetu preduzetništva. Fokus grupe podrazumevale su dinamični i interaktivni razgovor između 6 preduzetnica u intervalu od više meseci, tokom kojih su od strane istraživača prikupljani podaci u vezi sa njihovim stavovima o ženskom preduzetništvu i mestu koje Romkinje mogu imati u sferi samozapošljavanja.

Istraživanje, kao i sami razgovori prethodno su planski osmišljeni, poštujući pravila, sugestije i moguća ograničenja u vezi sa primenom metoda fokus grupa (Morgan, 1997; Smithson, 2000; Lane, McKenna, Ryan, Fleming, 2002; Kreuger, 1998; Sagoe, 2012)².

¹Prilikom odabira kvalitativnog metoda i analize njegovih ključnih karakteristika konsultovani su brojni metodološki izvori - Halmi, 2005; Esterberg, 2002; Denzin, 1989; Gubrium, Holstein, 1997; Patton, 1990). Zaključeno je da u skladu sa navedenim izvorima i za potrebe ovog istraživanja, u njemu primenjeni kvalitativni metod možemo posmatrati kao način dinamične interpretacije pružanja smisla, pravilnosti i naučnih obrazaca u stavovima ispitanica, uz poštovanje otvorenosti i multidimenzionalnosti odnosa između položaja žena preduzetnica marginalizovanih društvenih grupa i mogućnosti jačanja njihove socio-ekonomske baze.

²Radi se o brojnim pitanjima koja navedena literature ističe kada je reč o primeni naučnog razgovora putem fokus grupa - poput (Smithson, 2000: 115) *“dominantnih glasova, konstruisanja drugog, normativnog diskursa ili korišćenja fokus grupa za proučavanje*

Prvenstveno su targetirane osnovne zajedničke karakteristike ispitanica (preduzetnice, pripadnice romske populacije), koje su činile okosnicu, odnosno metodološko jezgro uzorka.

Istraživanje je sprovedeno na teritoriji Novog Sada, iako se ispitanice mestom svog života i rada vezuju za više mesta i gradova na području Južnobačkog okruga. Prosečna starost učesnica istraživanja bila je 34 godine. Takođe, istraživači kao moderatori razgovora težili su da i pored potrebne pripreme i planski osmišljenih žarišta diskusija, poštuju nesmetanu razmenu informacija, vrednosti i uverenja ispitanica o različitim aspektima problema ženskog preduzetništva osetljivih/marginalizovanih društvenih podgrupa (nacionalnih manjina), poput romske populacije. Interpretacija prikupljenih podataka bazirala se na uočavanje ponovljenih obrazaca, kao i na sličnostima i razlikama u odgovorima ispitanica. Komparacija njihovih refleksija i uočavanje onoga što se može izvesti kao zajednički imenitelj prikazana je u nastavku teksta. Sve originalne rečenice sagovornica citirane su i pretočene u pisanu formu, na osnovu audio zapisa sa održavanja fokus grupa, kako bi se zadržao moment autentičnosti i relevantnosti zaključaka.

3. REZULTATI ISTRAŽIVANJA

U diskusiji, tokom primene metoda fokus grupa, sagovornice su istakle da su se često osećale kao da su ponekada sve morale same i da im je nedostajalo zvanične institucionalne podrške, kao i da privatni posao konstantno iziskuje ulaganja i izvore prihoda. Primećen je obrazac koji se često ponavljao u zabeleženim rečima ispitanica, a to je da postoji određena odrođenost nadležnih institucija od stvarnih, životnih problema preduzetnika. Taj povremeni osećaj diskonekcije sa donosiocima odluka i predstavnicima institucija jedan je od faktora koji uliva nesigurnost i odbojnost u namerama Romkinja preduzetnica da započnu i/ili razviju svoj posao.

“Mislim da ti pozivi i konkursi ne dolaze do onih kojima su najpotrebniji. Manje ili više se u tim pozivima vrte isti ljudi, dok većina ostaju neinformisani. Ne vidim tu dovoljno žena iz marginalizovanih grupa. Treba nam pomoći, ali ne na papiru, nego u realnosti” (sagovornica 1). Kao posebno osetljiv i najmanje informisan deo žena preduzetnica iz romske populacije se navode žene sa sela. *“Mislim da bi tu trebalo doći lično, da im se predoče i objasne njihove mogućnosti”* (sagovornica 2).

sukoba i kontradiktornosti”, zatim pitanja *“segmentacije”* i *“homogenosti”* o kojima govori Morgan (Morgan, 1997), ili pak koncepcije razmišljanja *“da je velika snaga metodologije fokus grupa visok nivo doprinosa koji učesnici daju istraživanju”* (Sagoe, 2012: 5).

Najviše ih je mučilo/plašilo da li će im uloženi novac biti vraćen, da li će se njihova ulaganja, trud i rad isplatiti. One se zaista vode racionalnim motivima, iako iza lične i poslovne priče svake od njih stoji čitav splet pomešanih emocija i želje za samostalnim uspehom. Neizvesnost posla, tržišta i poslovanja im predstavlja veliki problem, posebno za male proizvođače ili pružaoce usluga. Veliko pitanje za njih i njihova poslovanja bilo je da li je i kako moguće povratiti uloženi novac, uz nesigurnost vremenskih okvira koji su potrebni za tako nešto. *“Sve ovo je za nas veliki rizik sa kojim moramo da živimo”* (sagovornica 6).

Povezano sa tim osećajima u poslovanju, često se može primetiti i doza straha da li će postići uspeh i da li će se ostvariti u svom poslu. Problemi u poslovanju su brojni, a mnoge strahuju i od 1. nelojalne konkurencije, 2. velikih lanaca na tržištu, 3. monopola u određenim proizvodnim granama, 4. mogućnosti dolaska do klijenata i 5. generalno početaka, koji su uvek izuzetno teški.

Istaknuta je velika uloga današnjih sredstava za komunikaciju i društvenih mreža za razvoj posla od strane učesnica fokus grupnih razgovora. Ono što je interesantno primetiti jeste da su zabeleženi i praktični moment razgovora, gde su prodeuzetnice međusobno razmenjivale različite metode i tehnike za reklamiranje u savremenom digitalnom svetu. Međutim, neke od njih su istakle i da još uvek važi i vredí preporuka od usta do usta, odnosno na osnovu ličnih iskustava i kontakata. Takođe, istaknuto je i koliko se one same osećaju srećno kada vide da im se klijenti vraćaju i da imaju osmeh na licu. *“Najviše me raduje kada vidim da sam dobro obavila svoj posao i da ljudi žele ponovo da dođu kod mene”* (sagovornica 6).

Neke od učesnica su istakle i da nisu bile u potpunosti zadovoljne nekim onlajn edukacijama i da su se najbolje osećale na individualnim učenjima, u vezi sa svojim poslom i strukom. Takođe, opšti utisak je i da je uvek izuzetno teško početi i da počeci mogu biti veoma teški. „Probiti se“ na tržište, kako one to opisuju, nije ni malo lak posao. U poslu im je izuzetno bitno da osećaju podršku zajednice, da šire mrežu kontakata (rastući efekat socijalnog kapitala), ali i da osećaju svojevrsnu dozu nezavisnosti. Osećaj da su nezavisne (finansijfski pre svega) od ostalih muških članova porodice budi u njima percepciju sebe kao uspešne žene, koja je u stanju da se izbori sama za sebe. To je slika žene koja je, kako kažu, multifunkcionalna. To znači da je istovremeno „na sve strane“ (sagovornica 4) i da obavlja više uloga i funkcija istovremeno. Ponekada je ona istovremeno i knjigovođa i blagajnik i direktor, ali i spremačica i domaćica.

Mnoge od njih su se susrele sa preranim osuđivanjem od strane društva i primarne društvene sredine, kada su imale osećaj da niko ne vidi ili neće da vidi koliko su one truda, rada i sebe uložile u svoje poslove, ali i konstantne edukacije i usvajanja novih znanja. Radi se o efektu nevidljivosti pripadnika određenih društvenih slojeva ili (pod)grupa.

Sagovornice primećuju da zlonamerni pojedinci često vide samo završni produkti i krajnji rezultat njihovog rada, ali da nikoga ne interesuje šta stoji iza površine i spoljašnjosti i koliko su se one zapravo potrudile da budu tu gde jesu. Percipiraju sebe i slične sebi, kao nekoga ko je izložen stalnim (društvenim) pritiscima, osudama i omalovažavanjima. *“Možda sam najviše osuda dobila od muževih roditelja, u početku, ali se zaista kasnije i to promenilo kada su videli kako i šta radim i privredjujem”* (sagovornica 2). Pored šire zajednice, podrška porodice (kao najvažnije društvene grupe) se za njih, takođe, pokazuje kao izuzetno važna. Bez nje bi osećale disbalans i neravnotežu u životnim odlukama i procesima. Porodica je sigurno mesto i izvor motivacije, kako bi one same bile još bolje i uspešnije, kako za svoju celokupnu porodicu, ali i za same sebe.

“Sigurno je ženama teško kada žele da započnu svoj posao, a čuju reći iz svoje okoline – šta sad ti hoćeš? Šta sad izmišljaš? Nije ti dovoljno ovo što imaš. Ima i ovako dovoljno posla oko kuće” (sagovornica 5).

Međutim, motiv nezavisnosti je ponovo prisutan. *“Možda mi želimo da se oprobamo i u nečemu novom i uspemo”* (sagovornica 5) Izazov je uklopiti sve obaveze (radne i porodične) na svakodnevnom nivou.

Neke od sagovornica istakle su i da u samom startu nisu bile sigurne i i nisu znale šta zapravo znači u praksi biti preduzetnica. Nisu bile upoznate sa svim odgovornostima i izazovima koje ovaj posao nosi sa sobom. Jedna preduzetnica istakla je da je nepravедно da mali proizvođači nose istu odgovornost kao i velike multinacionalne kompanije i da *„ona nije Loreal, pa da mora da plaća sve poreze i cene kao i oni“* (sagovornica 1). Suštinski utisak je da se mnogo više očekuje na zaštiti malih proizvođača i preduzetnika, makar u vidu omogućavanja poštenih uslova za poslovanje na tržištu. U skladu sa tim, neke od preduzetnica govorile su i o kursovima prelaska sa tradicionalnog na moderno poslovanje i pozitivnim efektima takve prakse. *“Država je ta koja mora da omogući pozitivnu poslovnu klimu za sve, pa i za nas male proizvođače”* (sagovornica 3). Preduzetništvo iziskuje stalna ulaganja i zahteva da mu se posvetite. Ne trpi trajnost i zanemarivanje. Ono je dimenzijski i višeslojan posao, posao koji prirašta za srce. Čak, kažu one, danas nije dovoljno raditi i živeti od jednog posla. Moramo stalno biti angažovane na više polja i kroz više aktivnosti. Danas se život ostvaruje i za njega se zarađuje na mnogo načina, retko ko ima privilegiju da živi samo od jednog posla. Sa druge strane, jedan od njihovih osnovnih strahova je da li će uspeti da pokriju svaki aspekt svog poslovanja, jer, kako kažu, *“ne žele da duguju nikome ništa, posebno ne državi”* (sagovornica 6).

Primećeno je da su ciljevi i motivi učesnica fokus grupnih razgovora da govore o sebi, svojim emocijama, poslu i životnim odlukama i izborima na kraju prevazišli prvobitne okvire postavljenih ciljeva istraživanja. Ispitanice su u prenesenom značenju “uronile” u interakciju koja je podrazumevala - međusobnu pomoć, osećaj bliskosti, empatije,

solidarnosti, udruživanja, timskog rada, deljenja sličnih iskustava, razmene znanja i mišljenja, zajedničke diskusije na različite teme. Sa druge strane, sve to su videle kao korak ka daljem procesu sitcanja pune nezavisnosti, vere u sebe i osećaja postignuća. Tokom fokus grupnih razgovora, sagovornice su pokazale visok stepen adaptacije, prilagođavanja izmenjenim ili novim uslovima koje poslovanje stalno iziskuje i spremnost da uče i usavršavaju se. Većina učesnica pokazala je i potencijal i želju da se angažuje i u međunarodnim organizacijama, a neke od njih to vrlo uspešno čine za sada. Pored velike volje i želje da uspeju na međunarodnom planu, osećaju da bi nepoznavanje jezika i formalnih procedura moglo biti potencijalno najveća prepreka.

5. ZAKLJUČNA RAZMATRANJA - (ne)svetla budućnost žena preduzetnica pripadnica marginalizovanih društvenih grupa

Potencijalna ograničenja istraživanja poklapaju se sa standardnim prigovorima koji se mogu uputiti kvalitativnim istraživačkim metodama i podacima dobijenim putem primene fokus grupa. Međutim, iako istraživanje nije imalo za cilj strogu kvantifikaciju dobijenih podatak, već naprotiv analizu stavova, percepcije i samopogleda na sopstveni društveni i tržišni položaj, ovi metodi i tehnike pokazali su se kao produktivni i primereni. Imajući u vidu da sfera ženskog preduzetništva, a pogotovu preduzetništva pripadnica nacionalnih manjina još uvek predstavlja nedovoljno istražen fenomen, podaci do kojih se došlo ovim razgovorima mogu pružiti relevantan okvir za sva buduća istraživanja različitih aspekata (ne)svetle budućnosti samozapošljivosti žena iz dodatno osetljivih društvenih grupa. Iako višestruko opterećene, suočene sa brojnim društvenim i poslovnim izazovima preduzetnice pripadnice romske populacije pokazuju visok stepen otpornosti, zainteresovanosti i želje da sebe i svoje okruženje obogate i oplemene putem izmene klasičnih radnih uloga u neke sasvim nove obrasce. To iz stručne perspektive možemo nazvati delom procesa transformacije ženskih radnih uloga i položaja. Stoga se zaključuje da samozapoljavanje jeste jedan od mehanizam za izmenu tradicionalnih kulturnih i tržišnih obrazaca i ustaljenih načina razmišljanja. Međutim, i pored niza uspešnih primera i pozitivnih samopercepcija žena preduzetnica iz romske populacije, ostaje evidentno da je postoji ogroman prostor za poboljšanje njihovih opštih životnih i radnih uslova, putem izmene višestrukih relevantnih faktora. Radi se pre svega, o 1. podizanju stepena njihove društvene vidljivosti, 2. pružanja početne podrške u pokretanju njihovih poslovanja, 3. snažnije, konkretnije i energičnije uloge zvaničnog institucionalnog sistema u jačanju njihove preduzetničke baze i socijalnog kapitala 4. stimulisanju njihovog poslovanja različitim kreditnim, projektnim i konkursnim linija 5. pružanju ne samo materijalne, već

i logističke i savetodavne pomoći institucija u njihovom radu 6. borbi protiv predrasuda i stereotipa, uz pružanje podrške kako bi uspele da postignu balans u svojim životima (prepletanje radnih i porodičnih uloga) 7. jačanju njihovih saznanja o važnosti upotrebe različitih savremenih kanala komunikacije i digitalnog marketinga 8. podizanju svesti o značaju autentičnosti usluge ili preduzetničkog proizvoda, imajući u vidu visok stepen prisutnosti konkurencije na tržištu 9. sistemskom i kontinuiranom jačanju njihovih kapaciteta za učenjem i sticanjem novih znanja i veština (jezika, digitalne pismenosti i sl.) 10. jačanju njihove resursne baze i osnove socijalnog kapitala sa kojim raspolažu. Naposljetku, možemo zaključiti da se rezultati istraživanja poklapaju sa slikom žene preduzetnice kao osobe čije se poslovanje (barem za sada) vezuje za mikrookvir – *“preduzetništvo žena je domanantno mikropreduzetništvo”* (Babović, 2012: 129), uz fokus na trgovinsku ili uslužnu delatnost (Stanković, Marković, 2011) u okviru koje dominiraju i poslovi sagovornica u ovom istraživanju.

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**ROMA WOMEN IN THE WORLD OF ENTREPRENEURSHIP:
OPPORTUNITIES AND CHALLENGES FOR ACTIVE PARTICIPATION AND
STRENGTHENING OF THE SOCIO-ECONOMIC RESOURCE BASE**

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ABSTRACT:

The paper focuses on the dynamic and complex relationship between the position of women entrepreneurs belonging to marginalized social strata and the opportunities for strengthening their socio-economic resource base. Bearing in mind that their social and market position is limited by numerous factors, prejudices and stereotypes, the paper raises the question of self-perception of their own position by women who have decided to open and run their own businesses. Research used a focus group, as a form of group intervju, which brought together six participants from the Roma population who are entrepreneurs. The goal of focus group was aimed at exchanging ideas about the various difficulties when it comes to the above-mentioned problem. In the concluding remarks, room was left for discussion of more practical strategies for the inclusion of Roma women in the labor market, which will have positive implications for inclusion in social flows as well.

Keywords: entrepreneurship, Roma women, labor market, discrimination and prejudice.

FAKTORI MOTIVACIJE U MARKETING TIMU

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SAŽETAK:

Polazeći od značaja teorija motivacije u domenu menadžmenta organizacije, cilj ovog rada je da se istraže motivacioni faktori koji pokreću članove marketing tima. Istraživanje je zasnovano na primeni anketnog upitnika na uzorku od 32 ispitanika u sektoru marketinga u obrazovanju Republike Srbije, prilikom čega je ukazano na efekte motivacije na zadovoljstvo članova marketing tima i njihovu produktivnost u poslu. Prilikom obrade predmeta istraživanja pošlo se od toga da obrazovne institucije služe kao proizvođači obrazovnih usluga, koje povećavaju ljudski kapital studenata kao potrošača. Tokom obrade i analize podataka korišćena je deskriptivna statistika i t-test. Rezultati istraživanja upoređeni su sa relevantnim studijama koje su se bavile pitanjem motivacije u sektoru marketinga prilikom čega je sačinjena korisna saznanja osnova za buduća izučavanja ove oblasti.

Ključne riječi: *motivacija, faktori motivacije, marketing tim, zadovoljstvo poslom, angažovanost*

1. UVOD

Radna motivacija igra ključnu ulogu u postizanju fakultetskih ciljeva. Zaposleni u marketing timovima treba da posjeduju snažnu želju i volju da unaprede svoje napore ka ostvarenju tih ciljeva. U ovom istraživanju, fokus je stavljen na analizu radne motivacije članova marketing tima na visokoškolskim institucijama u Republici Srbiji, uzimajući u obzir njihove radne karakteristike. Cilj rada je bio da se analizira važnost koju zaposleni u oblasti marketinga pridaju pojedinim faktorima motivacije. Za analizu rezultata su korišćeni deskriptivna statistika i t-test. Inicijalni model je postavljen kao osnova za analizu radne motivacije. Deskriptivna statistika je primenjena kako bi istraživači dobili opšti uvid u radnu motivaciju članova marketing tima, kao i u strukturu uzorka prema starosti, polu i obrazovanju. Takođe, t-test je korišćen kao statistički alat za procenu srednjih vrednosti u odgovorima ispitanika. Ovaj test omogućio je istraživačima da uporede razlike između grupa i identifikuju značajne varijable koje mogu uticati na motivaciju. Rezultati ovog istraživanja pružaju korisne uvide u radnu motivaciju članova marketing tima u oblasti obrazovanja. Razumevanje faktora koji utiču na motivaciju omogućava menadžerima marketing timova da identifikuju ključne elemente i donesu informisane odluke u cilju unapređenja radne motivacije.

2. PREGLED LITERATURE

Nekada su zaposleni smatrani samo još jednim inputom u proizvodnji dobara i usluga. Međutim, istraživanje poznato kao Hawthorne studije, koje je sproveo Elton Mayo od 1924. do 1932. godine, promenilo je takav način razmišljanja o zaposlenima. Ova studija je pokazala da zaposleni nisu motivisani samo novcem i ponašanjem nadređenih, već da je motivacija povezana sa njihovim stavovima i osećajem važnosti. Hawthorne studije su započele pristup upravljanja ljudskim odnosima, pri čemu su potrebe i motivacija zaposlenih postali primarni fokus menadžera. Koncept zadovoljstva poslom je takođe dobio značajnu pažnju u istraživanjima. Značajan doprinos istraživanju zadovoljstva poslom dao je Frederick Taylor 1911. godine. On je smatrao da nagrade kao što su zarada na poslu, stimulativne isplate, unapređenje, zahvalnost i mogućnosti za napredak mogu dovesti do povećanog zadovoljstva poslom.

Različiti istraživači su definisali pojam zadovoljstva poslom na različite načine. Na primer, Wiener (1982.) navodi da je zadovoljstvo poslom stav prema uslovima, aspektima ili elementima posla. Feinstein i Vondrasek (2001) smatraju da je zadovoljstvo poslom više odgovor na određeni posao ili različite aspekte posla. Učinak zaposlenih ima značajan uticaj na organizaciju, pa menadžment treba razmotriti načine poboljšanja učinka radnika u svojim preduzećima tako što će ih podsticati da svoje zadatke i dužnosti obavljaju što efikasnije. U tom kontekstu, motivacija ima ključnu ulogu u firmama jer može pozitivno uticati na ponašanje zaposlenih. Psiholozi veruju da je motivacija proces koji pokreće pojedinca ka postizanju cilja. Osim toga, motivacija daje osobi svrhu i nagon za postizanje tih ciljeva.

Danas poslodavci pokazuju interesovanje za razumevanje motivacije i kako motivisati svoje zaposlene kako bi poboljšali produktivnost. Bez obzira na teoriju koju primenjujemo, evidentno je da su zanimljiv rad i plata ključni faktori za povećanje motivacije zaposlenih. Razmatranje opcija kao što su proširenje posla, obogaćivanje posla, unapređenje, interni i eksterni podsticaji, novčane i nematerijalne nagrade takođe može biti od koristi. Proširenje posla se može koristiti kako bi se posao učinio zanimljivijim putem povećanja broja i raznolikosti aktivnosti koje se obavljaju. Obogaćivanje posla može doprineti većem interesovanju i motivaciji zaposlenih kroz dodavanje višeg nivoa odgovornosti na posao, uz obezbeđivanje finansijske nadoknade (povišice ili stipendije) za prihvatanje te odgovornosti. Ovo su samo primeri beskrajskih metoda za povećanje motivacije zaposlenih. Ključni faktor za motivaciju zaposlenih je razumevanje njihovih motivacionih potreba i dizajniranje motivacionog programa koji se temelji na tim potrebama.

U skladu sa navedenim stavovima definisane su ključne varijable koje su korišćene u ovom istraživanju, sa ciljem da ukaže na značajne faktore motivacije marketing tima u sektoru visokog obrazovanja. Pregled literature ukazuje na postojanje nekoliko značajnih

studija koje su se bavile tematikom motivacije zaposlenih u sektoru marketinga. Levin et al. (2012) ukazuju na značaj motivacije kod zaposlenih koji se bave marketingom u sektoru maloprodaje. U studiji koju su sproveli Peñalba-Aguirrezabalaga et al. (2021) analizirana je motivacija članova marketing tima i njen uticaj na korisničko iskustvo. U aktuelnoj literaturi zastupljena su istraživanja motivacije zaposlenih koji se bave digitalnim marketingom (Azmy et al. 2022). Međutim, treba naglasiti da postoje izvesna ograničenja u pogledu istraživanja motivacije zaposlenih u sektoru visokog obrazovanja, a posebno marketing tima iz ove oblasti. Ovakvo ograničenje je ujedno bilo i jedno od polazišta istraživanja, koje treba da obezbedi doprinos upravo u prepoznavanju bitnih faktora koji će povećati motivisanost zaposlenih i radni učinak u sektoru obrazovanja.

Još jedna značajna studija (Burns et al, 2008), koja je korišćena za potrebe ovog istraživanja bavila se polnim razlikama u motivaciji studenata volontera. Nalazi do kojih su došli autori studije značajno su uticali na postavke empirijskog istraživanja iz ovog članka, koje je takođe imalo za cilj da analizira razlike u faktorima motivacije muških i ženskih ispitanika iz uzorka.

Posmatrano iz konteksta marketinga u visokom obrazovanju značajno je istaći studiju kojom su se bavili Stephenson et al. (2014). Njihov rad analizirao je motivaciju kod članova alumni kluba fakulteta, kao i njen uticaj na brendiranje u visokom obrazovanju.

2.1. Metode i rezultati istraživanja

Istraživanje je zasnovano na primeni anketnog upitnika na uzorku od 32 ispitanika u sektoru marketinga u obrazovanju Republike Srbije, prilikom čega je ukazano na važnost koju pojedini članovi marketing tima pridaju određenim faktorima motivacije, koji su značajni za zadovoljstvo poslom.

Prilikom dizajna upitnika korišćen je instrument koji je razvio autor Anđela Golubović, i koji se dokazao u praksi kao verodostojan i validan.

<https://www.morganmckinley.com/hk/employers/talent-solutions/insight/top-9-factors-impact-employee-motivation>

U obradi podataka korišćena je deskriptivna statistika sa funkcijama frekvencije, srednjih vrednosti i standardne devijacije. Prilikom poređenja srednjih vrednosti primenjen je t – test.

Opis uzorka

Uzorak je obuhvatio 32 člana marketing tima, koju su zaposleni na pet visokoobrazovnih institucija u Republici Srbiji. Struktura uzorka analizirana je prema godinama, polu i obrazovanju ispitanika, kao što je prikazano u narednim tabelama. Prema podacima iz

tabele 1 može se zapaziti da u uzorku dominiraju starosne kategorije od 20-25 godina (37,5%) i od 26-30 godina (28,1%).

Godine ispitanika					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-25	12	37.5	37.5	37.5
	26-30	9	28.1	28.1	65.6
	31-36	5	15.6	15.6	81.3
	37-42	2	6.3	6.3	87.5
	43-50	3	9.4	9.4	96.9
	50+	1	3.1	3.1	100.0
	Total	32	100.0	100.0	

Tabela 1: Starosna struktura uzorka
Izvor: Kalkulacija autora u SPSS-u

U polnoj strukturi uzorka primećena je neznatno veća zastupljenost ženskih ispitanika (frekvencija =17) naspram muških ispitanika (frekvencija =15).

Pol ispitanika					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Muški	15	46.9	46.9	46.9
	Ženski	17	53.1	53.1	100.0
	Total	32	100.0	100.0	

Obrazovanje ispitanika					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	srednje obrazovanje	4	12.5	12.5	12.5
	visoko obrazovanje - osnovne studije	14	43.8	43.8	56.3
	master studije	7	21.9	21.9	78.1
	Doktorat	7	21.9	21.9	100.0
	Total	32	100.0	100.0	

Tabela 3: Obrazovna struktura uzorka
Izvor: Kalkulacija autora u SPSS-u

Sledeća kategorija opisa uzorka odnosila se na obrazovanje. Uvidom u podatke prikazane u tabeli 3 može se zapaziti da većina ispitanika pripada obrazovnoj kategoriji – visoko obrazovanje iz domena osnovnih studija, koje čini oko 43,8% uzorka.

Analiza rezultata istraživanja

Cilj ovog rada je bio da se istraže motivacioni faktori koji pokreću članove marketing tima iz visko obrazovnih ustanova. Treba naglasiti da je uzorak obuhvatio ispitanike sa privatnih fakulteta i visokih škola u Republici Srbiji. Rezultati istraživanja predstavljeni su kroz niz parametara koji su dobijeni iz sprovedene ankete. Odgovori ispitanika rangirani su prema Likertovoj skali po važnosti, gde je 1-najmanje važno, 2-manje važno, 3-srednje važno, 4-važno, 5-veoma važno. U nastavku rada analizirani su rezultati za sedam pitanja, odnosno varijabli iz domena motivacije zaposlenih koje su identifikovane kao ključni nosioci istraživanja.

Tabela 4 prikazuje srednje vrednosti i standardne devijacije za svih sedam varijabli, na osnovu čega se može zaključiti njihov značaj u motivaciji članova marketing tima iz uzorka, imajući u vidu da su sve vrednosti veće od 3.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Var 1: Mogućnost povećanja plate u toku radnog odnosa	32	4.4375	.87759	.15514
Var 2: Nefinansijski podsticaji	32	3.7500	.95038	.16801
Var 3: Važno mi je da mogu podeliti svoja osećanja sa kolegama na radnom mestu	32	3.1563	1.29787	.22943
Var 4: Organizaciona kultura	32	4.4063	.66524	.11760
Var 5: Važno mi je da poslodavac pruža priliku za lični i profesionalni razvoj	32	4.8750	.33601	.05940
Var 6: Važno mi je da uloge u organizaciji budu jasno definisane	32	4.5000	.95038	.16801
Var 7: Važno mi je da poslodavac pokazuje empatiju za probleme zaposlenih	32	3.7188	1.14256	.20198

Tabela 4: Srednje vrednosti odgovora ispitanika za faktore motivacije
Izvor: Kalkulacija autora u SPSS-u)

Ipak treba naglasiti da su najveće srednje vrednosti (Mean) u odgovorima ispitanika zabeležene kod sledećih varijabli:

- Var 5: Važno mi je da poslodavac pruža priliku za lični i profesionalni razvoj (Mean=4.8750, SD=.33601)
- Var 6: Važno mi je da uloge u organizaciji budu jasno definisane (Mean=4.5000, SD=.95038)
- Var 1: Mogućnost povećanja plate u toku radnog odnosa (Mean=4.4375, SD=.87759).

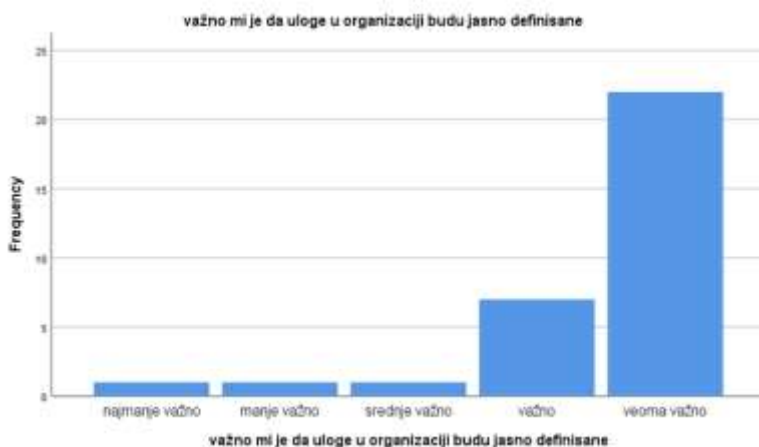
Grafik 1 prikazuje odgovore ispitanika za varijablu “Važno mi je da poslodavac pruža mogućnost za lični i profesionalni razvoj” Od ukupno 32 ispitanika 28 je istaklo da smatra ovaj faktor veoma važnim za motivaciju, što čini oko 87,5% uzorka. Preostali deo uzorka (12,5%) takođe je pozitivno odgovorio na ovo pitanje, odabравši broj 4 koji ukazuje na važnost faktora za motivaciju poslom.



Grafik 1: Odgovori ispitanika na pitanje Važno mi je da poslodavac pruža mogućnost za lični i profesionalni razvoj.
Izvor: Kalkulacija autora

Na osnovu rezultata prikazanih na ovom grafiku može se zaključiti da mogućnost za lični i profesionalni razvoj ima veliki značaj za motivaciju članova marketing tima u privatnim obrazovanim ustanovama Republike Srbije.

Grafik 2 prikazuje odgovore ispitanika za varijablu „Važno mi je da uloge u organizaciji budu jasno definisane“. Skoro 70 % (frekvencija =22) ispitanih članova marketing tima prepoznaje da je ovaj faktor veoma važan za motivaciju poslom.



**Grafik
2:**

Odgovori ispitanika za varijablu „Važno mi je da uloge u organizaciji budu jasno definisane“

Izvor: Kalkulacija autora

Sledeća varijabla koja je analizirana u ovom radu je “Važna mi je mogućnost povećanja plate u toku radnog odnosa”. Prema podacima iz ankete, od 32 ispitanika 19 njih (ili 59,4%) je istaklo da im je ova mogućnost veoma važna. Takođe, treba istaći da je svega 1 ispitanik naveo da mu mogućnost povećanja zarade tokom radnog odnosa nije važna za motivaciju poslom. Odgovori ispitanika koji se odnose na ovo pitanje predstavljeni su na grafiku 3.



Grafik 3: Odgovori ispitanika na pitanje „Važna mi je mogućnost povećanja plate u toku radnog odnosa“
 Izvor: Kalkulacija autora

Dalji tok istraživanja usmeren je ka analizi razlika u odgovorima, odnosno faktorima motivacije, kod ženskih i muških ispitanika. Prema podacima iz tabele 5 može se primetiti da su veće vrednosti zabeležene kod odgovora ženskih ispitanika osim kod varijable „važno mi je da mogu podeliti svoja osećanja sa kolegama na radnom mestu“, kod koje su odgovori muških ispitanika imali nešto veću srednju vrednost.

Group Statistics

		pol	N	Mean	Std. Deviation	Std. Error Mean
mogućnost povećanja plate u toku radnog odnosa	muški		15	4.2667	1.09978	.28396
	ženski		17	4.5882	.61835	.14997
nefinansijski podsticaji	muški		15	3.6000	.91026	.23503
	ženski		17	3.8824	.99262	.24075
važno mi je da mogu podeliti svoja osećanja sa kolegama na radnom mestu	muški		15	2.9333	1.38701	.35813
	ženski		17	3.3529	1.22174	.29632
organizaciona kultura	muški		15	4.1333	.74322	.19190
	ženski		17	4.6471	.49259	.11947
	muški		15	4.7333	.45774	.11819

važno mi je da poslodavac pruža priliku za lični i profesionalni razvoj	ženski	17	5.0000	.00000	.00000
važno mi je da uloge u organizaciji budu jasno definisane	muški	15	4.2000	1.26491	.32660
	ženski	17	4.7647	.43724	.10605
važno mi je da poslodavac pokazuje empatiju za probleme zaposlenih	muški	15	3.5333	1.24595	.32170
	ženski	17	3.8824	1.05370	.25556

Tabela 5: Razlika u odgovorima prema polu ispitanika
 Izvor: Kalkulacija autora u SPSS-u

Uvidom u prezentovane rezultate u tabelama 5 može se zaključiti da je najveća razlika zabeležena kod varijable „Važno mi je da uloge u organizaciji budu jasno definisane“, pri čemu je $p < .005$. Veće srednje vrednosti u odgovorima na ovo pitanje zabeležene su kod ženskih ispitanika.

3. ZAKLJUČAK

Motivacija predstavlja značajan proces koji utiče na zadovoljstvo poslom i radni učinak zaposlenih. U oblasti visokog obrazovanja motivacija zaposlenih ima dalekosežniji uticaj i značaj, imajući u vidu da visoke škole i fakulteti proizvode javne usluge, od čijeg kvaliteta zavisi privredni i društveni razvoj. Posmatrano iz konteksta studenta kao pojedinca, motivacija zaposlenih u obrazovanju je od značaja za kreiranje njegovog korisničkog iskustva, koje je takođe uslovljeno specifičnostima obrazovne usluge. Ovaj rad pruža uvid u osnovne faktore motivacije koji pokreću članove marketing tima u visokom obrazovanju da daju veći doprinos u svom radu. Rezultati empirijskog istraživanja na uzorku ($N=32$) pokazuju da ispitanici posebno cene ako im poslodavac pruža priliku za lični i profesionalni razvoj. Osim toga, članovi marketing tima iz uzorka smatraju da je važno da uloge u organizaciji budu jasno definisane, a kao treći značajan motivacioni faktor prepoznata je visina plate, odnosno mogućnost njenog povećanja tokom radnog odnosa. Rezultati koji su prezentovani u ovom radu predstavljaju saznanju osnovu koja je korisna za buduća istraživanja motivacije u oblasti visokog obrazovanja, ali i za studije koje će se baviti faktorima motivacije u sektoru usluga i marketinga generalno. Prilikom tumačenja rezultata treba imati u vidu i određena ograničenja, koja se odnose na ton da su uzorkom obuhvaćeni samo članovi marketing tima iz privatnih viskoobrazovnih institucija.

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MOTIVATION FACTORS IN A MARKETING TEAM

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ABSTRACT:

Strating from the importance of motivation theories in the field of organizational management, the aim of this paper is to investigate the motivation factors that drive members of a marketing team. The research is based on a survey conducted on a sample of 32 respondents in the education marketing sector in the Republic of Serbia, during which the effects of motivation on the satisfaction of marketing team members and their productivity at work were pointed out. During the research process, educational institutions were perceived as providers of educational services, which increase the human capital of students as consumers. Descriptive statistics and t-test were used during data processing and analysis. The results of the research were compared with relevant studies that analyzed the issue of motivation in the marketing sector, during which a useful knowledge base was created for future studies in this area.

Keywords: motivation, motivation factors, marketing team, job satisfaction, engagement

SOCIAL AND HUMANITARIAN DIMENSION OF THE MEANING EVOLUTION OF THE RUSSIAN CINEMATOGRAPHY

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ABSTRACT:

In this paper examines the social and mental aspects of the formation of Russian cinema in different historical periods. It is believed that until 1917 the formation of Russian cinema was determined by the monarchical regime and the Russian Orthodox Church, and after the revolutionary events during the years of "war communism" only the Soviet government. However, a study of documents and materials of that time indicates that Russian cinematography developed in accordance with global trends, although taking into account the specifics of the social and political conditions in Russia. Especially during the years of the new economic policy in Soviet Russia in 1921-1928.

Keywords: cinema, Russian cinematography, idioms, social meanings, ideologies.

The first years of the formation of Russian cinema are marked by a large number of films that cannot yet be called adaptations, but can be defined as screen illustrations of literary works. In 1909, in Russia, in addition to the studios of L. Gaumont and Ch. Pate, there appeared the studios of A. Khanzhonkov and S. Drankov, where directors such as V. Goncharov and P. Chardynin worked. During these years, films based on the works of L. Tolstoy, F. Dostoevsky, N. Gogol, A. Chekhov, M. Lermontov and other Russian classics were created. The formation of national cinematography proceeded on the basis of classical fiction. A new kind of visual art drew plots and images from the treasury of textbook Russian classics. The use of popular works was caused not only by the desire to promote domestic literature, but also by a more mundane task - to create a recognizable and understandable plot in the absence of professional screenwriters.

In the first decade of the 20th century, many domestic films about Russian historical and statesmen were released. Already in 1908, the film "Boris Godunov" was released. The following films are released next year: "The Death of Ivan the Terrible", "Ermak Timofeevich - the Conqueror of Siberia", "Peter the Great" and a number of others. This topic does not mean that it was initiated by any official structures. The youngest of the arts, represented by its pioneers, on its own initiative, tried to orient itself in its activities to the already established ideological attitudes in society. That is how, in 1912, in order to fulfill the "historical duty to the national cinematography", the first Russian full-length

film "The Defense of Sevastopol" appeared. The initiator of the creation of this film was N. Goncharov. It was he who turned to Nicholas II with a request to support this project and received the highest approval. This made it possible to involve the army in mass battle shootings, get advice from military experts, use costumes and military weapons as props. Despite the fact that the head of the studio A. Khanzhonkov was not completely satisfied with the result, the film was a huge success. The history of the creation of the film "Defense of Sevastopol" shows that the initiators of the creation of this work on a patriotic theme were not the state, but private individuals. This fact once again shows that ideological attitudes and concepts are formed not only from above, but also from below. It should also be taken into account that cinema, like any innovation, has not yet had a certain political reputation either with the public or with those in power. The presence of such a printing press resulted in the creation of an institution of censorship. No action has been taken with respect to cinema. There were separate attempts to do something about specific films by the Ministry of Public Education of the Russian Empire. In particular, a circular was created in the bowels of this ministry, forbidding high school students to watch the film by V. Gordin and Y. Protazanov "The Keys of Happiness", but here the main reason for the ban was not political, but moral and ethical considerations. Not for nothing, and the press did not unequivocally evaluate this work, pointing out that thanks to the film, the cinema found itself in "... the sad role of a hotbed of bad taste [1, 113]". The Russian Orthodox Church has often spoken out about specific films, but not harshly. Political and public figures behaved more aggressively. For example, the leader of the socio-political organization "Russian People's Union named after Michael the Archangel" V. M. Purishkevich. Cultural figures could also express their opinion, but state structures in this era took a neutral position in relation to cinema. During the war, from 1914 to 1919, the Skobelev Committee was active, but it dealt with repertoire policy issues only indirectly. Even in the most difficult years for the country, the issue of total censorship in cinema was not seriously considered. The idea of nationalizing the production and distribution of films had supporters and could even be brought up for discussion at the February session of the State Duma in 1917, but, for obvious reasons, was not considered. In revolutionary Petrograd after 1917, relations between the new government and cinema did not develop immediately. The first People's Commissar of Education in Soviet Russia, Anatoly Vasilievich Lunacharsky, in a short time was able to create a powerful structure to promote a new culture and ideology. It was a mass cultural, educational, literary and artistic organization of proletarian amateur performances - "Proletkult". It united figures of culture and art, the organization included amateur theaters, folk clubs, circles, etc. The technically complex production of film production was a costly affair and, in terms of the efficiency of its impact, was significantly inferior to print and theatrical performances. The only fact of interaction between the authorities and cinematographers at that time that deserves attention is that the cameramen of the Skobelev Committee received permission from the Petrograd Military Revolutionary Committee to film chronicles in the city. As a result, the film "October Revolution" or ("Second Revolution") was made. The fact that the Soviet government has not yet decided on cinema during this period is evidenced by the opinion of People's Commissar A.V. Lunacharsky about the possibility

of his nationalization, which he expressed on April 13, 1918 in the newspaper "Evening Life": "... the nationalization of the entire cinematographic business in Russia is not needed and even, if you like, harmful [2, 46]". Even then he liked the idea of creating a public sector in the production and distribution of paintings, competing with the private sector, but at that time it was absolutely unrealistic.

New opportunities were not only used by those who, using cinema, offered high, divine and, as a rule, eudaimonic prosperity. Examples of the exploitation of fears and base desires of a person can be the so-called satanic films that at that time poured onto the screen: "Satan jubilant" dir. Ya. Protazanova (1917), "Maiden Mountains" - the first film production by A. A. Sanin (1919), "Scherzo of the Devil" by V. Turzhansky (1917), "Satan crowned them" dir. VC. Wiskovsky (1918) and many others. This phenomenon is also not new. George Sand also argued that "Satan is the legitimized father of the revolution." Satanic themes were extremely fashionable not only among filmmakers, but also among decadent Russian intellectuals and writers. In 1917, a series of paintings appeared under the general title "Our Crowned". These are illustrated anecdotes about the life of the imperial family. The titles of most of the works speak for themselves: "The Jester on the Throne", "Favorites of Catherine II", "The Secret of Peter's Death" and others..

In 1919, the film "Iron Heel" based on the novel by D. London was released, where the directors were V. Gardin and E. Ivanov-Barkov, and A. Lunacharsky participated as a screenwriter. This was the first experimental production of the State Film School, in which, according to the plot, historians of the state of victorious socialism of the 27th century find a diary that tells about the socialist movement in the early 20th century in the United States, about the crisis, the establishment of a fascist dictatorship and the subsequent world revolution. This film can be attributed to the genre of fantasy, but the fantastic plays a secondary role here. The main thing is the confirmation of the proposed due, confirmation of the correctness of the chosen path. In 1923, another film based on the play of the same name by A. Lunacharsky "Locksmith and Chancellor" was released. The director was again V. Gardin. The action of the film takes place in the fictional country of "Norland", and the events are very reminiscent of what happened in Russia in 1917. The same technique was used in Y. Protazanov's film "Aelita" (1924), where the events are transferred to another planet. In A. Ptushko's film "New Gulliver" (1935), which is rightfully considered a masterpiece of three-dimensional animation, revolutionary events take place in the puppet "Lilliput".

During these years, highly artistic dramatic films were also shot. In 1919, A. Sanin made the film «Polikushka», which was one of the first domestic films to receive worldwide recognition. The film was shot based on the story of the same name by L. Tolstoy. In the center of the story is the tragic fate of the "little man". The success of the film was brought by the acting, and especially the excellent performance of Ivan Moskvina, who, despite the fact that he acted in films for the first time, managed to create a memorable image of this "insignificant" and "messy" person. An interesting fate has developed for the film by Y. Protazanov "Father Sergius". The idea of film adaptation of L. Tolstoy's story arose from the authors a few years before the release of the film, but it so happened that the film began to be shot after the February Revolution, and finished after the October Revolution. The

premiere of the film, conceived back in Tsarist Russia, took place in May 1918 at the height of the "cavalry attack on capital" ... and everything connected with it in any way. Hence the mixed reviews of the film. The huge success of the film among the audience in Moscow and in Paris, where he was taken illegally. But the opinions of film experts were divided.

During this period, cinemas showed not only new films promoting the ideas of "war communism", proletarian culture, world revolution, but also pre-revolutionary films, foreign films. All this diversity of film production on the screen was not the result of any deliberate strategy of compromising the old and the new. The presence on domestic screens of film production, which promoted completely different ideological principles, was due to the lack of opportunities at that time for the new government to remove anything from the screens en masse. The decree of the Small Council of People's Commissars on the transfer of photographic and cinematographic trade and industry to the People's Commissariat for Education was issued in August 1919. It formally gave the right to nationalize the industry, but there were no opportunities for its implementation during the years of the civil war, so no real action followed.

After the war, the Soviet government had to revise a lot in socio-economic policy. An understanding of the need for a policy of compromise between the new socio-political system and some of the old, time-tested forms of management has come. During the time of the New Economic Policy, a thesis was put forward in film production: cinema is commercial, and the repertoire is revolutionary.

At the beginning of 1922, V. I. Lenin, after getting acquainted with the project of the People's Commissariat of Education of the RSFSR on the organization of cinematographic activities in the country, gives the following instructions: "The People's Commissariat of Education must organize monitoring of all performances and systematize this matter. All tapes that are shown in the RSFSR must be registered and numbered in the People's Commissariat for Education Pay special attention to the organization of cinemas in the villages and in the East, where they are new and where, therefore, our propaganda will be especially successful [3, 360].

This rather voluminous quote illustrates almost all the main directions of the work of the national cinematography during the years of the New Economic Policy. The seeming inconsistency of the main thesis of the 20s "cinema is commercial, and the theme is revolutionary", nevertheless, made it possible to solve the stated tasks and make films of revolutionary content that were commercially successful. Thus, the historical-revolutionary picture of the director A. Ivanovsky "The Palace and the Fortress" (1923) was a success among both domestic and foreign viewers. The film was shot in Leningrad at the Sevzapkino factory, which traces its lineage to the Skobelev Committee (now: Lenfilm Film Studio). At the same time, everything in the film works for the revolutionary ideology, both the plot of the film about the tragic fate of a prisoner of the Peter and Paul Fortress, and the director's innovative techniques, symbolically demonstrating the intransigence of the two worlds.

The first full-length film by S. Eisenstein "The Strike" (1924) was highly appreciated by filmmakers and in the press, but it was not successful with the audience. The film for the

ordinary viewer was oversaturated with innovation. The abundance of "movie metaphors", cinematic "attractions", "theatre-circus" inserts created serious problems for the perception of the motion picture. Other than that, there was absolutely no plot. The main character of S. Eisenstein was the working masses. This fully corresponded to the views of the director himself and the ideological guidelines of the proletarian movement. This line was based on the principles of historical materialism of the Marxist theory, according to which the role of the individual in history was reduced to a minimum, and the masses, classes, etc. were declared the main driving force of social development. The inexperienced viewer did not know this and was disappointed not to see the usual dramatic plot on the screen. The next picture of S. Eisenstein "Battleship Potemkin" was a success both in the country and abroad. This picture was shot by the same team, the same innovative techniques were used: "montage of attractions", unusual angles, a fantastic number of cuts - 1280 (in a modern film - 300), but the result was both ideological and commercial. All reviews of the Soviet and foreign press were enthusiastic. The fact that in most European countries the official screening of the film was banned indicates the level of the film's ideological impact on the audience. The ban only fueled public interest in the film. In Germany, in the parliament, for several months there was a struggle "for" and "against" the demonstration of S. Eisenstein's painting, and in order to avoid a public scandal, it was decided to release the film for hire. Even the "Battleship Potemkin", cut by American censorship, marched victoriously through cinemas in the United States. In 1926, the American Film Academy recognized it as the best foreign film. In France, Holland and already fascist Italy, at closed screenings, the audience invariably gave a standing ovation after the picture was shown.

It is worth noting the fact that the "Battleship Potemkin" can be seen as a product of a new ideological paradigm, the emergence of which was associated with the result of the internal political struggle in Soviet Russia. The struggle was between the supporters of the permanent revolution and their leader in the person of L. Trotsky and those who advocated the rejection (at least temporarily) of the idea of the World Socialist Revolution. The latter (V. Lenin, I. Stalin, etc.) believed that after the end of World War I, which was bloody for European countries in 1919, and the civil war in Russia, the Soviet country had a chance to build socialism in one single country - the USSR. Initially, almost all prominent Bolshevik figures and theorists believed that the victory of the socialist revolution would lead to similar revolutions in other countries in Europe and America, so Soviet Russia must be seen as an armed camp to help liberate workers in other countries. This largely explains the behavior of the Bolshevik government after the October events, which easily parted with significant territories that were part of the Russian Empire. One can recall the history of Finnish independence or the humiliating conditions of the Brest-Litovsk peace. At that time, almost all revolutionaries believed that the revolutionary events in Russia were the first signs in a series of similar events around the world. After the victory, the socialist United States of Europe and Asia will arise, where there will be not only no exploitation of the working people, but also no territorial boundaries. That did not happen. Separate uprisings in Hungary, Germany and a number of other countries were weak and were soon suppressed by government troops. The continuation of this strategy was the

creation of the Communist International in 1919 in Moscow, which was supposed to act as a coordinator of the activities of communist and workers' parties around the world. A serious blow to the idea of a permanent revolution was the defeat of the Red Army near Warsaw during the Soviet-Polish War. The position and positions of L. Trotsky as the leader of the Red Army and his associates in the Soviet government were significantly weakened. Specially filmed for this war, the film "Long Live Workers' and Peasants' Poland!" and the corresponding slogans, sent to the archive. Hopes for a world revolution were fading and, accordingly, revolutionary mysteries such as "Toward a World Commune" gave way to other plots.

By 1925, it became clear that the world revolution is a matter of a very distant future, so the film "Battleship Potemkin" is more a story about the revolutionary past of a particular country. There is no open call for a world revolution here, just as there is no propaganda for the export of the revolution. S. Eisenstein's painting, using new artistic techniques, affects the emotions and subconscious of the audience to a greater extent to explain why the revolution in Russia was natural. The same problem was solved by other films of this period, in particular the film "The End of St. Petersburg" (1927) directed by V. Pudovkin. These films are not instructions on how classmates should act today. The stories told in the film evoke strong emotions and sympathy, but there is no call "Do as we do!". The famous picture of the execution on the stairs in Odessa in the film "Battleship Potemkin" evokes hatred for the perpetrators of the tragedy, but this feeling is addressed to specific individuals who by that time had already been thrown out of history, and some of them out of life.

The gradual departure from the ideas of the world revolution in Soviet cinema in the mid-1920s was replaced by the theme of the opposition of the Soviet Republic to the capitalist encirclement. It is interesting that during these years a large number of feature films were released in which, according to the plot, the socialist movement was assigned the role of a victim of an attack by capitalist aggressors. Director Semyon Alekseevich Timoshenko in 1925 made his first film Napoleon Gas on this subject. In this picture, with the help of a new terrible weapon - gas that burns all life, world fascism, represented by the US Minister of War, is preparing a military operation to deliver a mortal blow to the USSR. Despite the obviously propaganda content, the film turned out to be interesting from the point of view of directing and camera work. This was the first film for both cameraman Svyatoslav Aleksandrovich Belyaev and his assistant Andrey Moskvina. Both are rightfully considered representatives of the Leningrad "painting school". The film takes place in the city of three revolutions and in capitalist countries. The cameramen filmed daytime Leningrad and its environs in a very interesting way, but in addition to this, their excellent camera work made it possible to turn Leningrad at night into a capitalist world, which, according to critics, looked more attractive on film than the Soviet one. Perhaps it happened by chance, but then the filmmakers were forced to try to combine the commercial and the ideological. The situation when the demonstration of the "beautiful life" of the Western world served as a lure for the audience to the cinemas was quite common. The capitalist world has always been portrayed negatively on the screens of Russian cinema: intrigue, deceit, hatred - all these were obligatory attributes of Soviet

films, but chic interiors, furniture, decorations, clothes of representatives of the upper class of capitalist society served as a means of attracting viewers of Soviet Russia who yearned for a good life.

Another film (in fact, this is the first Soviet series) - "Miss Mend" (1926), received devastating reviews from critics, colleagues and ... seven years of full house in the cinemas of the country. This adventure film was shot by the wonderful Soviet director Boris Vasilyevich Barnet. The film was dedicated to the history of preventing another attempt by the capitalist world to destroy the USSR. Many of this remarkable director's films have received mixed reviews from filmmakers and critics. About the talent of this Soviet director, who won the Mussolini Cup at the Second Venice Film Festival in Italy and the Stalin Prize for the film *The Feat of the Scout*, Gennady Poloka very accurately said: and there are, I would say, average. It feels like they were filmed by different directors. The reason for this interest is that he (a Russified Englishman, a soldier of the Red Army of anti-proletarian origin) really "didn't make commissioned films [4, 46]". That is why many words, phrases, the characters themselves, including even those from his propaganda films, are perceived today as modern and relevant. Creative activity of B.V. Barnett testifies that the artist, even under strict conditions of control, is able to bring lively intonation into the most protocol plot and ensure the freshness of perception of the most miserable ideas. As the analysis of the responses of Internet visitors shows, many still watch the films of Boris Vasilyevich Barnet with interest. The most grandiose audience success at that time was the film by Ivan Perestiani "Red Devils" (1923). This two-part picture of the adventure genre with a full the basis can be called the leader of the film distribution of this period in Soviet Russia. On the one hand, I. Perestiani's motion picture responded to the revolutionary-romantic spirit of the era, and on the other hand, it gave a worthy answer to westerns, which at that time still felt at ease in the Soviet box office.

Soviet cinema in the first half and mid-1920s still had the opportunity to use very bold, and sometimes cruel, means and forms to enhance the emotional impact on the audience. The authorities allowed such methods if these funds worked for the right idea, and the public, represented by cinema visitors, hardened during the years of revolutions and civil war, did not express their indignation at the demonstration of cruel scenes. What today is called "violence on the screen" was in abundance in the films of I. Perestiani, where his characters killed White Guards by carloads. A. Room in the film "Bay of Death" in his supernaturalistic manner demonstrated the atrocities of the White Guards, shocking with shots of the corpse of a child in a bucket. His unwillingness to stray from the authenticity of cinematic art, even in the most difficult episodes, even led to the appearance of the term - "Roomian de-aestheticism." One can recall the extremely naturalistic scenes in V. Gardin's film *The Cross and the Mauser* (1925), A. Anoshchenko-Anoda's *The Tripoli Tragedy* (1926), the cruel scene with the revived Red Army soldier in F. Ermler's film *The Fragment of the Empire* (1929) and etc.

Many critics called such frankness on the screen "the exposure of the film truth." The emergence of the term "film truth" is directly related to the emergence of the new Soviet cinema. Initially, this concept arose in documentary films. At the beginning of 1922, the innovator of newsreel and documentary cinematography, director Dziga Vertov, in his

manifesto “We” proclaimed a new era: “We call ourselves kinoks, in contrast to the “cinematographers” - a herd of junk dealers who sell their rags not badly. We do not see the connection between the slyness and calculation of the hucksters and genuine cinematography. All areas of the “old” cinema got from the movies: both the “heavy visions” film drama and the adventurous “Pinkertonism [5, 36]”. Then it seemed to many that pre-revolutionary cinema with its techniques and patterns was outdated: “The insides are falling out ... from the belly of cinematography, torn open by the reef of the revolution.” In its place, a new art will come, which in essence will be a social study, in which on the “wings of hypotheses” “our rolling eyes will scatter into the future [5, 35]” . Asserting the onset of a new way of visual perception, Dziga Vertov turned out to be a visionary in his concept of the “cinema eye”. Today, in the conditions of total domination of visual images in information communications, many researchers rightly believe that it is necessary to study the “chaos of visual phenomena that fill space [5, 15]”. Other radical changes proposed by “kinopravda” did not take place: feature films, plot, professional actors were preserved. From the cinemas there remained the ideas of abandoning the varnishing of reality and the use of cinema for scientific research and educational purposes. One of the founders of the Factory of an eccentric actor, Grigory Mikhailovich Kozintsev, wrote at the very beginning of this movement: “Life requires art that is hyperbolically rude, dumbfounding, hitting on the nerves [6, 15]”. Faxes themselves, speaking with outrageous ideas in their manifestos, did not implement everything in practice. Judging by the works of Grigory Kozintsev and Leonid Trauberg, the promised radical revision, from the films *The «Adventure of Oktyabrina»* (1924), through *The Overcoat* (1926), and S.V.D. transformation of screen action and understanding the need for a more respectful attitude to the canons of cinematography that have developed over several decades.

Experimentation in the domestic cinema art during this period was almost the norm. Sergei Eisenstein in the film “October”, which was dedicated to the tenth anniversary of the October events of 1917, continued his experimental work. He continues the line proclaimed in the “montage of attractions” about the need to expose the viewer “... to sensual or psychological influence, experimentally verified and mathematically calculated for certain emotional upheavals of the perceiver, in turn, in the aggregate, they alone determine the possibility of perceiving the ideological side of what is being demonstrated - the final ideological conclusion [7, 270]”. The director quite boldly for the era of militant materialism plays in the historical-revolutionary film “October” with such concepts as space and time, objective and fictional reality, using a complex metaphorical language. S. Eisenstein himself said that courage and this desire for innovation is not an end in itself “... not overturning the foundations of cinematography or changing course in the understanding of our cinematography. For us, this is another change of attraction - another tactical maneuver in attacking the viewer under the slogan of October [8, 464]”.. Apparently, the overabundance and complexity of maneuvers affected viewers and critics. The film “October” met with a cool reception, but this did not cool the ardent desire to experiment. Sergei Eisenstein continues his creative search and sets himself even more difficult tasks: to film not only plots, but also scientific concepts, combining the language

of art and science. He begins work on a new project to screen the work of K. Marx "Capital", where he intended to show the relationship of economic, social and political processes outside the plot and outside the spatio-temporal characteristics. The idea of the great director-innovator was not realized, but many of his paradoxical ideas played an important role in the development of domestic and world cinema.

The classic of pre-revolutionary cinema, Yakov Alexandrovich Protazanov, represented the traditional direction in cinema. After the difficult fate of his famous film "Father Sergius", he left the country after some time and successfully worked at studios in Paris and Berlin. After returning to Soviet Russia, he made the film *Aelita* (1924) at the Mezhrabpom-Rus studio. The main problem of cinema in this period was not in the production or distribution of film products, but in the socio-political sphere, and specifically in the opposition to the political power that the Bolsheviks had and the old economic methods of management proclaimed during the period of the new economic policy. The rental system was focused on the wealthy part of the country's population, on those who had the opportunity to visit cinemas. They were not attracted to revolutionary and socialist ideas, even in the form of revolutionary melodrama. Separate successful attempts to combine revolutionary ideology and commercial success in the films "Battleship Potemkin", "Forty-first", "Red Devils" and others could not become a strong and long-term basis for the development of the film industry in the twenties

In Soviet Russia, the New Economic Policy was forcibly curtailed in the late twenties. In 1928, in the first five-year plan for the development of the national economy of the USSR, a course was taken for the total nationalization of the economy. Everything that was still privately owned under the NEP: food and light industry, agriculture, retail trade, the service sector, including, in part, the cinema, became state property. The course towards the industrialization of the country could not but affect the management system in the cinema. The resolution of the Council of People's Commissars of the RSFSR "On the main guidelines for drawing up a five-year plan for the development of filmmaking in the RSFSR" provided for strict requirements for achieving indicators in film production and distribution. In particular, they discussed the creation of film products on a domestic production base, the exclusion of foreign films from distribution, and the creation of a personnel training system for the domestic film industry. The era of compromise in the film industry, when the ideological and the commercial were balancing on the brink of economic failure or political obstruction, is over. During this very fruitful and peculiar period, a new domestic cinematography was formed, in social and political factors played an important role in its basis. Thanks to these features, Russian cinematography of the 1920s has become a recognized phenomenon in world cinematography.

The contradictions of the 1930s were fully reflected in the cinema of the USSR. Heroic deeds. enthusiasm, hope for a better life, selfless work and at the same time the ruin of millions of peasants in the process of collectivization, the tightening of the repressive apparatus. The thirties for the national cinema became a time of serious technical innovations associated with the creation of sound films. The advent of sound in cinema has become a serious test for actors, directors and screenwriters. Nevertheless, it is at this time that films are released that will rightfully be considered classic films and will be in

demand by viewers for many years. At the same time, the ideological flywheel of the fight against dissent in literature, art, including cinematography, will begin to unwind. Socialist realism became the official and only true creative method. Everything that did not correspond to the new canons was declared alien to Soviet art.

Since the mid-1930s, in connection with the changing international situation in the world, the main cinematic hero of the country has become the defender of the fatherland. The foreboding of a big war in society and the understanding of its inevitability by the leadership of the USSR forced us to reconsider the previous ideological attitudes towards the heroic pages of the history of pre-revolutionary Russia. Soviet cinema creates a number of films in which historical justice is restored in relation to those who defended the country's independence in the pre-Soviet period.

After the end of World War II, the geopolitical situation changed dramatically. The struggle of two socio-political systems turns the world into a bipolar one, and the USSR becomes the second power in the world. Under these conditions, domestic cinema is becoming one of the main participants in this confrontation. The technical capabilities of cinema (color, stereo cinema) are increasing. At the same time, the process of forming the canon of domestic films of historical, biographical, revolutionary themes is being completed. The situation during this period did not allow us to hope for the realization of any interesting new ideas, experiments, or simple innovation.

In the films of the 1950s and 1960s, the creators abandon schematism and excessive pomposity in depicting the characters of heroes and historical events. The middle and second half of the 50s became a time of rethinking for many figures of the national cinema. Screen adaptation of Russian classical literature of different times: F. Dostoevsky, B. Lavrenev. M. Sholokhov, K. Fedin and others made it possible to once again comprehend and understand not only the social basis of upheavals in Russia at the beginning of the 20th century, but also to reveal the psychological, deeply personal aspects that influenced the inner world of a person.

Despite the difference in artistic techniques and the originality of the original creative approaches of talented directors of this time, we can talk about the general humanistic orientation of a number of films of the early 60s. Films on the topic of modernity in the last decades of Soviet cinema were not distinguished by new interesting ideas and discoveries. With the exception of a few brilliant films in the last years of Soviet power, the social theme was poorly developed. Russian cinema of the 70-80s of the twentieth century could give a symptomatic of social problems, but could no longer offer anything specific to improve the situation in the political conditions of that time.

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EMOTIONAL INTELLIGENCE AS A SOURCE OF TRANSFORMATIONAL LEADERSHIP BEHAVIORS

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ABSTRACT:

This research study investigates the role of emotional intelligence of leaders in the transformational behaviors perceived from the perspective of employees in insurance companies in Serbia. In the scientific literature, the relationship between emotional intelligence and effective (transformational) leadership is considered mainly from two different positions. The first recognizes the concept of emotional intelligence as a key attribute of a leader, i.e. a significant predictor of his transformational behaviors. Another view represents the widespread skepticism about the connection between emotional intelligence and leadership outcomes. Accordingly, the main goal of the research is to examine and prove that the emotional abilities of the leader positively influence on his leadership style. The research study was conducted through a structured online survey using a random sampling technique. The sample consisted of 130 employees in two insurance companies in Serbia who had the task of evaluating the transformational leadership style and emotional intelligence abilities of their immediate leaders. The Pearson correlation coefficient shows a strong positive relationship between emotional intelligence and perceived transformational leadership style. However, only two emotional intelligence abilities (appraisal of others' emotions and use of emotions) make a significant contribution to predicting the transformational behaviors of leaders.

Keywords: *emotional intelligence, transformational leadership, the ability model of emotional intelligence, managing emotions.*

1. INTRODUCTION

In today's business world, which has changed beyond recognition since the pandemic, leaders face an unprecedented set of critical challenges. Reconstruct or even reinvent your business in line with drastic changes in demand. Making difficult decisions that affect the lives of employees, hiring a workforce that has to deal with social, environmental and economic challenges that have become part of everyday life. Focus on business needs, manage your own emotions and respond to your employees with empathy and inspiration. Because of all this, pairing business expertise with emotional intelligence no longer just sounds nice, but represents a bet for future success. Leaders will be distinguished by whether they lead with humanity, authenticity, and heart, not just instructions and guidelines. For these reasons, the dilemma about the necessity of emotional abilities of leaders becomes meaningless. The results of one study show that there is a huge gap between the need for emotionally intelligent leadership and the ability of leaders to fulfill this requirement. Namely, only 22% of the 155,000 surveyed leaders demonstrate at least

9 out of 12 emotional competencies every day. The remaining 88% report a moderate level of emotional intelligence or even less ([Spencer, Barnfield, 2021](#)).

In accordance with the above, this paper expands existing research by examining the relationship between the emotional intelligence of leaders and their transformational behaviors perceived by employees in insurance companies in Serbia. The study aims to advance our understanding of the interpersonal processes within which the emotional exchange between leaders and employees takes place.

2.LITERATURE REVIEW

The "affective revolution" ([Barsade & Gibson, 2007](#)) has taken root in the leadership literature with the emergence of emotional intelligence, which is increasingly seen as a significant topic in this domain ([Ashkanasy & Daus, 2002](#); [Brown & Moshavi, 2005](#); [George, 2000](#)). Some practitioners have gone so far as to suggest that emotional intelligence explains up to 90% of the differences between leaders classified as "star" performers and their average-performing counterparts ([Goleman, 2000](#)). Such statements have in fact encouraged practitioners to claim that "emotional intelligence is the sine qua non of leadership" ([Goleman, 1998, p. 93](#)). Yet academic perspectives on the role of emotional intelligence in leadership remain more qualified and controversial ([Antonakis, Ashkanasy & Dasborough, 2009](#)). [Locke \(2005, p. 425\)](#) for example, argued that „emotional intelligence is invalid because it is not a form of intelligence and because it is so broadly defined“ and [Antonakis \(2003, p. 359\)](#) that empirical evidence for the relevance of emotional intelligence in leaders "does not exist or is in at best very weak, or contradictory at worst."

Others, in contrast, have developed conceptual frameworks linking emotional intelligence to leadership performance ([George, 2000](#)) and have continued to empirically examine these relationships ([Rubin, Munz & Bommer, 2005](#)). [Walter, Cole and Humphrey \(2011\)](#) conclude that despite conflicting perspectives on the definition and measurement of emotional intelligence and amid ongoing debate about construct validity, empirical research on the relationship between emotional intelligence and leadership has yielded significant results. Although the scientific literature does not support hyperbolic claims regarding the relevance of emotional intelligence to the leadership process, evidence suggests that it has the potential to help scientists better understand the emergence of leadership, the specific behaviors, and effectiveness of leaders.

Research based on combined models of emotional intelligence ([Barling, Slater & Keloway, 2000](#); [Cartwright & Pappas, 2008](#); [Gardner & Stough, 2002](#); [Palmer, Walls, Burgess & Stough, 2001](#); [Sosik & Megerian, 1999](#)) provided different outcomes in terms of how it relates to transformational leadership.

The results of [Barling, Slater and Keloway \(2000\)](#) research on the relationship between emotional intelligence and transformational leadership suggest that emotional intelligence is related to three aspects of leadership: idealized influence, inspirational motivation and individualized consideration. Leaders who exhibit these behaviors are assumed to be more effective in the workplace. The authors believe that a leader who understands and effectively manages his own emotions, but also shows self-control, is likely to be seen by

his followers as a role model, thus developing trust and respect for him. Palmer, Walls, Burgess and Stough (2001) used a self-report measure of emotional intelligence in 43 managers to assess the relationship between emotional intelligence and leadership style. They found a significant relationship between selected components of transformational leadership and subscales of emotional intelligence. Specifically, the inspirational motivation and individualized approach components of transformational leadership were correlated with emotion monitoring and management abilities. Gardner and Stough (2002) based on the analysis of data obtained from 110 high-ranking managers, proved that transformational leadership is positively correlated with emotional intelligence, especially intellectual stimulation, which achieves the strongest connection. At the same time, the emotional ability to understand others' emotions is the most significant predictor of variance in transformational leadership.

It is similar to the results obtained based on the examination of the relationship between transformational leadership and emotional intelligence understood as mental ability. (Brown & Moshavi, 2005; Cartwright & Pappas, 2008; Hayashi & Ewert, 2006; Leban & Zulauf, 2004; Mandell & Pherwani, 2003; Weinberger, 2004), which increasingly strengthens the need for further research in this area.

Analysis Sivanathan and Fekken (2002) suggests that emotionally intelligent managers are perceived by subordinates as more effective and transformative. They found that emotional intelligence is related to transformational leadership in the sense that a leader's specific transformational behaviors are directly proportional to his emotional intelligence. Based on the results of the regression analysis, Downey, Papageorgiou and Stough (2006) find that emotional intelligence is a significant predictor of transformational leadership, with emotional ability to manage emotions accounting for 20% of the variance in transformational leadership. Harms and Crede (2010) came to the conclusion that the relationship between emotional intelligence and transformational leadership is strong ($r=0.41$). At the same time, the analysis showed that the validity assessment was much higher ($r=0.59$) in situations where assessments of emotional intelligence and leadership behavior came from the same source compared to assessments from different sources ($r=0.12$). Similar to them, Hur, Van den Berg and Wilderom (2011) showed that emotional intelligence, in addition to positively correlating with transformational leadership, significantly predicts it even after controlling for demographic characteristics of the respondents (leader's age, level of education and group size).

Mathew and Gupta (2015) they believe that awareness of their own and other people's emotions, intelligent management of emotions, self-motivation and empathy contribute to a transformational leadership style. Downey, Papageorgiou and Stough (2006) believe that understanding emotions, managing emotions and controlling emotions are positively correlated with transformational leadership behaviors. Research by Alexander, Popejoy, Lyons, Shumate, Mueller, Galambos and Flesner (2016) highlights the link between emotional intelligence skills and transformational leadership. Their analysis revealed significant correlations in the areas of idealized leader influence, individualized consideration, and intellectual stimulation. Alston, Dastoor and Loy (2016) found that one

factor of emotional intelligence (appraisal of own/other's emotions) was associated with transformational leadership.

Other researchers emphasize the significant connection between transformational leadership and emotional intelligence, adding that transformational leadership has a significant correlation with all abilities of emotional intelligence, i.e. emotional intelligence with each dimension of transformational leadership (Khafaji, Abu-Salih & Mohsen, 2016). Matjie (2018) identified the effectiveness of leadership and emotional competence of managers as important ingredients of organizational success. Effectiveness and efficiency can only be achieved if the appropriate leadership style is based on emotionally competent leaders.

In accordance with the above, the main goal of this paper is to examine the relationship between emotional intelligence and transformational leadership. It is based on the assumption of a significant connection between perceived transformational leadership and overall emotional intelligence and its individual dimensions.

3.METHODOLOGY

For the purposes of examining the relationship between emotional leadership and employee satisfaction, the multiple regression method was used. The research study was conducted through a structured online survey using a random sampling technique. Two questionnaires were used in the research. The first was related to the measurement of emotional intelligence WLEIS (Wong & Law, 2002). The questionnaire consists of 16 items that measure emotional intelligence as an ability according to the revised model of Salovey and Mayer (1990); Mayer and Salovey (1997). The items in the questionnaire refer to four dimensions: (1) Self-Emotion Appraisal (SEA), (2) Appraisal of Others' Emotion (AOE), (3) Use of Emotion (UOE) and (4) Regulation of Emotion (ROE). Respondents were asked to rate their immediate supervisor's emotional competence using a five-point Likert-type scale where 1 represented "strongly disagree" and 5 represented "strongly agree."

The second questionnaire served to measure MLQ 5X leadership (Avolio & Bass, 2004) which is considered the most widely used instrument (Antonakis, 2012). The questionnaire adapted for the purposes of this research contained 20 items related to transformational leadership categorized into the following subscales: attributed idealized influence, idealized influence behavioral, inspirational motivation, intellectual stimulation, individualized consideration. Respondents were asked to rate the transformational behaviors of their supervisor using a five-point Likert-type scale where 1 represented "strongly disagree" and 5 represented "strongly agree."

The research was conducted in the life insurance sales sectors of the two largest insurance companies on a sample of 130 employees of different gender, age and educational structure. In the research, convenience sampling method was used, which is based on the inclusion of those members of the basic set who are available. The research was started in mid-December 2022 and finished at the end of January 2023. All analyzes in the research were performed using the software package SPSS for Windows, version 21.

4.RESULTS

To investigate the relationship between emotional intelligence and transformational leadership from a unidimensional and multidimensional perspective, this study employs the descriptive and correlation analyses. The results of descriptive statistics shown in Table 1. show that respondents perceive supervisor as transformational leaders ($M=4,26$; $SD=0,78$) who possess a high level of emotional intelligence ($M=4,08$; $SD=0,80$). Among the components of the transformation model, respondents rated the supervisor's inspirational motivation ($M=4,35$, $SD=0,76$) and intellectual stimulation ($M=4,31$, $SD=0,77$) the most, while the least perceived individualized influence ($M=4,18$, $SD=0,84$). When it comes to the abilities of emotional intelligence, the respondents perceive the supervisor's ability to use emotions to the greatest extent ($M=4,39$, $SD=0,61$), while the supervisor's ability to regulate emotions is rated the lowest ($M=3,92$; $SD=1,03$).

Table 5. Descriptive Statistics

	MEAN	STD. DEVIATION
IUA	4,18	0,84
IUP	4,24	0,86
IM	4,35	0,76
IS	4,31	0,77
IP	4,22	0,86
SEA	4,00	0,96
AOE	4,00	1,00
UOE	4,39	0,61
ROE	3,92	1,03
TL	4,26	0,78
EI	4,08	0,80

Pearson's correlation was applied in order to examine the relationship between emotional intelligence and transformational leadership. Table 2. presents the results. In accordance with the Pearson's correlation values, we observe that between the overall perceived transformational leadership and overall emotional intelligence there is a positive and strong statistically significant relationship ($r=0,893$, $p<0,001$), whereby emotionally intelligent supervisor show transformational behaviors.

Table 6. Correlation between transformational leadership and emotional intelligence (unidimensional approach)

		TL	EI
TL	PEARSON CORRELATION	1	0,893**
	SIG. (2-TAILED)		<0,001

EI	PEARSON CORRELATION	0,893**	1
	SIG. (2-TAILED)	<0,001	

** . Correlation is significant at the 0.01 level (2-tailed).

Pearson's correlation was applied in order to examine the relations between dimensions of emotional intelligence and components of transformational leadership. Table 3. presents the results. In accordance with the Pearson's correlation values, we observe that all components of transformational leadership achieve positive and strong connections with all dimensions of emotional intelligence, where the correlation coefficients are statistically very significant. In Table 3, we see that the highest correlation is between idealized influence and the ability to assess others' emotions ($r=0,869$, $p<0,001$), while the lowest is observed between idealized influence and the ability to use emotions ($r=0,617$, $p<0,001$).

Table 7. Correlation between transformational leadership and emotional intelligence (multidimensional approach)

		IUA	IUB	IM	IS	IC
SEA	PEARSON CORRELATION	0,719**	0,766**	0,643**	0,740**	0,782**
	SIG. (2-TAILED)	<0,001	<0,001	<0,001	<0,001	<0,001
AOE	PEARSON CORRELATION	0,820**	0,869**	0,749**	0,828**	0,853**
	SIG. (2-TAILED)	<0,001	<0,001	<0,001	<0,001	<0,001
UOE	PEARSON CORRELATION	0,623**	0,617**	0,651**	0,756**	0,647**
	SIG. (2-TAILED)	<0,001	<0,001	<0,001	<0,001	<0,001
ROE	PEARSON CORRELATION	0,776**	0,804**	0,754**	0,779**	0,821**
	SIG. (2-TAILED)	<0,001	<0,001	<0,001	<0,001	<0,001

** . Correlation is significant at the 0.01 level (2-tailed).

The multiple regression method was used to examine the predictive role of emotional intelligence dimensions on perceived transformational leadership. The results are presented in Table 4. and show the ability of this set of variables to predict the level of transformational leadership. In addition to multicollinearity, preliminary analysis examined the assumptions of normality, linearity, homoscedasticity, and the presence of multivariate extreme values. No violation of the assumptions for the use of multiple regression was observed.

The data in the Model Summary table show that the coefficient of determination is $r^2=0,846$, which means that the dimensions of emotional intelligence (self-emotion appraisal, appraisal of others' emotion, use of emotions, regulation of emotions) explain

as much as 84.6% of the variance of perceived transformational leadership. It is a statistically significant contribution as shown by the data in the ANOVA table ($F=75,352$, $p<0,001$).

Table 8. **Model Summary**

MODEL	R	R SQUARE	ADJUSTED SQUARE	STD. ERROR OF THE ESTIMATE
1	0,920 ^A	0,846	0,834	0,31947

a. Predictors: (Constant), ROE, UOE, SEA, AOE
 ANOVA^a

MODEL		SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
1	REGRESSION	30,762	4	7,691	75,352	<0,001 ^B
	RESIDUAL	5,613	55	0,102		
	TOTAL	36,376	59			

a. Dependent Variable: TL
 b. Predictors: (Constant), ROE, UOE, SEA, AOE

The data presented in Table 5. show how much of the unique variance of transformational leadership is explained by each of the dimensions of emotional intelligence. From the Beta Standardized Coefficients column, we notice that the highest beta coefficient is 0,564, which is the value for the dimension of appraisal of others' emotion. This variable individually contributes the most to explaining perceived transformational leadership when the variance explained by all other variables in the model is subtracted. The beta coefficients for the ability to use emotions $\beta=0,318$ and the ability to regulate emotions $\beta=0,305$ are slightly smaller. The lowest beta coefficient was recorded for the ability to self-emotion appraisal ($\beta=-0,147$).

Table 9. **Coefficients^a**

MODEL		UNSTANDARDIZED COEFFICIENTS		STANDARDIZED COEFFICIENTS	T	SIG.
		B	STD. ERROR	BETA		
1	(CONSTANT)	0,289	0,300		0,961	0,341
	SEA	-0,120	0,093	-0,147	-1,290	0,202
	OEA	0,440	0,093	0,564	4,705	<0,001
	UOE	0,406	0,082	0,318	4,972	<0,001
	ROE	0,231	0,082	0,305	2,806	0,007

a. Dependent Variable: TL

However, the values in Table 5. column Sig. point that only two abilities of emotional intelligence (appraisal of others' emotions and use of emotions) make a significant unique contribution to the prediction of transformational leadership.

5. CONCLUSION

In this paper, a unidimensional and multidimensional analysis of the relationship between transformational leadership style and emotional intelligence was conducted. We started from the assumption that there is a statistically significant and positive relationship between the constructs. In accordance with expectations, the results of the analysis point that the relationship between the overall perceived transformational leadership and emotional intelligence is statistically significant, that is, the overall emotional intelligence of supervisor is related to the transformational leadership style. The obtained findings are consistent with the results that verified the connection between transformational leadership and emotional intelligence abilities (Brown & Moshavi, 2005; Cartwright & Pappas, 2008; Hayashi & Ewert, 2006; Leban & Zulauf, 2004; Mandell & Pherwani, 2003; Weinberger, 2004). The results of this research confirmed the analysis of Sivanathan and Fekken (2002) according to which the specific transformational behaviors of a leader are directly proportional to his emotional intelligence, and the meta-analysis of Harms and Crede (2010) in which an extremely strong relationship between emotional intelligence and transformational leadership was proven ($r=0,41$).

At the same time, the findings of this research contradict the critical views regarding the importance of the leader's emotional competencies in the manifestation of his transformational behaviors. Thus Weinberger (2004) ailed to find a significant relationship between emotional intelligence and transformational style perceived by employees, as well as Antonakis, Ashkanasy and Dasborough (2009) who did not prove that a leader's emotional abilities significantly contribute to his specific transformational behaviors.

It was also expected that the subscales of emotional intelligence provide a statistically significant contribution to the transformational leadership style in insurance companies in Serbia. It has been proven that the abilities of emotional intelligence, appraisal of others' emotions and use of emotions have a positive and statistically significant relationship with perceived transformational leadership. The research results are contrary to the findings of Alston, Dastoor and Loy (2016) that only one factor of emotional intelligence (self-emotion appraisal) is related to leadership, as well as Downey, Papageorgiou and Stough (2006) that the emotional ability to manage emotions accounts for 20% of the variance in transformational leadership. The findings of this research confirm the results of Ayiro (2009) hat transformational leadership behaviors are based on the ability to appraisal of others' emotions and use of emotions, but not emotional understanding and management. Contrary to expectations, the self-emotion appraisal and regulate emotions do not significantly contribute to the prediction of transformational leadership. A possible explanation may lie in the details of the exchange between supervisor and employees. Namely, negative emotional reactions and attitudes of employees towards job can be a

consequence of perceiving a supervisor who has the ability to self-emotion appraisal as less sincere. Frequent experiences of other-directed positive emotions have been shown to motivate leaders to act in accordance with their values concerning others. Self-transcendent values and positive emotions directed at others are important determinants of authentic leadership (Michie & Gooty, 2005). A leader who is motivated by positive emotions directed at others is someone who understands, cares for others, has a strong will, psychological harmony, good relationships and a realistic sense of his own self-worth (Schulman, 2002). This description reflects the concept of authentic leaders as positive and moral individuals who are aware of the context in which they lead, their own and others' emotions, knowledge and strengths (Luthan & Avolio, 2003). The results of this research, consistent with the above argument, suggest that frequent experiences of self-directed positive emotions (e.g., a leader's ability to self-emotion appraisal) can lead to negative, while other-directed positive emotions (e.g., appraisal of others' emotions) can lead to positive outcomes in regarding the perception of the transformational leader. Supervisor who frequently experience self-directed emotions may be perceived as manipulative or insincere from the employees' perspective.

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EMOTIONAL INTELLIGENCE AS A SOURCE OF TRANSFORMATIONAL LEADERSHIP BEHAVIORS

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ABSTRACT:

This research study investigates the role of emotional intelligence of leaders in the transformational behaviors perceived from the perspective of employees in insurance companies in Serbia. In the scientific literature, the relationship between emotional intelligence and effective (transformational) leadership is considered mainly from two different positions. The first recognizes the concept of emotional intelligence as a key attribute of a leader, i.e. a significant predictor of his transformational behaviors. Another view represents the widespread skepticism about the connection between emotional intelligence and leadership outcomes. Accordingly, the main goal of the research is to examine and prove that the emotional abilities of the leader positively influence on his leadership style. The research study was conducted through a structured online survey using a random sampling technique. The sample consisted of 130 employees in two insurance companies in Serbia who had the task of evaluating the transformational leadership style and emotional intelligence abilities of their immediate leaders. The Pearson correlation coefficient shows a strong positive relationship between emotional intelligence and perceived transformational leadership style. However, only two emotional intelligence abilities (appraisal of others' emotions and use of emotions) make a significant contribution to predicting the transformational behaviors of leaders.

Keywords: emotional intelligence, transformational leadership, the ability model of emotional intelligence, managing emotions.

1. INTRODUCTION

In today's business world, which has changed beyond recognition since the pandemic, leaders face an unprecedented set of critical challenges. Reconstruct or even reinvent your business in line with drastic changes in demand. Making difficult decisions that affect the lives of employees, hiring a workforce that has to deal with social, environmental and economic challenges that have become part of everyday life. Focus on business needs, manage your own emotions and respond to your employees with empathy and inspiration. Because of all this, pairing business expertise with emotional intelligence no longer just sounds nice, but represents a bet for future success. Leaders will be distinguished by whether they lead with humanity, authenticity, and heart, not just instructions and guidelines. For these reasons, the dilemma about the necessity of emotional abilities of

leaders becomes meaningless. The results of one study show that there is a huge gap between the need for emotionally intelligent leadership and the ability of leaders to fulfill this requirement. Namely, only 22% of the 155,000 surveyed leaders demonstrate at least 9 out of 12 emotional competencies every day. The remaining 88% report a moderate level of emotional intelligence or even less ([Spencer, Barnfield, 2021](#)).

In accordance with the above, this paper expands existing research by examining the relationship between the emotional intelligence of leaders and their transformational behaviors perceived by employees in insurance companies in Serbia. The study aims to advance our understanding of the interpersonal processes within which the emotional exchange between leaders and employees takes place.

2.LITERATURE REVIEW

The "affective revolution" ([Barsade & Gibson, 2007](#)) has taken root in the leadership literature with the emergence of emotional intelligence, which is increasingly seen as a significant topic in this domain ([Ashkanasy & Daus, 2002](#); [Brown & Moshavi, 2005](#); [George, 2000](#)). Some practitioners have gone so far as to suggest that emotional intelligence explains up to 90% of the differences between leaders classified as "star" performers and their average-performing counterparts ([Goleman, 2000](#)). Such statements have in fact encouraged practitioners to claim that "emotional intelligence is the sine qua non of leadership" ([Goleman, 1998, p. 93](#)). Yet academic perspectives on the role of emotional intelligence in leadership remain more qualified and controversial ([Antonakis, Ashkanasy & Dasborough, 2009](#)). [Locke \(2005, p. 425\)](#) for example, argued that „emotional intelligence is invalid because it is not a form of intelligence and because it is so broadly defined“ and [Antonakis \(2003, p. 359\)](#) that empirical evidence for the relevance of emotional intelligence in leaders "does not exist or is in at best very weak, or contradictory at worst."

Others, in contrast, have developed conceptual frameworks linking emotional intelligence to leadership performance ([George, 2000](#)) and have continued to empirically examine these relationships ([Rubin, Munz & Bommer, 2005](#)). [Walter, Cole and Humphrey \(2011\)](#) conclude that despite conflicting perspectives on the definition and measurement of emotional intelligence and amid ongoing debate about construct validity, empirical research on the relationship between emotional intelligence and leadership has yielded significant results. Although the scientific literature does not support hyperbolic claims regarding the relevance of emotional intelligence to the leadership process, evidence suggests that it has the potential to help scientists better understand the emergence of leadership, the specific behaviors, and effectiveness of leaders.

Research based on combined models of emotional intelligence ([Barling, Slater & Keloway, 2000](#); [Cartwright & Pappas, 2008](#); [Gardner & Stough, 2002](#); [Palmer, Walls, Burgess & Stough, 2001](#); [Sosik & Megerian, 1999](#)) provided different outcomes in terms of how it relates to transformational leadership.

The results of [Barling, Slater and Keloway \(2000\)](#) research on the relationship between emotional intelligence and transformational leadership suggest that emotional intelligence is related to three aspects of leadership: idealized influence, inspirational motivation and

individualized consideration. Leaders who exhibit these behaviors are assumed to be more effective in the workplace. The authors believe that a leader who understands and effectively manages his own emotions, but also shows self-control, is likely to be seen by his followers as a role model, thus developing trust and respect for him. Palmer, Walls, Burgess and Stough (2001) used a self-report measure of emotional intelligence in 43 managers to assess the relationship between emotional intelligence and leadership style. They found a significant relationship between selected components of transformational leadership and subscales of emotional intelligence. Specifically, the inspirational motivation and individualized approach components of transformational leadership were correlated with emotion monitoring and management abilities. Gardner and Stough (2002) based on the analysis of data obtained from 110 high-ranking managers, proved that transformational leadership is positively correlated with emotional intelligence, especially intellectual stimulation, which achieves the strongest connection. At the same time, the emotional ability to understand others' emotions is the most significant predictor of variance in transformational leadership.

It is similar to the results obtained based on the examination of the relationship between transformational leadership and emotional intelligence understood as mental ability. (Brown & Moshavi, 2005; Cartwright & Pappas, 2008; Hayashi & Ewert, 2006; Leban & Zulauf, 2004; Mandell & Pherwani, 2003; Weinberger, 2004), which increasingly strengthens the need for further research in this area.

Analysis Sivanathan and Fekken (2002) suggests that emotionally intelligent managers are perceived by subordinates as more effective and transformative. They found that emotional intelligence is related to transformational leadership in the sense that a leader's specific transformational behaviors are directly proportional to his emotional intelligence. Based on the results of the regression analysis, Downey, Papageorgiou and Stough (2006) find that emotional intelligence is a significant predictor of transformational leadership, with emotional ability to manage emotions accounting for 20% of the variance in transformational leadership. Harms and Crede (2010) came to the conclusion that the relationship between emotional intelligence and transformational leadership is strong ($r=0.41$). At the same time, the analysis showed that the validity assessment was much higher ($r=0.59$) in situations where assessments of emotional intelligence and leadership behavior came from the same source compared to assessments from different sources ($r=0.12$). Similar to them, Hur, Van den Berg and Wilderom (2011) showed that emotional intelligence, in addition to positively correlating with transformational leadership, significantly predicts it even after controlling for demographic characteristics of the respondents (leader's age, level of education and group size).

Mathew and Gupta (2015) they believe that awareness of their own and other people's emotions, intelligent management of emotions, self-motivation and empathy contribute to a transformational leadership style. Downey, Papageorgiou and Stough (2006) believe that understanding emotions, managing emotions and controlling emotions are positively correlated with transformational leadership behaviors. Research by Alexander, Popejoy, Lyons, Shumate, Mueller, Galambos and Flesner (2016) highlights the link between emotional intelligence skills and transformational leadership. Their analysis revealed

significant correlations in the areas of idealized leader influence, individualized consideration, and intellectual stimulation. Alston, Dastoor and Loy (2016) found that one factor of emotional intelligence (appraisal of own/other's emotions) was associated with transformational leadership.

Other researchers emphasize the significant connection between transformational leadership and emotional intelligence, adding that transformational leadership has a significant correlation with all abilities of emotional intelligence, i.e. emotional intelligence with each dimension of transformational leadership (Khafaji, Abu-Salih & Mohsen, 2016). Matjie (2018) identified the effectiveness of leadership and emotional competence of managers as important ingredients of organizational success. Effectiveness and efficiency can only be achieved if the appropriate leadership style is based on emotionally competent leaders.

In accordance with the above, the main goal of this paper is to examine the relationship between emotional intelligence and transformational leadership. It is based on the assumption of a significant connection between perceived transformational leadership and overall emotional intelligence and its individual dimensions.

3. METHODOLOGY

For the purposes of examining the relationship between emotional leadership and employee satisfaction, the multiple regression method was used. The research study was conducted through a structured online survey using a random sampling technique. Two questionnaires were used in the research. The first was related to the measurement of emotional intelligence WLEIS (Wong & Law, 2002). The questionnaire consists of 16 items that measure emotional intelligence as an ability according to the revised model of Salovey and Mayer (1990); Mayer and Salovey (1997). The items in the questionnaire refer to four dimensions: (1) Self-Emotion Appraisal (SEA), (2) Appraisal of Others' Emotion (AOE), (3) Use of Emotion (UOE) and (4) Regulation of Emotion (ROE). Respondents were asked to rate their immediate supervisor's emotional competence using a five-point Likert-type scale where 1 represented "strongly disagree" and 5 represented "strongly agree."

The second questionnaire served to measure MLQ 5X leadership (Avolio & Bass, 2004) which is considered the most widely used instrument (Antonakis, 2012). The questionnaire adapted for the purposes of this research contained 20 items related to transformational leadership categorized into the following subscales: attributed idealized influence, idealized influence behavioral, inspirational motivation, intellectual stimulation, individualized consideration. Respondents were asked to rate the transformational behaviors of their supervisor using a five-point Likert-type scale where 1 represented "strongly disagree" and 5 represented "strongly agree."

The research was conducted in the life insurance sales sectors of the two largest insurance companies on a sample of 130 employees of different gender, age and educational structure. In the research, convenience sampling method was used, which is based on the inclusion of those members of the basic set who are available. The research was started in

mid-December 2022 and finished at the end of January 2023. All analyzes in the research were performed using the software package SPSS for Windows, version 21.

4.RESULTS

To investigate the relationship between emotional intelligence and transformational leadership from a unidimensional and multidimensional perspective, this study employs the descriptive and correlation analyses. The results of descriptive statistics shown in Table 1. show that respondents perceive supervisor as transformational leaders ($M=4,26$; $SD=0,78$) who possess a high level of emotional intelligence ($M=4,08$; $SD=0,80$). Among the components of the transformation model, respondents rated the supervisor's inspirational motivation ($M=4,35$, $SD=0,76$) and intellectual stimulation ($M=4,31$, $SD=0,77$) the most, while the least perceived individualized influence ($M =4,18$, $SD=0,84$). When it comes to the abilities of emotional intelligence, the respondents perceive the supervisor's ability to use emotions to the greatest extent ($M=4,39$, $SD=0,61$), while the supervisor's ability to regulate emotions is rated the lowest ($M=3,92$; $SD =1,03$).

Table 10. Descriptive Statistics

	MEAN	STD. DEVIATION
IUA	4,18	0,84
IUP	4,24	0,86
IM	4,35	0,76
IS	4,31	0,77
IP	4,22	0,86
SEA	4,00	0,96
AOE	4,00	1,00
UOE	4,39	0,61
ROE	3,92	1,03
TL	4,26	0,78
EI	4,08	0,80

Pearson's correlation was applied in order to examine the relationship between emotional intelligence and transformational leadership. Table 2. presents the results. In accordance with the Pearson's correlation values, we observe that between the overall perceived transformational leadership and overall emotional intelligence there is a positive and strong statistically significant relationship ($r=0,893$, $p<0,001$), whereby emotionally intelligent supervisor show transformational behaviors.

Table 11. Correlation between transformational leadership and emotional intelligence (unidimensional approach)

		TL	EI
TL	PEARSON CORRELATION	1	0,893**
	SIG. (2-TAILED)		<0,001
EI	PEARSON CORRELATION	0,893**	1
	SIG. (2-TAILED)	<0,001	

**, Correlation is significant at the 0.01 level (2-tailed).

Pearson's correlation was applied in order to examine the relations between dimensions of emotional intelligence and components of transformational leadership. Table 3. presents the results. In accordance with the Pearson's correlation values, we observe that all components of transformational leadership achieve positive and strong connections with all dimensions of emotional intelligence, where the correlation coefficients are statistically very significant. In Table 3, we see that the highest correlation is between idealized influence and the ability to assess others' emotions ($r=0,869$, $p<0,001$), while the lowest is observed between idealized influence and the ability to use emotions ($r=0,617$, $p<0,001$).

Table 12. Correlation between transformational leadership and emotional intelligence (multidimensional approach)

		IUA	IUB	IM	IS	IC
SEA	PEARSON CORRELATION	0,719**	0,766**	0,643**	0,740**	0,782**
	SIG. (2-TAILED)	<0,001	<0,001	<0,001	<0,001	<0,001
AOE	PEARSON CORRELATION	0,820**	0,869**	0,749**	0,828**	0,853**
	SIG. (2-TAILED)	<0,001	<0,001	<0,001	<0,001	<0,001
UOE	PEARSON CORRELATION	0,623**	0,617**	0,651**	0,756**	0,647**
	SIG. (2-TAILED)	<0,001	<0,001	<0,001	<0,001	<0,001
ROE	PEARSON CORRELATION	0,776**	0,804**	0,754**	0,779**	0,821**
	SIG. (2-TAILED)	<0,001	<0,001	<0,001	<0,001	<0,001

**, Correlation is significant at the 0.01 level (2-tailed).

The multiple regression method was used to examine the predictive role of emotional intelligence dimensions on perceived transformational leadership. The results are presented in Table 4. and show the ability of this set of variables to predict the level of transformational leadership. In addition to multicollinearity, preliminary analysis examined the assumptions of normality, linearity, homoscedasticity, and the presence of multivariate extreme values. No violation of the assumptions for the use of multiple regression was observed.

The data in the Model Summary table show that the coefficient of determination is $r^2=0,846$, which means that the dimensions of emotional intelligence (self-emotion appraisal, appraisal of others' emotion, use of emotions, regulation of emotions) explain as much as 84.6% of the variance of perceived transformational leadership. It is a statistically significant contribution as shown by the data in the ANOVA table ($F=75,352$, $p<0,001$).

Table 13. **Model Summary**

MODEL	R	R SQUARE	ADJUSTED R SQUARE	STD. ERROR OF THE ESTIMATE
1	0,920 ^A	0,846	0,834	0,31947

a. Predictors: (Constant), ROE, UOE, SEA, AOE
 ANOVA^a

MODEL		SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
1	REGRESSION	30,762	4	7,691	75,352	<0,001 ^B
	RESIDUAL	5,613	55	0,102		
	TOTAL	36,376	59			

a. Dependent Variable: TL
 b. Predictors: (Constant), ROE, UOE, SEA, AOE

The data presented in Table 5. show how much of the unique variance of transformational leadership is explained by each of the dimensions of emotional intelligence. From the Beta Standardized Coefficients column, we notice that the highest beta coefficient is 0,564, which is the value for the dimension of appraisal of others' emotion. This variable individually contributes the most to explaining perceived transformational leadership when the variance explained by all other variables in the model is subtracted. The beta coefficients for the ability to use emotions $\beta=0,318$ and the ability to regulate emotions $\beta=0,305$ are slightly smaller. The lowest beta coefficient was recorded for the ability to self-emotion appraisal ($\beta=-0,147$).

Table 14. **Coefficients^a**

MODEL		UNSTANDARDIZED COEFFICIENTS		STANDARDIZED COEFFICIENTS	T	SIG.
		B	STD. ERROR	BETA		
1	(CONSTANT)	0,289	0,300		0,961	0,341
	SEA	-0,120	0,093	-0,147	-1,290	0,202
	OEA	0,440	0,093	0,564	4,705	<0,001

	UOE	0,406	0,082	0,318	4,972	<0,001
	ROE	0,231	0,082	0,305	2,806	0,007

a. Dependent Variable: TL

However, the values in Table 5. column Sig. point that only two abilities of emotional intelligence (appraisal of others' emotions and use of emotions) make a significant unique contribution to the prediction of transformational leadership.

5.CONCLUSION

In this paper, a unidimensional and multidimensional analysis of the relationship between transformational leadership style and emotional intelligence was conducted. We started from the assumption that there is a statistically significant and positive relationship between the constructs. In accordance with expectations, the results of the analysis point that the relationship between the overall perceived transformational leadership and emotional intelligence is statistically significant, that is, the overall emotional intelligence of supervisor is related to the transformational leadership style. The obtained findings are consistent with the results that verified the connection between transformational leadership and emotional intelligence abilities (Brown & Moshavi, 2005; Cartwright & Pappas, 2008; Hayashi & Ewert, 2006; Leban & Zulauf, 2004; Mandell & Pherwani, 2003; Weinberger, 2004). The results of this research confirmed the analysis of Sivanathan and Fekken (2002) according to which the specific transformational behaviors of a leader are directly proportional to his emotional intelligence, and the meta-analysis of Harms and Crede (2010) in which an extremely strong relationship between emotional intelligence and transformational leadership was proven ($r=0,41$).

At the same time, the findings of this research contradict the critical views regarding the importance of the leader's emotional competencies in the manifestation of his transformational behaviors. Thus Weinberger (2004) failed to find a significant relationship between emotional intelligence and transformational style perceived by employees, as well as Antonakis, Ashkanasy and Dasborough (2009) who did not prove that a leader's emotional abilities significantly contribute to his specific transformational behaviors.

It was also expected that the subscales of emotional intelligence provide a statistically significant contribution to the transformational leadership style in insurance companies in Serbia. It has been proven that the abilities of emotional intelligence, appraisal of others' emotions and use of emotions have a positive and statistically significant relationship with perceived transformational leadership. The research results are contrary to the findings of Alston, Dastoor and Loy (2016) that only one factor of emotional intelligence (self-emotion appraisal) is related to leadership, as well as Downey, Papageorgiou and Stough (2006) that the emotional ability to manage emotions accounts for 20% of the variance in transformational leadership. The findings of this research confirm the results of Ayiro (2009) hat transformational leadership behaviors are based on the ability to appraisal of others' emotions and use of emotions, but not emotional understanding and management.

Contrary to expectations, the self-emotion appraisal and regulate emotions do not significantly contribute to the prediction of transformational leadership. A possible explanation may lie in the details of the exchange between supervisor and employees. Namely, negative emotional reactions and attitudes of employees towards job can be a consequence of perceiving a supervisor who has the ability to self-emotion appraisal as less sincere. Frequent experiences of other-directed positive emotions have been shown to motivate leaders to act in accordance with their values concerning others. Self-transcendent values and positive emotions directed at others are important determinants of authentic leadership (Michie & Gooty, 2005). A leader who is motivated by positive emotions directed at others is someone who understands, cares for others, has a strong will, psychological harmony, good relationships and a realistic sense of his own self-worth (Schulman, 2002). This description reflects the concept of authentic leaders as positive and moral individuals who are aware of the context in which they lead, their own and others' emotions, knowledge and strengths (Luthan & Avolio, 2003). The results of this research, consistent with the above argument, suggest that frequent experiences of self-directed positive emotions (e.g., a leader's ability to self-emotion appraisal) can lead to negative, while other-directed positive emotions (e.g., appraisal of others' emotions) can lead to positive outcomes in regarding the perception of the transformational leader. Supervisor who frequently experience self-directed emotions may be perceived as manipulative or insincere from the employees' perspective.

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TEATAR POTLAČENIH - IZMEĐU POZORIŠNE PRAKSE I SREDSTAVA ZA DRUŠTVENU PROMENU

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SAŽETAK:

Primenjeno pozorište jeste važno sredstvo rada sa zajednicom koje može uticati na pokretanje društvenih promena, na senzitivizaciju zajednice i na njeno udruživanje. Teatar potlačenih jeste jedna od formi primenjenog pozorišta koja je tokom svog razvoja korišćena u različitim kontekstima. Od dramske tehnike koja se bavi isključivo socijalno - političkim problemima u Brazilu, pa sve do danas kada se ova metodologija koristi u svetu kao univerzalni alat za edukaciju i osnaživanje ranjivih grupa ali i kao deo procesa stvaranja umetničkih dela, performansa i pozorišnih predstava.

Kao edukativna tehnika, Teatar potlačenih se pokazao vrlo efektivnim pri mapiranju, analiziranju i rešavanju različitih društvenih i ličnih problema kroz dramsko izražavanje.

Rad se bavi Teatrom potlačenih, teorijom i praksom, opisujući korake procesa forum teatra i nudeći konkretne primere upotrebe ove metodologije u pozorišnim i edukativnim praksama u Srbiji. Rad će pokušati da približi šta znači teatar potlačenih u praksi, koji su njegovi koreni i dometi, koliko je ova vrsta pozorišta umetnost a koliko društveni i edukativni alat, kao i na koji način se ova forma pozorišta menja i prilagođava društvenim potrebama i okolnostima.

Ključne riječi: teatar potlačenih, forum teatar, primenjeno pozorište, ranjive grupe

1. UVOD

Primenjeno pozorište jeste važno sredstvo rada sa zajednicom koje može uticati na različite promene u društvu. Teatar potlačenih jeste jedna od formi primenjenog pozorišta koja je tokom svog razvoja korišćena u različitim kontekstima. Teatar potlačenih u nastanku se bavio isključivo socijalno - političkim problemima u Brazilu, a danas je proširio svoju upotrebu u skoro svim zemljama kao univerzalni alat za edukaciju i osnaživanje ranjivih grupa. Kao edukativna tehnika pokazao se vrlo efektivnim pri mapiranju, analiziranju i rešavanju različitih problema kroz dramsko izražavanje. Praksa teatra potlačenih se nastavila kroz rad sa raznim grupama, najčešće onim najranjivijim.

Nedostupnost adekvatne literature ograničava domete ovog rada, kao i sam nedostatak prakse teatra potlačenih u Srbiji. Nedostatak trupa/grupa koje koriste isključivo ovu metodologiju i formu pozorišta, kao i česta banalizacija same metodologije, kao nečeg što se koristi isključivo kao usputna tehnika u kontekstu neformalnog obrazovanja, sužava mogućnost analize različitih pristupa metodologiji u Srbiji i regionu. Ipak, rad će pokušati

da približi šta znači teatar potlačenih u praksi, koji su njegovi koreni i dometi, kao i koje promene i prilagođavanja sama metodologija trpi u odnosu na novi društveni kontekst.

2. PRIMENJENO, INTERAKTIVNO, PARTICIPATIVNO POZORIŠTE

Primenjeno pozorište, podrazumeva primenu pozorišnih tehnika i metoda u različitim kontekstima, sa određenim društvenim ciljem koji se razlikuje od cilja „klasičnijeg“ pozorišta i drugih izvođačkih umetnosti. Konteksti u kojima se ovo pozorište/drama dešava, svakako prevazilaze pozorište kao instituciju, te se različite metodologije mogu primenjivati u školama, muzejima, zatvorima, domovima za starije i dece bez roditelja, bolnicama, i drugim institucijama, na ulici i drugim mestima.

Može se reći da je ovo „kišobran“ termin koji obuhvata različite prakse, različite metodologije od kojih su neke: pozorište zajednice, pozorište za obrazovanje (theatre/drama in education), teatar potlačenih, razvojno pozorište, pozorište u zatvoru, pozorište uspomena/sećanja, plejbek teatar (playback theatre) impro teatar, drama-terapija, muzejsko pozorište i druge tehnike.

Prema Philipu Tayloru, funkcije primenjenog pozorišta jesu: podizanje svesti o nekom problemu, podučavanje određenog koncepta/teme, istraživanje ljudskih postupaka i preveniranje određenih ljudskih ponašanja, lečenje ranjenih identiteta i promena stanja opresije. Isti autor naglašava da je primenjeno pozorište više konkretno nego apstraktno, te da su kod ovog pozorišta važna „tri P“: people (ljudi), passion (strast), platform (platforma) i temelji se na participativnosti, inkluzivnosti i osnaživanju ljudi da uzmu kontrolu nad svojim životom [1].

Osim primenjenog pozorišta, javljaju se razni izrazi kao što su angažovano pozorište, participativno pozorište, interaktivno pozorište i mnogi drugi izrazi koji imaju dosta sličnosti, često se koristeći za iste ili slične forme pozorišta.

Termin interaktivnog pozorišta predstavlja formu pozorišne predstave u kojoj se ruši četvrti zid, tj publika deluje aktivno u predstavi zajedno sa glumcima. Tokom ovakvog procesa postoji interakcija, medjudejstvo, medjuzavinost između publike i glumaca, i publika preuzima često ulogu aktivnog učesnika u predstavi. Participativno pozorište je sličan termin, koji obuhvata uključivanje zajednice u samostvaranje predstave, gde se briše granica između „umetnika“ i „zajednice“.

Teatar potlačenih, koji je fokus ovog rada, podrazumeva uključenost zajednice u svim fazama stvaranja predstave, i uključuje publiku na način da od pasivnog posmatrača, ona postaje – značajan akter u socijalnoj promeni.

3. DA LI JE PRIMENJENO POZORIŠTE - POZORIŠTE?

Postoje različite diskusije o umetničkim dometima primenjenog pozorišta, kao i o njegovim edukativnim/ osnažujućim/ terapijskim dejstvima.

Često je sam proces stvaranja predstave važniji od rezultata. To je zato što je cilj procesa koji koristi neku od tehnika primenjenog pozorišta uglavnom menjanje svesti, uticaj na određeni problem, lični razvoj pojedinaca koji su uključeni u proces, i slično. Ipak, dosta

autora naglašava važnost estetskog i umetničkog dojma predstave u približavanju samog problema / teme publici, kako bi se publika uključila na pravi način, odnosno “isprovocirala” da postane aktivan akter u samoj predstavi.

Kad je u pitanju teatar potlačenih, u samom nazivu, ova forma pozorišta sadrži teatar-umetnički aspekt metodologije, i potlačenost- sociološki / društveni aspekt. Metodologija se naslanja , između ostalog, i na idejama koje je zastupao Paulo Freire u svojoj knjizi “Pedagogija potlačenog”[8]. On predstavlja revolucionarnu pedagogiju oslobođenja, koju mogu pokrenuti obespravljeni. On uvodi termin osvešćivanja ili konscijentizacije, koji objašnjava kao filozofiju oslobođenja, proces osvešćivanja. Na isti način kako Freire vidi potencijal obespravljenih, potlačenih i njihovu moć i snagu da menjaju društveni kontekst, tako i Boal vidi potlačene, dajući šansu za osnaživanje, prosto za “probu za realnost” da potlačeni osvajaju prostor na sceni, pa onda i u stvarnom životu.

4. POZORIŠTE POTLAČENIH (eng. Theatre of the Oppressed)

„Svi moramo da učestvujemo u teatru - kako bismo saznali ko smo i otkrili šta bismo mogli postati.“ (Augusto Boal)

Teatar potlačenih je nastao 1971. godine u Brazilu i osnivač je brazilski reditelj i aktivista Augusto Boal (1931-2009) i njegove kolege. Teatar potlačenih u nastanku se bavio isključivo socijalno-političkim problemima (koncipiran je tako da bi se pomoglo marginalizovanoj latinoamerickoj populaciji u raspravi oko efikasnijih rešenja za probleme sa kojima se u svom preživljavanju suočavaju, koji su bili aktuelni na području Brazila u tom periodu dok je danas proširio svoju upotrebu i koristi se kao edukativna tehnika za mapiranje, analiziranje i rešavanje drugih različitih i raznovrsnih problema. Praksa teatra Potlačenih nastavila se kroz rad sa raznim grupama, najčešće onim najranjivijim.

Tehnike teatra potlačenih su se ubrzo proširile svetom i pokazale se vrlo efektne kao univerzalno sredstvo za edukaciju i alat za dramska izražavanja i transformaciju. Njegova posebna prednost jeste što nudi i povezuje kreativnost, igru, umetnost, prostor, publiku, učesnike, edukaciju, mapira probleme i nudi rešenja istih. Teatar potlačenih pruža publici mogućnost da se identifikuje sa problemom i da na kratko postanu kreatori i improvizatori vlastitih života i osećaju da je moguće menjati svet i društvo.

Boal je smatrao je da je tradicionalni teatar opresivan, jer publika nema priliku da se izrazi, dok u njegovoj ideji teatra publika aktivno učestvuje. Radeći na smanjivanju diskriminacije određenih grupa, suzbijanju opresije i rešavanju socijalnih problema putem pozorišta, A. Boal je osmislio tehniku Forum teatar kao mesto gde ljudi mogu da uče kako da menjaju svet. Boal je smatrao da samo potlačeni mogu osloboditi potlačene. Baš sa tom idejom nastaje metoda Forum teatar. Boal u svojoj metodologiji pominje dosta reči “opresija” i “moć”. Jedna od definicija opresije jeste ispoljavanje autoriteta ili moći na opterećujući, okrutan ili nepravedan način. Augusto Boal opresiju definiše kao odnos moći u kome nema dijaloga, već postoji samo monolog. Onog trena kada “dijalog postane monolog - počinje opresija”. Svrha i glavni cilj Boalovog teatra je da transformiše

monolog u dijalog. Za razliku od klasičnog teatra gde mirno sedimo i pasivno primamo sve što nam stiže sa pozornice, ovde publika aktivno učestvuje na "pozornici" i sopstvenim i pojedinačnim intervencijama menja tok predstave i ide u samu srž teatra - ljudsko biće [6].

5. FAZE U KOJIMA GLEDALAC POSTAJE AKTIVAN (*spect-actor*)

Boal navodi nekoliko faza u toku kojih gledalac (*spectator*) postaje aktivan (*spect-actor*). Kao prvo, osoba mora biti svesna svog tela koje je glavni izvor zvuka i pokreta. Dakle, prva faza je : poznavanje svog tela. Putem različitih vežbi, osoba se oslobađa „socijalne maske“, odnosno osvešćuje „mišićnu alijenijaciju“ koja je uslovljena poslom, statusom, klasom.

Druge faze podrazumeva činjenja tela ekspresivnijim. Setom vežbi i igara, osoba uči da se izražava telom, što je važno u kulturi koja se dosta oslanja na reči.

U trećoj fazi se nalaze različiti nivo i participacije osobe:

-Simultana dramaturgija: gde osoba iz publike daje rešenja, odnosno usmerava glumce i glumice na sceni, dajući predloge šta da rade dalje u predstavi.

-Teatar slika: ovde je osoba pozvana da da odgovor na određene teme, postavljajući sebe ili druge u „statuu“ ili „sliku“ koja je napravljena od tela. Na ovaj način osoba može izraziti sebe, a može i raditi „intervencije“ u postojećim slikama, dajući svoja rešenja.

-Forum teatar kao treći stepen: osoba iz publike učestvuje ulazeći u pripremljenu predstavu/ scenu, i pokušavajući da reši prikazani problem na sceni.

-Četvrtu fazu Boal zove „teatar kao diskurs“. U toj fazi, publika pita, raspravlja, postoji aktivan dijalog i publika aktivno učestvuje u njemu[5].

6. TEHNIKE/ GRANE TEATRA POTLAČENIH

Teatar potlačenih se sastoji iz više različitih tehnika, koje su komplementarne i vode ka društvenoj promeni. Boal je vremenom razvijao različite tehnike, u odnosu na praksu i definisane potrebe zajednice. Osim što su se tehnike menjale, i sam Boal je pozivao praktičare da u odnosu na kontekst menjaju tehnike, prilagođavaju ih.

Osim samog Boala, razni praktičari su prilagođavali samu metodologiju, pa su tako postojali „eksperimenti“ forumovanja telefonskim putem (simultana dramaturgija), dok su se scene forum teatra prikazivale na televiziji. Isto tako, uslovljeno pandemijom bolesti COVID19, postoje pokušaji forumovanja online.

Tehnike (u svom izvornom obliku) predstavljene kroz drvo teatra potlačenih (Slika 1.):

6.1 IGRE (GAMES)

Ova tehnika, kao i sam teatar potlačenih jeste spoj discipline i slobode. Igrama se probijaju barijere među učesnicima, stvara se poverenje i formira se bezbedno mesto i zabavna atmosfera među učesnicima procesa.

6.2 TEATAR SLIKA (IMAGE THEATRE)

Teatar slika je jedna od bitnijih tehnika teatra potlačenih, gde učesnici svojim telima bez verbalne i neverbalne komunikacije formiraju jednu određenu “zamrznutu” sliku koja formira određenu ideju, konflikt, emociju ili događaj...

6.3 LEGISLATIVNI TEATAR (LEGISLATIVE THEATRE)

Legislativni teatar je tehnika teatra potlačenih koja se fokusira na političke probleme i pomaže marginalizovanim grupama da učestvuju u zakonodavnim procesima.

6.4 NEVIDLJIVI TEATAR (INVISIBLE THEATRE)

Nevidljivi teatar je tehnika prikazivanja scene opresije koja se dešava u javnom prostoru bez najave i sa nekoliko glumaca koji predstavljaju realne situacije i probleme i za cilj ima opipavanje pulsa javnosti na problem prikazan u sceni.

6.5 DIREKTNJA AKCIJA (DIRECT ACTION)

Ova tehnika može uključuje teatralizaciju protesta, štrajkova, okupacija, blokada, demonstracija, sabotaža, itd. korišćenjem pozorišnih elemenata. Cilj je da se stvori javni pritisak na vlasti i da se zahtevi za promenom ili akcijom od vlasti učine neizbežnim.

6.6 TEATAR NOVINA (NEWSPAPER THEATRE)

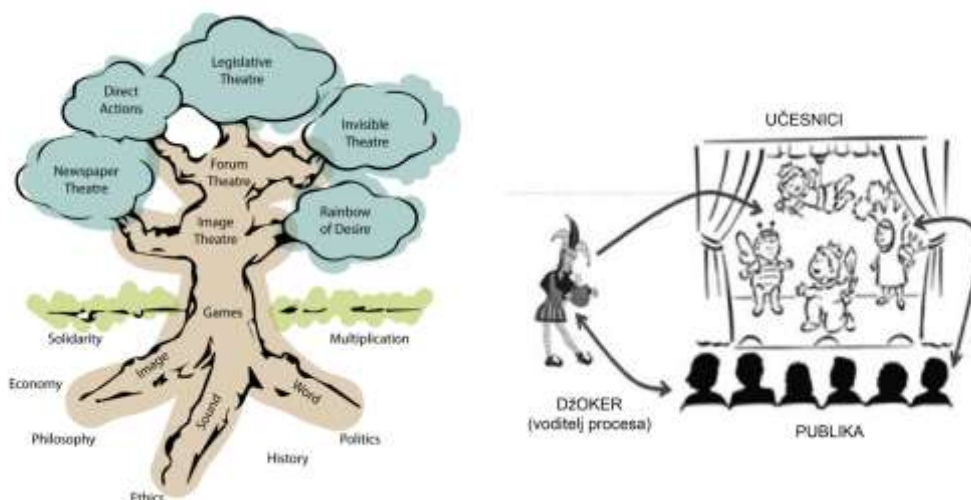
Teatar novina predstavlja skup tehnika osmišljen gde publici daje mogućnost transformacije novinskih članaka u pozorišnu scenu, koristeći različite strategije: dodavanje informacija koje su obično izostavljane od strane vladajuće klase; čitanje članaka u određenom ritmu (što predstavlja svojevrsni “filter” koji otkriva pravi sadržaj koji je često zamaskiran); paralelno prikazivanje radnje iz vesti pantomimom, dok se one naglas čitaju; konkretizovanje apstraktnih sadržaja vesti na sceni [6].

6.7 DUGA ŽELJA (RAINBOW OF DESIRE)

Duga želja je interaktivna tehnika u kojoj se koristi pozorište da se istraži ljudska želja i motivacija.

6.8 FORUM TEATAR (FORUM THEATRE)

Forum teatar je napopularnija tehnika poznata kao moderno sredstvo sredstvo za socijalne promjene, koja će biti u fokusu u nastavku rada.



7. FORUM TEATAR - KORAK PO KORAK

Forum teatar se koristi u skoro svim zemaljama sveta kao univerzalni alat za socijalne promene društva i koristi se u radu sa različitim grupama ljudi (uglavnom onim najranjivijim) kao što su : osobe koje su preživele bilo kakav vid nasilja (porodičnog, vrsnjačkog, rodno zasnovanog...), mladi uopšte, pripadnici romske populacije, LGBT osobe, korisnici pojedinih ustanova (psihijatarske ustanove, zatvori, starački domovi i sl.), svim osobama koji trpe diskriminaciju (na etičkoj, rasnoj, nacionalnoj, polnoj, seksualnoj, rodnoj i drugim osnovama).

7.1. Vežbe i igre

Prvi korak kroz proces forum teatra jesu igre i vežbe. One služe da se učesnici opuštaju, zabavljaju, upoznaju druge, a i sebe same, svoje telo, glas, razvijaju stavove i sl. Ova prva faza je jako bitna jer se ruše fizičke i psihološke barijere, gradi se poverenje i atmosfera zabave i sigurnosti, radi se na izgradnji tima i fizičkom zagrevanju.

7.2. Mapiranje problema

Sledeći korak jeste mapiranje problema u zajednici, koje učesnici i voditelji procesa prepoznaju kao važne. Problemi koji se mapiraju jesu u vezi sa opresijom i upotrebom moći na različitim nivoima (strukturna diskriminacija, nasilje, i slično). Učesnici i učesnice se podstiču da problem prepoznaju iz ličnog iskustva ili šireg okruženja, iz zajednice, medija. Bitno je u toku procesa definisati opresora, potlačenog/ protagnostu, kako bi se moglo delovati konkretno.

7.3. Formiranje likova i scena

Teatar slika je jedan od mogućih alata koji se koriste u procesu, gde se kreiraju zaleđene slike isključivo govorom tela koje prikazuju određene emocije, konflikte, događaje. U narednom koraku se ove slike “oživljavaju” i razvijaju u pojedinačne forum scene (kratke scene u kojima je vrlo konkretno prikazan problem opresije i diskriminacije). Formirane scene prikazuju obavezno dva karaktera/like: Opresora/ Tlačitelja, Potlačenog/ Protagonistu, a mogu imati i “neutralne likove”, kao i podrške opresoru ili potlačenom. Opresor ili Tlačitelj je osoba koja ima neku moć i zloupotrebljava je tako što diskriminiše ili vrši nasilje nad potlačenima. Potlačeni/a je osoba nad kojom se vrši nasilje ili diskriminacija. Džoker je spona između publike i učesnika i facilitator koji vodi ceo process.

7.4. Predstava

Proces Forum teatra i njegov krajnji rezultat jeste predstava koja se odigrava pred publikom. Ona može biti: realistična, simbolična, ekspresionistička, ali nikako ne bi smela biti iracionalna ili surealna [6]. Svrha predstave jeste da se stvori i razvije diskusija na

osnovu prikazanih forum scena i priča koje su predhodno odigrane. Forum teatar i jeste mešavina umetničke izvedbe i diskusije. Svaki lik mora imati specifične replike, težnja je da svaka scena i priča bude jasna i efektna da bi je publika lako prepoznala i identifikovala sa sa njom.

7.5. Diskusija sa publikom

Nakon odigranih unapred pripremljenih FT scena u kojima potlačeni akteri nisu uspeali da se dovoljno izbore sa situacijom opresije, Džoker započinje diskusiju sa publikom, gde se sumira svaka priča pojedinačno. Diskutuje se o tome koja priča je bila najrealnija, koja je ostavila najjači utisak, sa kojom se najviše empatiše, koja je aktuelna i sl. Tada počinje glavni deo forum teatra – forumovanje.

7.6. Forumovanje

Kao što je već pomenuto, Forum teatar je moderni alat za društvene intervencije, a najbolji način da se razgovara o realnosti jeste interakcija sa publikom, što je sastavni deo Forum teatra. Publika nakon predstave osim što ima priliku da diskutuje i kaže kako je doživela i shvatila postavljene scene, ona ima mogućnost i da kreira, izmeni predstavljenu scenu, i promeni kraj. Ovaj segment učestvovanja i intervencije publike naziva se forumovanje.

Nakon odigrane predstave i prikazanih forum scena, na scenu dolazi Džoker, koji je spona između publike i učesnika, koji vodi diskusiju, motiviše publiku da uzme učešće u scenama i saopštava pravila forumovanja. Najbitnije i osnovno pravilo Forum teatra pri intervenciji jeste da se Opresor ne može zameniti jer to ne bi prikazalo realnu situaciju, već bi značilo da posedujemo magični štapić kojim problem nestaje.

Cilj je postaviti na scenu realne situacije i ohrabriti publiku da nađe način da odreaguje i promeni situaciju. Nakon diskusije gde su analizirane sve priče, sledi glasanje. Publika glasa koja je priča najpogodnija za intervenisanje i gde oni smatraju da je moguće izmeniti situaciju i naći rešenje da se suzbije opresija. Kad bude izglasana, izabrana priča se ponovo izvodi, a publika dobija “ imaginarni daljinski upravljač” gde može da vraća scene unazad, u bilo kom trenutku kada primeti problem može zamrznuti određenu scenu tako što kaže “STOP”, i zameni ulogu sa bilo kojim akterom a da to nije Opresor i svojom intervencijom ponudi predlog sopstvenog rešenja (Slika 2). Dok se događa intervencija osobe iz publike, vrlo je važno da svi ostali akteri/ke ostaju u svojim ulogama a posebno Opresor koji mora da se trudi da zadrži svoju nadmoć i bude nepokolebljiv u svojim namerama.

Cilj Forum teatra nije da se dobije jedan ispravan odgovor, već da se ponudi što više rešenja. Bitno je razdvojiti da je svaka intervencija represent pojedinca i njegovih stavova i mišljenja a ne cele publike. Posle svake scene Džoker komunicira sa ostatkom publike, otvara diskusiju o postignutim promenama na sceni, podstičući ostatak publike da se uključi i ponudi nova rešenja.

7.7. Vruća stolica

Bitan deo Forum teatra jeste vruća stolica, gde publika može da postavi pitanja jednom od karaktera u sceni (u ovom segmentu, i Opresor može sedeti na vrućoj stolici). Pitanja

publike se mogu odnositi na biografiju lika, njegove postupke, motive, istoriju, dublji odnos sa drugim likovima i slično. Na taj način publika bolje upoznaje lika, dobija informacije koje mogu biti značajne pri intervenciji i zameni uloga. Iz tog razloga učesnici sami pišu biografije likova tako da što više budu spremni za vruću stolicu.

8. FORUM TEATAR- PRAKSA U REGIONU

Forum teatar je sve češće korišćen kao alat i edukativno sredstvo u neformalnom obrazovanju, a tehnike i vežbe iz Forum teatra, i generalno iz primenjenog pozorišta, bivaju sve zastupljeniji način dolaženja do materijala za predstave. Trenutno u svetu postoji više grupa koje koriste teatar potlačenih kao glavno sredstvo, a neke od njih su:

-Cardboard Citizens- grupa iz Londona, usmerena na osnaživanje beskućnika i ljudi sa sličnim iskustvima putem pozorišta.

-Jana Sanskriti centar Teatra potlačenih- grupa koja deluje na području Indije, koristeći uglavnom Forum teatar u različitim zajednicama.

Kad je u pitanju naša zemlja i region, ima više grupa i organizacija koje koriste tehnike primenjenog pozorišta a neke od njih su: BAZART, CEDEUM, DAH TEATAR, APS ART i ostale grupe, kao što je Mostarski teatar mladih (BIH). Tu su i nevladine organizacije koje sve češće tehnike teatra potlačenih koriste za rad sa mladima ili drugim osetljivim grupama.

Pomenuću nekoliko projekata koji su koristili teatar potlačenih u regionu, kao sredstvo u radu sa različitim društvenim grupama:

- Banja robija, predstava organizacije Beogradski centar za ljudska prava i organizacije ApsArt. Predstava se bavi problemima sa kojima se susreću lica lišena slobode, kao i bivši osuđenici, a nju upravo i izvodi grupa ljudi sa ovim iskustvom. Predstava je otvorila pitanja zdravstvene zaštite, hijerarhije i tretmana u kaznenim ustanovama i druge probleme.
- Priče iz duše, predstava nastala u okviru projekta udruženja “Duša”, a predstavu izvode korisnici psihijatrijskih usluga. Jedna od retkih predstava koja ovu osetljivu grupu stavlja u fokus.
- Predstava “To”, kao deo projekta “Kroz okvire” organizacije OKVIR iz Sarajeva, kreirana je 2017 godine, nakon višednevnih radionica teatra potlačenog sa grupom mladih osoba koje pripadaju LGBTIQ+ zajednici. Predstava je prikazala svakodnevne probleme s kojima se susreće ova zajednica, a uglavnom u vezi sa diskriminacijom, neprihvatanjem i neregulisanim pravnim statusom. Istraživački proces koji je doveo do predstave je podrazumevao i istraživanje medija, sprovođenje anketa u zajednici, deljenje ličnih priča koje su postale deo predstave. Tokom forumovanja, različite intervencije od strane publike su urađene i predstava je postala mesto razmene i prepoznavanja, solidarnosti i akcije.

- Neke od predstava koje su koristile vežbe i igre primenjenog pozorišta (i posebno Teatra potlačenih) kako bi došli do materijala za predstavu jesu omladinske predstave kao što su “Kuća velikog rata” – ApsArt i Beogradski centar za ljudska prava, “Kafanski priručnik” – Beogradski centar za ljudska prava, dok su predstave kao što je Jami distrikt, ili Beton mahala, one koje su koristile različite druge tehnike primenjenog pozorišta, kao devising theatre i slično.

9. EVOLUCIJA TEATRA POTLAČENIH

Naivno bi bilo smatrati da je Teatar potlačenih sada isti kao što je bio u jeku svog razvoja. Sam tvorac teatra potlačenih je menjao tehnike i osmišljavao nove vremenom, u odnosu na potrebe koje su se nametale. A.Boal je tokom svog boravka u Americi i Evropi usled egzila, počeo da razvija nove metode, trudeći se da odgovori na probleme koje je tada primetio u delu sveta za koji je smatrao da sistem nije toliko opresivan ali da su ljudi i dalje “zarobljeni”. Tako je nastala tehnika Duga želja, koja je slična Teatru slika ali se bavi ličnim opresijama, ili “policajcima u glavi”, pa tako i podseća na psihodramu. Tokom 90-tih se Boal više angažovao u politici pa je razvijao tehniku legislativni teatar, koja predstavlja vrhunac participacije, gde osnažene grupe učestvuju u kreiranju zakona. Ono što je očigledno jeste da se menjaju konteksti u kojem se ova metodologija koristi, pa se čini da preuzima sve “sigurnije” okvire, osnažujući različite grupe “predviđene projektom”, pa se i promene u zajednici čine “kozmetičkim”. Osim toga, čini se da se baveći se raznim problemima, kao da se skreće pogled sa onoga što je bila ključna tema i razlog nastanka ove forme pozorišta opresija i sa njom povezana upotreba moći i neravnomerna raspodela resursa.

10. ZAKLJUČAK

Teatar potlačenih predstavlja jako bitno sredstvo društvene promene, koje sada, u doba velikih društvenih previranja, može biti od ključne važnosti da pokrene promene koje idu iz zajednice, kreirajući demokratsko društvo koje je okrenuto svakom pojedincu. Teatar potlačenih ima snagu menja društvo, dajući glas onima koji ga nemaju, osvešćujući na taj način važnost dijaloga i participacije u društvima u kojima opresivni sistemi i dalje opstaju ili nastaju. Osim toga, u doba svetske zdravstvene krize u kojem je kontakt - opasnost, pozorište i ovakve forme pozorišta mogu biti od velikog značaja za društvenu koheziju, bliskost i solidarnost. Svaka forma pozorišta se svakako menja u odnosu na promenu društvenog konteksta. Pozorište je često i posmatrano kao ogledalo stvarnosti ali i ono koje pomera društvene granice i norme, ono koje na neki način kreira novu stvarnost. Čini se da je teatar potlačenih još u tešnjoj vezi sa društvenim kontekstom, jer je sam cilj ove forme pozorišta- promena postojećeg stanja stvari. Zato ova forma je “živa” i čak i ima obavezu da se menja, kako bi bila u stalnoj komunikaciji sa realnošću. Čak i sam A.Boal je naglašavao da je način na koji on primenjuje metodologiju podložan promeni i

prilagođavanju od strane praktičara. U prilog toj fleksibilnosti govore i promene pravila same metodologije koja su se menjala u odnosu na dati kontekst

Ono što se može očekivati jesu nove tehnike koje postaju deo metodologije teatra potlačenih a koje odgovaraju društvenom momentu (primena u digitalnom svetu, primena novih tehnologija), ali i promena u diskursu, temama koje se obrađuju već postojećim tehnikama.

Bez obzira na promene koje predstavljaju prirodan tok razvoja ove metodologije, jedno je sigurno - teatar potlačenih svakako predstavlja značajan okvir za promenu odnosa u društvu, i potreba za ovakvim načinom rada na društvenoj promeni će biti sve veća.

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THE THEATRE OF THE OPPRESSED - BETWEEN THEATRE PRACTICES AND TOOLS FOR SOCIAL CHANGE

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ABSTRACT:

Applied theatre is an important tool for working with a community that has the power to instigate social change, as well as to promote sensitization of the community and its unification. The Theatre of the Oppressed is indeed one of applied theatre formats, which has, during its development, been used in a variety of contexts. It has gone from a drama technique which dealt only with socio-political issues in Brazil, to the present-day when this methodology is used all over the world as a universal tool for education and empowerment of vulnerable groups, but also as part of the process in creating works of art, performances and plays.

As an educational technique, the Theatre of the Oppressed has proven to be highly effective when mapping, analyzing, and solving different social and individual problems through dramatic expression.

The paper will explore the Theatre of the Oppressed, the theory and practice, by describing the process of the forum theatre step by step and by offering specific examples of usage of this methodology in both theatre and educational practices in Serbia. The paper will attempt to paint a better picture of what the Theatre of the Oppressed looks like in practice, what its roots and scope are, as well as to what extent this type of theatre is art, and to which it is an educational tool. Finally, it will explore how this theatre format has changed and adjusted to the social needs and circumstances.

Keywords: *The Theatre of the Oppressed, forum theatre, applied theatre, vulnerable groups*

A CRITICAL REVIEW OF THE INFLUENCE OF SOCIETY, RELIGION AND POLITICS ON CULTURAL-HISTORICAL OBJECTS IN NOVI PAZAR (CASE STUDY OF THE ARAB MOSQUE)

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ABSTRACT:

The old bazaar in Novi Pazar is part of the historical city center on the banks of the river Raška. There is a large number of architectural and urban values that belong to the group of protected cultural buildings. One of those is the Arab Mosque, an Islamic religious building from the 16th century. The task of the research will be to examine the attitude of the competent authorities towards the historical heritage when it comes to the reconstruction given that the Arab mosque was demolished. In its place a new mosque was built based on the principles of the old one, yet from completely new materials. Deriving inspiration from this occurrence, the paper will examine whether there were potential methods for preserving the original object and what are the factors that led to demolition of it. Therefore, the question arises whether the mosque could have been saved and completely reconstructed on the basis of the preserved project documentation and according to which regulations and adherence to which standards the demolition was carried out. This paper aims to show the importance of historical and cultural heritage and its impact on the architectural and urban context and to position them in primarily in relation to current political and sociological events. Also, the goal is to objectively and studiously analyze the course of events and the influence of external factors which led to this event, with the initial hypothesis stating that it is the product of social, religious and political pressures.

Keywords: *Old bazaar, cultural-historical heritage, politics, religion, sacred objects*

1. INTRODUCTION

There are few cities in Serbia that successfully retain the essence of ambient architecture and preserve the legacy of traditional objects, as is the case with Novi Pazar. The old bazaar, which is a crucial component of the central core of Novi Pazar, is an extremely significant location because it represents a part of the historical segment of the old city

core. The basic structure of the Old Bazaar is made up of a series of objects that were largely constructed during the Ottoman Empire and are dispersed throughout Prvomajska Street. The stretch of today's Old Bazaar begins at the Raska River bridge and includes the fortress, the hammam, the Arab Mosque, and the Altun-Alem Mosque. Additionally, there are also many craft workshops, etc. The most renowned architects and experts from around the world have been addressing the problem of protecting cultural and historical heritage for centuries; thus, there is terminology that is universally understood and pertains to the preservation of historic structures. To maintain authentic architecture in accordance with the principles of current conservation theory and practice, one must first take a very cautious approach and implement the necessary technical protective measures. "Conservation" is the most crucial technical protection measure that should always be used, followed by the static-constructive consolidation of buildings. The original structural assemblage must be preserved with the fewest possible interventions required for constructive reasons. The main goal of conservation is to take action to extend life and stop deterioration, including condition checks, documentation, and preventive protection. The authenticity and integrity of the cultural heritage should be preserved as the primary objectives of conservation. [1]

2. THE SIGNIFICANT ROLE OF MOSQUES

In a practical sense, building a mosque means establishing a location for the congregation, or Muslim community, to gather as well as for a variety of religious, educational, cultural, and social activities. Mosques are a way to create a focal point for identification on a cultural and social level, whether they are in an urban or rural setting. It has been established over the years that constructing a mosque is an essential institution of any Islamic community, and despite the impending modern era, respect for this institution does not diminish. More than 60 mosques may be found inside the boundaries of Novi Pazar, making them the source of the community's greatest pride. The most renowned mosques are The Arab Mosque, Altun Alem Mosque, Lejlek Mosque, Bor Mosque.. Since the old mosques in Novi Pazar were constructed over a lengthy period of five centuries, it is important to note that they were made in various social contexts and conditions. When the first waqfs in the history of this city were established, two of them—Lejlek and Tabak Ishak—were constructed. The Arabic verb "veqafe," which meaning "to stop, keep, or dedicate," is the root of the word "waqf," which denotes that bequeathed property that is excluded from ordinary legal proceedings and set aside for special purposes is waqf property. Waqf is based on the rules of Sharia law, which is based on the Qur'an and the Hadith, two primary sources of Sharia. The construction of nine mosques marks the apex of Novi Pazar's development during the 16th century. The Altun Alem mosque, a work of art and the only mosque constructed during the 16th century that managed to maintain its original appearance, is unquestionably one of the most emblematic of them. We cannot ignore the fact that the other eight mosques—Ahmed-vojvoda, Iskender Celebi, Hajrudin Bajramli, Sinan-begova, Arab, Chalap Verdi, Ferhadija, and Bor mosques—built during the 16th century, did not fully manage to preserve their original appearance due to wars

and destruction during the later centuries. Nine mosques, practically all of which were first documented in 1528 are 210 meters apart from each other. Even more intriguing is the fact that they resemble the fortress almost exactly when combined.[2] We have not found any proof of the existence of the mosques in Novi Pazar, which were constructed in the 18th century, based on the data and sources we currently have access to. The restoration of the old mosques, which had been largely demolished in 1689, may have prevented the construction of new ones during the 18th century. In the vicinity of Novi Pazar, only a single mosque was constructed in the 19th century. The socio-political environment of that time, including in Novi Pazar, should be the first place to look for the explanation for why only one mosque was built throughout the whole 19th century. The period that followed was full of migration. This significantly exacerbated economic issues and had an impact on the city's development's standstill.

2.1. Architecture and interiors of Balkan mosques

It is believed that man's sense of beauty is a gift from God and should be fostered to its maximum is the basis of inspiration for Islamic religious architecture. You cannot separate art from technology in this style of building since the pursuit of beauty and the construction method always go hand in hand. The fundamental goals of Ottoman architecture were to emphasize the monolithic nature of their designs and to connect the rational and the beautiful in the construction system. Mosques served as both spiritual and social centers. In all Islamic architecture, the space of the mosque is the architect's most significant duty. The mosque's interior, which is designed to promote absolute focus of mind and perfect peace, adds to the feeling of intimacy. The interior is valuable in every way. Only the mihrab's location (the imam's niche) is highlighted. Because it indicates the direction toward Mecca in which believers are required to face in their prayers, the mihrab has symbolic meaning. Unquestionably, the mihrab is a work of religious art, and its shape is the subject of exceptionally deep and rich symbolism. The Arabic word for mosque derives from a root that means "to gather, to unite." Originally, it referred to a mosque that was also available for the required Friday noon-time prayers. A speech, or khutbah, was frequently included in these prayers, for which a platform for preaching was constructed. The Prophet utilized a three-tiered chair in Medina as the forerunner of the minbar when addressing the believers. The minbar's current design was developed during the Seljuk era and is composed of an entrance at the foot of a steep staircase with handrails on both sides and a pyramid at the top of the ground floor. The mosque's interior had a gallery (mahfil) in front of the doorway wall. The carpet on the floor adds warmth and comfort to the area and is a typical element of the mosque. The minaret is used for the call to prayer. At the beginning of Islam, the muezzin called from the roof of a mosque or any other elevated surface.[3]

3. SANDZAK'S SOCIO-POLITICAL CLIMATE

3.1. The political scene in Sandzak

After World War II, the formation of the first Bosnian political party was enthusiastically welcomed and gave a feeling that the years of repression, pressure, and infringement of fundamental human and communal rights were finally behind them. For the first time since the establishment of the communist government, Bosniaks joyfully underlined the necessity to restore the historical name of their people, the Bosnian language, and they had the chance to freely express their national and religious features. SDA was formally established in 1990, in Novi Pazar as a part of the political organization for the former SFRY, with headquarters in Sarajevo. In 1993, the Meihat of Sandzak was established, and Muamer Zukorlic was chosen to lead it as the town's mufti. Today, Sandzak is home to many Bosniak political players. These are conventional political groups and national movements where Bosniaks from different political parties in the country congregate. The most significant Bosniak-identified organizations and parties in the Serbian portion of Sandzak throughout the 1990s included the Bosniak National Council of Sandak, Party of Democratic Action, Sandak Democratic Party, Party for Sandak, and People's Movement of Sandak, which stopped functioning. There was pluralism in Bosniak political activity with the creation of the BDZ (now the SPP Justice and Reconciliation Party), the SNP, and several other smaller parties.

3.2. Islamic communities in serbia and their splits

Since the end of the 19th century, the time of Turkey's withdrawal, and since the Berlin Congress in 1878, various instability has shaken the Muslim communities in the Balkans. It is important to point out that Muslims on the Balkan Peninsula are regionally and ethnically diverse, and that their situation was very unequal following Turkey's exit. After the Turks left, the region became independent, and a state was established. With the approval of the Meshihat in Istanbul through the awarding of the mensura of Sheikh-ul-Islam, the Muslim population started to form Islamic religious communities, the goal of which is to preserve Islam and the spiritual selves of Muslims. On July 9, 1930, the Kingdom of Yugoslavia's Islamic Religious Community established its first constitution. The Islamic Religious Community was granted equality with other religious communities and was recognized as the official religion of the Kingdom of Yugoslavia by this decree. The Islamic religious community is structured according to agreements governing religious instruction and endowment property. This neighborhood was controlled in accordance with Sharia laws, the law, and the Islamic religious community's constitution. The mufti, whose residence is in Nis, was in charge of the Islamic Community of Serbia. A recognized Islamic scholar who has the ability to interpret or apply Sharia law is known as a mufti. On particular topics, he issues fatwas, which are religious stances, opinions, or directives. His fatwas are applicable to that territory and his followers only; other Muslims are not required to abide by them. The mufti's religious-legal power is restricted to a certain area. The opinions and viewpoints of the mufti in the region where the religious authority of a certain mufti or grand mufti is recognized must be applied by qadis (judges) in particular court proceedings. The term "chief of scholars" or "supreme religious

scholar" is reis ul ulema. The Arabic name for an Islamic scholar is alim, and its plural is ulema, which is most commonly rendered as "Islamic." Majlis means "council" or "assembly," whereas reis means "chief" or "leader." [4] The establishment of the Islamic Community of Sandzak in 1993, with its headquarters in Novi Pazar, marked the beginning of the division between the Islamic groups in Sandzak. The newly appointed mufti of Novi Pazar, Muamer Efendija Zukorli, took leadership of the Islamic Community of Sandzak.

4. CASE STUDY – ARAB MOSQUE

4.1. The initial state of the Arab mosque

The Arab, or Hasan Celebi, mosque is located in the center of the city in the Old Bazaar. The original mosque was demolished at the end of the 17th century; the old one was built or rebuilt in the same place, and the minaret remained authentic. It is assumed that the mosque got its present appearance at the beginning of the 19th century as a single building, together with the minaret. The Arab mosque is surrounded by a series of trade and craft shops that form an entire block. Judging by its current dimensions, the Arab mosque was created in two phases. In the first, the mosque itself, rectangular in shape with a four-pitched roof, was built, and in the second, the area in front of the mosque was closed and a two-story part was formed, the structure of which rests on a corner column, which covers the entrance to the mosque itself. The prayer area has an elongated rectangular shape and is very spacious. It is illuminated by rectangular windows and has no decorative elements. The mihrab is built in the form of a niche with a profiled frame, next to which there is a minbar. Above the entrance, which is placed asymmetrically, there is a mahvil from which you can enter the minarets. Mahvil has a great depth, rests on two rows of pillars, and is entered from the upper floor. In its external appearance, the main part of the mosque cannot be distinguished due to the subsequently added shops that are connected by roofs into large masses. The Arab mosque does not belong to the type of mosque with a dome. It can be said that it is a mosque of local character with a wooden sloping roof. The advantage and specificity of the mosque are precisely that part of its local identity compared to the Ottoman one, precisely that sloping roof. So we can call it a mosque with the character of local heritage. All windows are rectangular, without decorative elements. The minaret, somewhat stocky and archaic in appearance, is expertly walled and decorated, built with a combination of stone and brick and low in height with a simple sherefet on top. The architecture of the Arab mosque represents a unique architectural solution, resulting from the irregularity of the plot on which it was built and the connection with bazaar buildings and shops that are in oriental style. Since 1997, the Arab Mosque has been constantly undergoing restoration work as the need arises due to its age. The roof was partially reconstructed again, the windows and floor were replaced, a new ablution was made, the interior of the mosque was completely renovated, with a new mihrab and minbar, as well as a new mat, steam heating and air conditioning. [5]



Fig. 1. Arab mosque in its original state

4.2. The initial state of the Arab mosque

Due to the previously mentioned political and religious disputes, circumstances arise where, as in the case of the Arab mosque, the right and lawful course of action is not followed in order to preserve public peace. The mufti Muamer Zukorli takes decisions based on his personal desires and views while using religion as his main defense. Despite widespread public outcry, the state has made it clear that it will not respond to or take action because it does not wish to meddle in the affairs of the Islamic community. It is a very complex issue that can be regarded from several angles to adapt the architectural religious heritage, which is recognized as heritage, to the needs of current use. The public is unaware of the project documentation during the renovation of the Arab Mosque, as has been the case with all prior interventions on cultural and historical landmark buildings in Novi Pazar. Additionally, there is no sign on the construction site, such as a construction board with basic information or other information required for the transparency of the work that must exist when dealing with objects of public interest. Ignorance, or a lack of understanding of the value of keeping a culturally and historically significant object in its original form, is one of the major issues. In those circumstances, people's good intentions to take part in something as exquisite as the "renovation of the mosque" start to backfire. We arrive to the conclusion that the level of knowledge held by residents of a small city with a substantial and well-respected past among historians and conservators from other countries is too high. People must be made aware of the fundamentals of protecting cultural heritage and, more importantly, the value of doing so for a community. Although the method used by the institute to protect monuments is essentially sound, it is frequently very slow, leading the majority of citizens to accuse the government of failing to preserve cultural and historical heritage. Strong collaboration between the institute for the protection of monuments and other parties is necessary to expedite its approach which, given the long-standing political division, is currently all but impossible. Depending on the availability of financial resources, all adjustments are frequently implemented without

the proper circumstances, even in the few instances where the necessary conservation conditions were secured for such alterations. Since 1987, the Institute for the Preservation of Monuments has issued warnings about the situation and predicted that, if existing practices do not change, the historic bazaar in Novi Pazar will be completely destroyed, as we are now seeing 30 years later. We can easily draw the conclusion that not nearly enough care has been taken because we can count the cultural and historical objects that have at least partially retained their identity on the fingers of one hand. The evaluation of a building's historical significance and worth is the first step in conservation..[6] The object is then precisely measured utilizing contemporary measuring techniques in the following phase. The structure's own stability as well as the environment in which it is located are then examined. All of the building's installations, including the lighting and fire protection, are then inspected. To choose a conservation strategy, every piece of obtained data is thoroughly evaluated.



Fig. 2. Arab mosque in the first phase of demolition



Fig. 3. Arab mosque with completely new materials and roof

4.3. Proposal for a possible way of conservation of the arab mosque

The joints need to be cleaned, filled with longitudinal mortar, and plastered because the stone walls were constructed with mud plaster. Since these are foundation walls, foundation tests must be performed in order to implement the proper consolidation and constructive insurance measures. To ensure that the brick walls can support the weight of the balcony and roof structure, replacement beams that are constructed of wood or potentially metal must be inserted. In any instance, the plaster layer must be removed and replaced with mud plaster, which can be accomplished by applying two layers of plaster over a woven rabic net fastened to a wooden frame. If more thermal insulation is required, it is customary to install the insulation from the inside, being careful not to use a method that would greatly thicken the walls. Think about replacing the mezzanine structures or adding new girders to strengthen them further. The preservation of the existing slate ceiling is of utmost importance, as is planning for the restoration of authentic ceilings. The absence of motorized traffic and the establishment of a pedestrian zone in the protected area are fundamental requirements for the restoration of the historic market, including the Arab mosque.[7]

5. CONCLUSION

Novi Pazar has a special history that has let it survive for more than 500 years as a multicultural and multiethnic city. There are also some of the most significant Christian monuments, in addition to Islamic cultural sites. It is essential to recognize their significance, keep them as close to their original condition as possible, and make use of these advantages for the city's advancement and well-being. Since there has long been a problem with the preservation and protection of very significant cultural and historical monuments, it is imperative that experts, the local community, the Islamic community, and all citizens work together to resolve it. It is clear that there is a problem with legacy preservation throughout the entire nation, but the issue is made considerably worse when it comes to national minorities' heritage and the maintenance of their identity.

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TEHNOLOGIJA KAO SILA DESTRUKCIJE U PESNIŠTVU TOMASA STERNZA ELIOTA

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SAŽETAK:

U radu se analizira nekoliko dela proslavljenog engleskog moderniste i nobelovca Tomasa Sternza Eliota karakterističnih po nesvakidašnjoj vizuelizaciji panorame modernog sveta kojoj je neodoljivi pečat udarila industrijska revolucija kao i ubrzani razvoj tehnologije. Pesnik se, u svojim kreativnim zahvatima, usredsređuje na negativne efekte procesa pomenutog razvoja koje dovode do društvene degradacije i, štaviše, nagoveštavaju njegov kolaps. Svakodnevni život se prikazuje kao tok čovekovog ontološkog osiromašenja odnosno destabilizacije identiteta i digniteta. Jukstapozirajući pustoš moderne civilizacije sa slikama antičke i renesansne književnosti, dovodeći je u vezu sa miotloško-religioznim prosegima, Eliot nam ukazuje da je zadatak samodefinisanja i davanja svrsishodnih odgovora na aporije modernog društva sada skoro nemoguće ostvariti. Primarna entropijska sila koja onemogućava dati proces je upravo moderna tehnologija koja ljude usmerava tokovima konzumerizma i antiintelektualizma čije je ishodište za sada nepoznato i otuda zastrašujuće.

Ključne riječi: modernizam, tehnologija, entropija, konzumerizam, intelektualizam.

1. UVOD

Prozna i pesnička umetnička dela, nastala u okrilju modernističkog pokreta s početka dvadesetog veka su implicitno ukazala na početak kao i na kontinuitet dezintegrativnih tendencija koje je razvoj modernih tehnologija prouzrokovao u savremenim društvima i to prevashodno u njihovoj duhovnoj sferi. Doslovno brisanje maltene svih paradigmi ukorenjenih u prošlosti, reifikacija sadašnjice, devaluacija religijskih vrednosti i ishodišta, umnožavanje po pravilu nepouzdatih perspektiva sagledavanja problema u svetu, labilan status ljudskog identiteta *sui generis*, samo su neki od efekata pomenutih stremljenja. Ona su se, poznato je, aktuelizovala u proznim i poetskim književnim delima na više ili manje uspešan način, direktno, odnosno prepoznatljivo, ili posredno, uz veći ili manji stepen simbolizacije odnosno apstrakcije. Sama književna kritika je, makar u prvi mah, težila da prenebregne distancu između tehnoloških procesa i formi koje su pomenuti procesi vremenom poprimali. Tehnološki

procesi i proizvodi su, gledano iz današnje perspective, emanirali jednu vrstu vlastite, specifične estetike, a književne forme dvadesetog stoleća nisu samo umetnički predstavljale datu estetiku već su i upozoravale na njene konsekvence. (Wasson 1969: 302) Današnja književna kritika je duboko prožeta svešću o obavezi koreliranja tehnologije i umetnosti jer, u protivnom, ona ne bi mogla reći puno o savremenom društvu i svetu. (Ibid.) Naš istraživački napor će se usmeriti kako na odvijanje tehnoloških procesa tako i na njihova ishodišta u smislu njihove aktuelizacije u pesničkim delima Tomasa Sternza Eliota (Thomas Stearns Eliot 1888-1965)

Poznato je da se Eliotova poetika proistekla iz specifičnog socijalnog i političkog okruženja koje su karakterisala mnoga protivrečja. Dvadesete godine prošlog stoleća, a to je priod pesnikove mladosti, obeležene su protestom protiv zloupotreba politike kao i izvršne vlasti poglavito u svrhu akumulacije kapitala koja je podrazumevala podsticanje razvoja novih tehnologija. Takva kretanja su neizbežno dovela do komercijalizacije sfere morala i kulture same po sebi. Eliot se, između ostalog, nije mogao pomiriti sa bogaćenjem vlastite porodice koja se time udaljavala od unitarijanskog, protestantskog ideala skromnosti i društvene jednakosti. On je sa indignacijom odbacio vladajuću ideologiju tehnokratskog kapitalističkog društva i, na tom antagonizmu je utemeljio svoju kritiku romantizma. (Saldanha 2020: 125) Već dvadesetih godina prošlog veka Eliot u svojim delima daje dokaze o dubini dekadencije zapadne kulture stvarajući karakteristične likove (Prufrok i g. Judženidiz), predočavajući process degradacije gradova kao mesta življenja i efemerizaciju religioznog pogleda na svet (*Gerontion* i *Pusta zemlja*). (Ibid.)

Pišući ovakvu poeziju Eliot, po mišljenju Henrija Adamsa, zapravo nastavlja putem koji su već utrli britanski filozof Frensis Bredli (F. H. Bradley) i potom, njegovi profesori filozofije sa Harvarda, Irvin Bebit (Irving Babbitt), Džordž Santajana (George Santayana) i Džosaja Rojs (Josiah Royce). Njihova intelektualna i kulturna pregnuća išla su u pravcu potrage za mogućnošću postizanja jedinstva sveta fragmentiranog kao nikada u istoriji. (Habib 2008: 12) Adams stoji na stanovištu da je: „Sprovođenje reda u haosu ... jedinstva u mnogostrukosti oduvek bila odnosno mora biti stvar obrazovanja.“ (Ibid.) Eliot koji je i sam bio filozof po obrazovanju, smatrao je da ono, dato u formi filozofskog odgovora na protivrečja koje razdiru moderni svet, jeste jedino sredstvo prevazilaženja buržoaske misli koja očigledno nije bila dorasla tom zadatku. Strategija koju Eliot i ostali filozofi, njegovi savremenici, preporučuju za ostvarenje tog cilja je autoironijska budući da „sve kontradikcije koje karakterišu objektivni svet prebacuje u sferu ljudske subjektivnosti kako bi se oba ova pola jedinstvo i raznolikost sagledala kao nešto što karakteriše ne svet sam po sebi već pogled na svet upravljen prema samom svetu.“ (14-15)

Pomenuta strategija je umetniku osigurala ekskluzivnu ulogu privilegovanog posmatrača datih entropijskih procesa, posmatrača sposobnog da ih, uz pomoć vlastitog pesničkog talenta, estetički uobliči. Kompleksnost tehnološkog razvoja i njegovih posledica iziskuje pristup koji pesničkoj percepciji daruje obol naučnosti. U predavanju iz 1919. godine naslovljenom „Moderne tendencije u poeziji“, Eliot tvrdi da je „poezija zapravo nauka.“ (2014: 212) Objašnjenje stvaralačkog procesa je takođe naučno budući da je u pitanju hemijsko – tehnološki proces u kojem se mešanjem kiseonika i sumpor-

dioksida dobija sumporna kiselina u prisustvu platine kao katalizatora. (2017: 14-15) Konstatujući da je „komad platine“ pesnikov duh Eliot tvrdi da „on može delimično ili isključivo da koristi iskustvo samog čoveka; ali ukoliko je umetnik savršeniji, utoliko će u njemu radikalnije biti izdvojen čovek koji pati od duha koji stvara; utoliko će njegov duh savršenije da vari i preobražava strasti koje su njegov materijal.“ (Ibid.) Priroda ovog objašnjenja ukazuje na činjenicu da je Eliot uistinu bio dete svog doba, svedok razvoja tehnologije i nauke i čoveka urbane svesti koji je oduvek živio u gradu nemajući kontakta sa prirodom. Uprkos tome, smatrao je da je „pravi i spontani seoski život, ne seoski život propisan zakonom, pravi život za veliku većinu pripadnika bilo koje nacije.“ (Diaper 2018: 41) Grad je u Eliotovoj ranoj poeziji prikazan kao poprište delovanja razornih tendencija urbanizacije potpomognute tehnologijom koja umesto da ga učini lepšim i ugodnijim za život čini upravo suprotno.

Glavni lik poeme *Ljubavna pesma Alfreda Prufroka* (1917), korača gradom čije su odrednice „polumračne ulice“ i „nеспokojne ноći u prenočištima prostim.“ (Eliot 1998: 5) Pesma „Preludijumi“ (1918) ne predstavlja grad u nimalo boljem svetlu jer ono što lirski subjekt vidi i pamti od svega na šta mu padne pogled su „blatnjavi komadi / uvelog lišća oko vaših nogu / i novine s praznih gradilišta.“ (15) Dok „kiša udara / slomljene kapke i vetrokaze“ ... lirski subjekat gleda „kaljave noge što žure / k ranim šankovima gde se kafa toči.“ Estetika ružnog, koja se odmaćila u periodu modernizma, dozvoljava autoru da grad prikaže kao mesto gde poezija odumire jer „Dušu pesnika koja se istegla preko nebesa ... / ... gaze nestrpljive stope.“ (16) Najzad ona nije ništa drugo do kolevka zla koje vreba u „Svesti jedne mračne ulice / nestrpljive da zauzme svet.“ (17) Predstavljanje grada kao legla zla je tekovina nemačkih ekspresionista Gotfrida Bena, Georga Trakla kao i engleskog autora Džeјmsa Tomsona (James Thompson) koji je napisao pesmu indikativnog naslova - „Grad jedne užasne ноći“. Uticaj ekspresionista na Eliota je, kada su u pitanju užasi urbanizacije, nesumnјiv.

2. U OKRILJU PUSTE ZEMLJE

Eliotova poema *Pusta zemlja* (1922) je umetnička artikulacija autorove želje da napusti modernu civilizaciju i grad, njenu osnovnu ćeliju. U njoj je predstavljena dezintegracija modernog društva i njegov konačni kolaps putem poetskog variranja brojnih motiva. Jedan od ključnih motiva je upravo uticaj tehnologije i industrijalizacije na izazivanje krize u zapadnim društvima. Strukturu poeme odlikuje fragmentarnost odnosno sekvencionalnost i nedovršenost što simbolizuje destruktivni potencijal pomenutih trendova. Jezik kojim se služe junaci poeme je necelovit i zbunjujući, što ukazuje na njihovu nemoć da na pravi način artikulišu vlastite misli. Stanovnike grada vidi kao hodajuće mrtvace koji hodaju ulicama „nestvarnog grada“ u „mrkoј magli zimskog praskozorja“, kao „gomilu koja teče preko Londonskog mosta.“ (Eliot 1998: 55) Beskrajne povorke radnika koji žure na posao, koje je Eliot i sam viđao idući istim smerom, idu „pogleda uprta preda se“ sa „uzdasima kratkim i retkim.“ (Ibid.) Njihovu duhovnu obamrlost nastalu kao posledicu svakodnevnog iscrpljujućeg rada, Eliot sumira stihom „Nikada ne bih pomislio kako smrt pokosila / toliko ih je.“ (Ibid.)

Citirani stih predstavlja inače dobro poznatu paralelu sa prostorima iz Danteovog *Inferna* (Murphy 2007: 440). čime se data scena modernog života upoređuje sa paklom. Slični intertastualni zahvati koje Eliot primenjuje samo su neka iz arsenala pesnikovih omiljenih tehnika intenziviranja efekta svojih stihova. U tu svrhu autor se služi i delima mitološkog karaktera nastalim u praskozorje postojanja čovečanstva, spisima nastalim u srednjem veku i renesansi kao i u kasnijim periodima. Citirani stihovi potiču iz prvog dela *Puste zemlje* koji nosi ominozan naslov „Sahranjivanje mrtvih“, aludirajući na duhovnu smrt ne samo Londonaca, iscrpljenih dehumanizujućim životnim tempom u fabrikama i kancelarijama, hramovima današnjice, već i na smrt pripadnika drugih zajednica koji žive na isti ili sličan način.

Drugi deo Eliotove poeme naslovljen „Partija šaha“ sadrži opis junakinje koja sedi u nekoj vrsti samoizgnanstva iz užasavajućeg spoljnog sveta no ne čini se da je zbog te činjenice osobito zadovoljna. Predmeti kojima je okružena i koji spadaju u kategoriju kiča zapravo su čudovišni surogat koji treba da joj zameni stvarnost odnosno pruži neku njenu makar podnošljiviju varijantu. Primerci umetničkih predmeta čija je izrada prvobitno bila unikatna su masovnom proizvodnjem svedeni na hrpu bezobličnih imitacija, „orlovske glave, lavlja stopala, baklje, grifoni i nimfe su pretvoreni u delove stolica, draperija žardinjera i kreveta.“ (Wasson 1969: 304) Na taj način je, tehnološkim pojednostavljivanjem proizvodnje, degradirana forma visokih umetnosti „stare Grčke, Rima, Egipta, Kine, umetnosti iz petog veka Stare ere, perioda vrhunca rimske vladavine, četrnaestog veka, skoro svih umetničkih epoha.“ (304-305) Poseban problem predstavlja umnožavanje tih predmeta koji se bez ograničenja kupuju zauzimanjući životni prostor lirskog subjekta koji pod navalom artikala te vrste regredira još i više. Konzumerizam ove vrste uspostavlja nesumnjivi primat reifikacije nad humanitetom.

Redukcija ličnosti se odvija i u drugim vidovima što potvrđuje činjenica da se na obzorju Eliotove *Puste zemlje*, na pozadini jednog tehnicizovanog i tehnologizovanog sveta *par excellence*, pojavljuju se *dramatis personae* koje mnogo efektnije od pomenute dame, koja dane provodi u konfinaciji, ilustruju procese erozije individualiteta. Oni su tipične, duhovno osiromašene individue, karakteristične za epohu modernizma koje Nortrop Fraj, u studiji *Anatomija kritike*, naziva ironijskim junacima. Svedeni na najnižu, tamnu stranu svoje egzistencije, oni su najbolji indikator duhovne bede industrijskog doba. Madam de Sosostriis proročica, poznata kao „najmudrija žena u Evropi / sa opakim špilom karata“ (Eliot 1998: 54), sa svojim aktivnostima predstavlja ironijski otklon u odnosu na prave izvore saznanja. Umesto da streme za njim, ljudi tehnološkog doba skloni su da pažnju i poverenje poklanjaju obmanjivačicama te vrste. Istaknuti predstavnik modernog humaniteta *Puste zemlje* je g. Judženidiz opskurni „trgovac iz Smirne, / neobrijan sa džepovima punim suvog grožđa“ koji na „prostačkom francuskom“ čini nepristojne usluge lirskom subjektu. (61)

Treći deo poeme pod naslovom „Propoved vatre“ započinje opisom reke Temze koja je u vreme Renesanse predstavljala idiličan prostor na šta nas podseća stih pesnika ser Edmunda Spensera iz poeme *Epitalamion* „Draga Temzo, teci tiho dok ne završim svoju pesmu.“ (60) Eliot ga citira kako bi istakao ironijski kontrast nekadašnjh lepota sa slikom Temze čiji je „rečni šator probijen“ i koju su „napustile nimfe“ i u kojoj su do

nedavno plivale „prazne boce, hartije od sendviča, / svilene maramice, kartonske kutije, pikavci“ a kroz okolno „rastinje pužu pacovi.“ (Ibid.) Temza je jedan od važnih Eliotovih toponima na kojima on prikazuje razarajuće posledice tehnološkog razvoja. On joj se iznova vraća služeći se paralelom koja jukstapozira nekadašnja idilična vremena kada su „Elizabeta i Lester / udarali vesla / krme izvijene / k'o školjke pozlaćene.“ (63) i sadašnjicu u kojoj „Reku probija znoj /katran i ulja / barke plove / oseka i plima.“ (Ibid.)

Delovanje entropijskih sila se ogleda ne samo u fizičkom smislu već i u sferi duha jer lirski subjekat traži odgovor u doktrinama tri najveće svetske religije. Usled vlastite nedoraslosti i suženja duhovnog horizonta nastalog kao rezultat mehanizacije životnih funkcija, on nije sposoban da shvati poruke koje mu dolaze. Poslednje pevanje *Puste zemlje* pod naslovom „Šta je rekao grom“ karakterističan je po opisu prve pošasti koja snalazi čovečanstvo a to je je suša. Ona može nastupiti i kao posledica ekološke katastrofe izazvane perteranom eksploatacijom vode. Lirski subjekat vapi: „Kad bi bilo vode / a ne kamenja / Kad bi bilo kamenja ali i vode.“ (67) Perceptivne i kognitivne moći ga izdaju i on nije u stanju da sagleda apokalipsu u kojoj će čovečanstvo nestati i koja je već započela. On se nemoćno pita „Kakav je to zvuk visoko u vazduhu / mrmor materinske jadikovke“ i nije mu jasno „Kakve to zakukuljene horde vrve / po beskrajnim ravnicama“ i „posrću po napukloj zemlji.“ i „Kakav je to grad nad brdima / što se lomi preobličava i rasprskava u ljubičastom vazduhu.“ (Ibid.) Ovaj nadrealni prizor biva racionalizovan autorovim komentarom koji jasno naznačava koje su prestonice zahvaćene misterioznim razaranjem: „Kule se ruše / Jerusalim, Atina i Aleksandrija, / Beč, London, / nestvarni.“ (Ibid.) Autor ne navodi poreklo pomenute apokalipse već prepušta čitaocima da zaključe da je ona možda izazvana nuklearnim ratom odnosno primenom visokih vojnih tehnologija.

3. ŠUPLJI LJUDI KAO ŽRTVE APOKALIPSE

Savremeni entropijski trendovi dobijaju svoje puno uobličjenje u poemi *Šuplji ljudi* (1925). Autor prikazuje neidentifikovani predeo, koji u prenosnom smislu može predstavljati celu planetu, pogođenu nekom vrstom kataklizme koja za sobom ostavlja samo „Bezoblični oblik, bezbojnu senku, / zatomljenu snagu, nepokretan gest.“ (79) Razorena zemlja je nastanjena individuuama koje sebe identifikuju rečima „Mi smo šuplji ljudi / mi smo punjeni ljudi / jedno o drugo oslanjamo se / glave ispunjene slamom“ (Ibid.) Rešenje ove enigmatične metafore leži u epigrafu koji je Eliot odabrao kao nešto što će odrediti značenje celokupne poeme. Epigraf glasi „Peni za starog Gaja“ što je zapravo rečenica koja se izgovovara prilikom proslave takozvanog *Dana Gaja Foksa* (Guy Fawkes), glavnog protagoniste Barutne zavere iz 1605. godine skovane kako bi se promenio državni poredak Engleske. Zaverenici na čelu sa Foksom su pohvatani i osuđeni a stanovnici Londona svakog 5. novembra nose lutku ispinjenu slamom koja prestavlja Gaja Foksa i koja se nakon toga spaljuje. Lutka ispunjena slamom tako postaje simbol stanovnika planete, savremenih ljudi koji, kao ni zaverenik Foks, uprkos velikim aspiracijama doživljavaju neuspeh i ne mogu kontrolisati svoju sudbinu. Današnji ljudi su, shodno tome, poput marioneta čiji su zajednički glasovi „Tihi i beznačajni / kao vetar u suvoj travi.“ (Ibid.)

Nije najjasnije da li je ljude takvim učinila nekakva epidemija li nuklearna katastrofa ali, takvi kakvi jesu, oni su nemoćni da bilo šta u svom životu promene. Pesnik nastavlja sa opisima postapokaliptične pustoši rečima „Ovo je mrtva zamlja / ovo je zamlja kaktusa“ i dodaje „ovde su likovi od kamena / osovljeni, ovde ih stiže ponizna molba ruke mrtvaca.“ (80) Simbol nemoći „šupljih ljudi“ da sagledaju svoju životnu situaciju i da se iz nje izvuku sadržan je u rečima „Nema očiju ovde / u ovoj dolini zvezda na umoru / u ovoj praznoj dolini.“ (81) Umesto sunca ovaj sumorni pejzaž osvetljava „zvezda koja pline“ (80) poput sunca čiji zruci ne mogu prodreti kroz oblake radijacije, a pod tom sablasnom svetlošću „šuplji ljudi“ izvode neki čudan ples „U kolo oko kaktusa / u pet sati izjutra.“ (81)

Besmisleni rituali su sve što je žrtvama kataklizme preostalo budući da ni religija u „zemlji kaktusa“ ne pomaže jer „Između ideje / i stvarnosti / između pokreta / i čina pada / senka / jer Tvoje jest Carstvo“ (82) Jedino u šta su „šuplji ljudi“ sigurni i što pouzdano znaju jeste neminovnost skorog i ponižavajućeg okončanja egzistencije iskazanog rečima „Ovako svetu dođe kraj / Ne s treskom već sa cviljenjem!“ (Ibid.)

Prisutna neverica i skepsa u blagotvorni uticaj pobožnosti i nade nagoveštava i duhovnu apokalipsu koja dolazi kao posledica fizičke katastrofe možda izazvane primenom tehnologija čiji su se tokovi oteli kontroli. Epitoma odsustva religioznosti je književni lik iz romana *Srce tame* Džozefa Konrada (Joseph Conrad), na kojeg asocira drugi deo Eliotovog epigrafa *Šupljim ljudima*. Pomenuta ličnost je Kurc, šef kolonijalne uprave belgijskog Konga, poznat kao otelotvorenje zla koje skriva pod maskom uljudnosti i humanosti. Deo pomenutog epigrafa koji glasi „gazda Kurc, on mrtav!“ (Konrad 2022: 5), su reči koje izgovara crni sluga obaveštavajući o njegovoj smrti. U jednoj od poslednjih scena romana, Kurc izdiše širom otvorenih očiju izgovarajući „Užas! Užas“ (161), što ukazuje da je u trenutku smrti spoznao zlo čiji je nosilac bio. Uprkos pokajanju i možda iskupljenju, zlo koje je Kurc, kao predstavnik prosvećenog Zapada, naneo stanovnicima Konga je nemerljiva jer unos novih tehnologija na te prostore nije značio ništa drugo do propast i smrt. Ostaje, naravno, da nagađamo da li će „šuplji ljudi“ ikada spoznati istinu za kojom uzaludno teže. Da li će to biti u trenutku smrti koja je Kurcu donela prosvetljenje? Ukoliko sudimo po poslednjim rečima poeme odgovor je pozitivan.

4. HOROVI IZ STENE KAO OSUDA TEHNOLOŠKOG RAZVOJA

Eliotovo dramsko delo iz 1934. godine je nedvosmislen odraz njegove religioznosti koja ga po tematici udaljava od matice modernističkog pokreta odnosno njihovih duhovnih aporija. Modernizam je relativizovao mnoge do tada čvrste egzistencijalne principe koje su određivale položaj čoveka u svetu kao totalitetu pojava. Jedino preostalo duhovno uporište je religija o čemu i sam Eliot svedoči svojim primerom budući da je 1927. godine postao član kongregacije crkve Svetog Stefana u Londonu odnosno aktivni vernik. Već prvo pevanje sadrži snažnu osudu naučno-tehnološke revolucije koja je upotpunosti transformisala svet. Nepoznati lirski subjekat u ime celog čovečanstva postavlja retorička pitanja:

„Gde nam je Život izgubljen u življenju?
Gde nam je mudrost izgubljena u znanju?
Gde nam je znanje izgubljeno u informaciji?
Krugovi neba u dvadesetom veku
Odvode nas sve dalje od Boga,
I sve bliže Prašini.“ (Eliot 1998: 123)

Ovo je možda i najmoćnija autorova osuda takozvanog tehnološkog napretka koji, očito, čoveka udaljava od života i čini da, vremenom, mudrost i znanje regrediraju do informacije što će reći da fundamenti obrazovanja bivaju dezintegrisani u informativnom toku koji danas preuzima njihovu ulogu. Ovaj čudovišni paradoks, kojeg tako moćno aktuelizuje Eliotova poezija, je zapravo profetska najava negativnih kretanja koje su obeležile doba postmoderne. Porazna je činjenica da dvadeset vekova ljudske istorije, koliko traje Hrišćanstvo, predstavlja ništa drugo do vremenski put koji vodi „sve dalje od Boga a sve bliže prašini.“

Kolateralna posledica tehnološkog razvoja je i sve veći broj nezaposlenih koji takođe dobijaju pravo glasa u Eliotov poemi. Njihova tužbalica počinje konstatacijom:

„Nas niko nije najmio
S rukama u džepu
Oborenih lica
Stojimo na vetrometini
I drhtimo po mračnim sobama.“ (126)“

Ni kraj ove ispovesti nije manje potresan jer, kako kažu, „naš život nikom nije drag / naša smrt je preskočena u 'Tajmsu'. “ (Ibid.)

Drugo pevanje sadrži implicitnu osudu britanskog kolonijalnog ekspanzionizma koje je donelo mnogo zla u svetu:

„A kad očevi vaši odrediše mesto Božije,
I središe nezgodne svece, apostole,
I mučenike, u neku vrstu Whipsnade-a,
Latiše se imperijalističke ekspanzije
Praćene industrijskim razvojem.
Izvoziše železo, ugalj, pamuk,
Intelektualno prosvetljenje,
I sve uključujući kapital,
Kao i nekoliko verzija Reči Božije:
Britanska rasa, budući uverena u misiju:
Izvrši je,
Al' kod kuće ostavi mnogo toga neizvesnog. (128-129)

Industrijskom razvoju, koji je bio podloga imperijalističke ekspanzije, prethodilo je, kao što se može videti, nasilno „preudešavanje“ religije odnosno njena besramna instrumentalizacija u svrhu opravdavanja osvajanja tuđih zemalja. Religija je, osim toga, poslužila i kao izvozni artikal u svrhu pokrštavanja odnosno „uzimanja duša“ čime su poreknute njene prave duhovne osnove. Najposle, kriza koju je takav tehnološko- socijalni „razvoj“ doneo vratila se u metropolu koja ju je i generirala.

Treće pevanje govori o otpadništvu modernog čoveka od religije i duhovnosti uopšte i neopravdanom polaganju nade u „kršnost vlastitog uma i slavi svog delanja / umetnostima i izumima, smelim poduhvatima“ kao i „diskreditovanim shemama / ljudske velelepnosti.“ (132) Eliot ne zaobilazi ni druge aspekte razornog delovanja tehnološkog razvoja čiji protagonisti snose krivicu jer:

„Oni primoravaju zemlju i vodu da im služe,
Eksploatišu mora i buše planine,
Dele zvezde na proste i otmene,
Izmišljaju savršene frižidere,
Projekte racionalne moralnosti,
Štampaju knjige do besvesti,
Kroje sreću i bacaju prazne flaše,
Beže od svoje praznine ga grozničavom entuzijazmu.“ (Ibid.)

Ugroženost ekosistema predstavljena u citiranim stihovima svrstava ovaj segment poeme u okvire ekopoetike koja teži da reafirmiše prirodu u svoj njenoj kompleksnosti narušenoj pomenutim zbivanjima. U ovom slučaju tehnološki razvoj svojim instrumentarijumom služi ne opštem napretku već ljudskoj sujeti kako bi pokazala svoju nadmoć nad prirodom. Zanimljiva je činjenica da je u ovom, danas pomalo zanemarenom segmentu Eliotovog opusa sadržana možda i najjača moralno –etička osuda entropijskog naboja moderne tehnologije. U tome leži nesumnjivi kvalitet poeme *Horovi iz Stene* koji će možda tek u budućem vremenu dobiti na aktuelnosti.

3. ZAKLJUČAK

Eliotov pesnički opus, razumljivo, sadrži još asepkata u kojima je prisutna otvorena ili manje otvorena osuda entropijskih sila moderne tehnologije koji se nisu mogli smestiti u okvire ove skromne studije koncentrisane na nekoliko ključnih pesničkih dela. Sprovedena analiza je na početku bila usmerena na genezu Eliotovog odnosa prema tehnologiji koji je proistekao iz duha vremena u kojem se odvijalo njegovo umetničko i intelektualno sazrevanje. Ukazano je i na filozofsko utemeljenje njegovog stava u odnosu na dekadentnost moderne civilizacije. Iako je bio stvaralac prevashodne urbane svesti, Eliot je smatrao grad poprištem a nije preterano reći i stratištem, u kojem je tehnologija iskazala svoju nakaradnu moć usmerenu ka destrukciji čovekovog okruženja i same njegove ontološke suštine. To je pokazano na primerima iz Eliotove rane poezije a onda je u fokus pažnje došla *Pusta zemlja* u kojoj se dati motiv obrađuje na mnogo širem planu

budući da počinje sa prikazom grada, konkretno Londona, kao mesta na kojem caruje zlo da bi se, kasnije, najavila apokalipsa koja će zahvatiti čitav svet i koja ima formu armagedona. Drugi pravac delovanja pomenutih sila, koji se u *Pustoj zemlji* analizira, je duhovna kriza koja počinje da dominira i koja je naznačena centralnom metaforom poeme koja celokupnu planetu identifikuje kao „pustu zemlju“.

Porazno dejstvo destruktivnih tokova kulminira i u narednoj poemi *Šuplji ljudi* koja se matrijalizuje kao svojevrсна vizija stanja modernog sveta nakon pretrpljene katastrofe. Analiza je ukazala na dvostruko dejstvo tehnologije koja je, kao prvo, stanovnike zemlje transformisala u „šuplje ljude“, duhovno prazne i nemoćne individue da shvate suštinu vlastitog bivstvovanja i, kao drugo, da uvide činjenicu da žive u potpuno destruiranom habitatu. Eliotovo odsustvo vere u budućnost čovečanstva ovoj poemi poprma svoj najradikalniji vid jer „šupljim ljudima“ ni vera ne može pomoći da izbegnu užasan, ponižavajući kraj. Analiza je obuhvatila i treću Eliotovu poemu, *Horove iz stene*, i ukazala na činjenicu da je Eliot, sada kao *homo religiosus*, komponujući je izrekao i najeksplitniju osudu faktora koji su doveli do krize. Posebno je naglašeno prisustvo socijalne dimenzije u celokupnoj stagnaciji a ocrтана je i fizionomija deintelektualizacije odnosno redukcije znanja koje se odvija kao antiteza tehnološkom napretku.

Celokupno Eliotovo pesničko pregnuće predstavlja traganje za smislom života koji kao i da ne postoji u svetu takvom kakav jeste. Traganje se u smislu impresivnog zahvata odvija kroz istorijske, mitološke i najzad religiozne paradigme da bi, na kraju, upravo poslednja bila ponuđena kao spasonosno rešenje u svom integralnom vidu. Prihvativši ovakav pristup u u doba moderne kada je depopularizacija religije već uveliko otpočela, Eliot je sebe osudio na neku vrstu ostrakizma među pripadnicima pokreta ali mu to nije umanjilo opštu popularnost niti su njegovi stavovi izgubili na aktuelnosti. To je možda i najbolji pokazatelj da prave odgovore nadolazećoj destrukciji treba tražiti u solipsističkoj usmerenosti ponorima vlastite psihe. Eliot ne nameće ovu alternativu kao jedinu istinitu ali nas svakako poziva da takvom sagledavanju i razumevanju damo svoj prilog.

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TECHNOLOGY AS THE DESTRUCTIVE POWER IN THE POETRY OF THOMAS STEARNS ELIOT

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ABSTRACT:

The paper analyzes several works of the famous English modernist and Nobel laureate Thomas Stearns Eliot, characterized by their unusual visualization of the panorama of modern world, which irresistibly marked by the industrial revolution and the rapid development of technology. In his creative endeavors, the poet focuses on the negative effects of the aforementioned development process, leading to social degradation and announcing its final decline. Everyday life is presented as a background of man's ontological impoverishment, i.e. destabilization of his identity and dignity. Juxtaposing the desolation of modern civilization with the images of ancient and Renaissance literature and connecting them with mythological and religious paradigms, Eliot indicates that the task of self-definition and providing purposeful answers to the aporias of modern society is almost impossible to achieve today. The primary entropic force that makes the given process impossible is but modern technology, compelling man to embrace consumerism and anti-intellectualism the issues of which are currently unknown and therefore frightening. The aim of such a poetization is to achieve permanence in providing at least, acceptable answers to the disastrous consequences thus making them easier to put up with.

Keywords: modernism, technology, entropy, consumerism, intellectualism.

„KNJIŽEVNA KLINIKA“: TUMAČENJE I/ILI UPOTREBA KNJIŽEVNIH TEKSTOVA U BIBLIOTERAPIJI*

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SAŽETAK: Rad se bavi razmatranjem iskustva i strategija čitanja kroz primenu dihotomije upotreba/tumačenje Umberta Eka. Ekova dihotomija pogodna je za motiv da se ovim naučnim radom ukaže na to da poimanje biblioterapije kao prakse korišćenja književnih tekstova prema zadatoj putanji i jasnim ciljevima duguje proizvoljnim čitanjima ogleda „Književna klinika“ („A Literary Clinic“, 1916) Samjuela Makorda Krodersa (Samuel McChord Crothers). Tekstualna uputstva data u vidu signala ironije i metakomentara očekuju vrstu saradnje kojom bi se pronašli i razmotrili konflikti odnosi između tekstualnih konstrukcija, čime bi se izbeglo nasumično biranje rešenja ili izdvajanje definicija kao i svođenje ogleda na rezultat „naučnog“ istraživanja.

Ključne reči: Samjuel Makord Kroders, čitanje, biblioterapija, tumačenje, upotreba

Arhiva promišljanja fenomena čitanja na koju se ovaj naučni rad poziva kazuje nam da je iskustvo čitanja uvek nešto više od opažanja manifestnog sadržaja i ekstrahovanja informacija koje su drugi uputili. Iako se to „nešto više“ može učiniti nečitljivim kretanjem, a onda i „beskonačni[m] neuspeh[om] da se značenje i smisao fiksiraju“ (Stošić 2014: xv), valja imati na umu da se čitanje isključivo kao traganje za objektivno upisanim i njegovo izvlačenje na površinu ne može smatrati pedantnijim. Oba vida, zapravo, iziskuju sporost i dubinu, povlačenje i osamu, a najpre dozvolu da „ja“ koje čita postaje kroz odgonetanje, opiranje, nagađanje, nekakvo – samo trenutno – konstruisanje, a onda oklevanje, prosuđivanje, prognoziranje koje je možda udaljavanje ili čak napuštanje lista papira, vraćanje na „pr(a)vi“, ne obavezno i jedini, put. Takav čin se, u najboljem slučaju, može opisati kao lutanje kroz narativnu šumu koje je, kod Umberta Eka, umetnost zamajavanja koja ne znači traćenje vremena (2003: 60), a u drugim slučajevima se može pamtititi kao (samo)destrukcija: autopsija teksta, materijalizacija (ličnog) sloma i krivotvorenje. Kako navodi Alberto Mangel u *Istoriji čitanja*:

Isti onaj čin koji oživljava tekst, dovodi do njegovog otkrovenja, umnožava njegovo značenje, odražava u njemu prošlost, sadašnjost i mogućnost budućnosti, može isto tako da uništi, ili da pokuša da uništi živu stranicu. Svaki čitalac izmišlja čitanja, što nije isto što i laganje; ali svaki čitalac može isto tako da laže, da hotimično proglašava tekst

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podređenim doktrini, proizvoljnom zakonu, ličnoj koristi, pravima robovlasnika ili autoritetu tirana. (2005: 301)

Prema drugim shvatanjima, višestrano kretanje ne razotkriva predmet čitanja niti ga, pak, remeti: čitanje, smatra Moris Blanšo, predstavlja čin slobode i dopuštanja da knjiga postane delo, a ne fiksiran i poznat predmet pažnje. Odgovarajući na poziv dela jednim lakim i nevinim Da, čitalac otvara prostor koji omogućava da se „potvrdi razarajuća odluka dela, afirmacija da ono biva – i ništa više“ (Blanšo 2014: 6). „[K]njiga koja ima svoje poreklo u umetnosti“ svoje postojanje duguje jedinstvenom, i nikada konačnom, čitanju (4). Ako je uslovljeno slobodnim pokretom, „jedinствeno“ ipak ne znači „proizvoljno“ ili, rečima Rolana Barta, „divlje“ čitanje koje iznalazi neverovatna značenja, već primanje simultane mnoštvenosti koja odoleva zakonima kontradikcije (Bart 2014: 48). Kao alternativu slobodnom i (potencijalno) beskrajnom čitanju Eko postavlja intenciju teksta (*intentio operis*): tekstualna koherencija upravlja nekontrolisanim nagonima čitaoca (Eko 2001: 33; Eco 2002: 65). Drugim rečima, čitalac uživa onoliko slobode koliko to tekst dozvoljava. Za razliku od upotrebe tekstova – čitanja u lične svrhe, čitanja kao vida sanjarenja nad tekstom i pronalaženja onoga što je izvan teksta, tumačenje predstavlja traganje za *intentio operis* ili postupno otkrivanje (nagađanje i proveravanje) tekstualne strategije kojim se stvara uzorni čitalac. O intenciji teksta je, dakle, moguće govoriti jedino kao rezultatu nagađanja čitaoca, to jest njegove odluke da „vidi“ tekstualnu strategiju (Eco 2002: 64). Ekova dihotomija upotreba/tumačenje pogodna je za motiv da se ovim naučnim radom ukaže na to da poimanje biblioterapije kao prakse korišćenja književnih tekstova prema zadatoj putanji i jasnim ciljevima duguje proizvoljnim čitanjima ogleđa „Književna klinika“ (“A Literary Clinic”) Samjuela Makorda Krodersa (Samuel McChord Crothers, 1857–1927). Tekstualna uputstva data u vidu signala ironije očekuju vrstu saradnje kojom bi se pronašli i razmotrili konflikti odnosi između tekstualnih konstrukcija, čime bi se izbeglo nasumično biranje rešenja ili izdvajanje definicija, kao i svođenje ogleđa na rezultat „naučnog“ istraživanja. Nije na odmet istaći da čitanje ogleđa koje sledi može biti samo „jedno od“ jer za svoj put bira i čitanja drugih čitanja, ispitivanje koje je podjednako skretanje a time i proveravanje dostupnih i nedostupnih staza.

„Književna klinika“, objavljena 1916. godine u časopisu *Atlantik mantli* (*The Atlantic Monthly*), se u prvom redu sastoji iz osvrtu na razgovor između neimenovanog naratora i njegovog prijatelja Bagstera povodom crkvenih prostorija koje su nedavno preinačene, kako kaže natpis, u Bibliopatski institut. Pre nego što će početi da navodi pojedinosti tog novog poduhvata baš onako kako ih je čuo od Bagstera, narator u kraćem uvodu predstavlja svog sagovornika kao stecište svakakvih inostranih ideja koje se teško odomaćuju na tom podneblju¹ (Crothers 1916: 291). U jednu od tih ideja očito spada

¹ “All sorts of ideas flocked from the ends of the earth and claimed citizenship in his mind. No matter how foreign the idea might be, it was never interned as an alien enemy. The result was, he had suffered from the excessive immigration of ideas that were not easily assimilated by the native stock.” (Svi prevodi citata sa engleskog jezika su autorkini, ukoliko u radu nije drugačije naznačeno)

sistem lečenja koji sveštenik–terapeut Bagster teži da razvije, a naziva ga, u skladu sa primarnim sredstvom svoje nove delatnosti, biblioterapija. Kako se njegova početna zamisao da od *svojih* misli odabere onu pravu pokazala neodrživom, Bagster se dosetio da lek za dušu i telo svojih pacijenata potraži u zalihama misli zanimljivih pojedinaca, što, prema njegovom mišljenju, književnost, ili bar ona vredna čitanja, i znači (292). Ono što autore izdvaja od većine, čime njihova dela pobuđuju interesovanje i zavređuju pažnju, jeste sposobnost da se odupru bolestima i opsesijama svojstvenim za društveni trenutak kada stvaraju, a time proizvedu količinu protivotrova od koje oni neotporni mogu imati koristi (300): „[s] moje tačke gledišta, knjiga je književni recept pripremljen za dobrobit nekoga kome je potrebna“ (293). Sa uverenjem da jedno književno delo kao odgovor na nadražaj društvenih toksina može da posluži uspostavljanju adekvatnog psiho-fizičkog funkcionisanja njegovih korisnika, Bagster razvrstava knjige prema njihovom učinku na stimulanse, sedative, provokacije i hipnotike: one ne služe toliko za zabavu već za ublažavanje stresa i simptoma, edukaciju, razmišljanje i emocionalno opismenjavanje. Ovako sadržajno pojednostavljen Bagsterov terapijski model se u stručnoj literaturi o biblioterapiji predstavlja kao najraniji pokušaj da se raznorodne pretpostavke o važnosti čitanja književnih tekstova za rešavanje problema i održavanje duševnog zdravlja uobliče u prepoznatljivu praksu. Tome se neretko dodaje i shvatanje da se model može smatrati rezultatom i produžetkom čovekoljubivih težnji sledbenika Filipa Pinela koje su obeležile XIX vek (v. Brewster 2019: 3–4). Međutim, opozicija otporno/neotporno upisana u Bagsterovim gore navedenim formulacijama autora, dela i čitanja navodi nas na preispitavanje pojma humanosti – čovekoljubivih težnji – čime se otvara put u narativne dimenzije Krodersovog oglada kojima se postulira veza između čitalačkih navika i određenih načela. Naime, ubrzo nakon što je Pinel 1794. godine (“Memoir on Madness”) glasnije usmerio pažnju na potrebu da se svet bolnica, *prihvatilišta* i domova za prinudni boravak oslobodi okova, tamnica i fizičkog kažnjavanja i to počeo da sprovodi u bolničkim kompleksima Bisetr (*Bicêtre*) i Salpetrijer (*Salpêtrière*) (v. Weiner 1992), u Engleskoj se osniva novi tip institucije pod nazivom Utočište (*The Retreat*) u okviru koje će Samjuel Tjuk slediti Pinelov takozvani „moralni“ metod lečenja, a svoje uvide objaviti u delu *Opis Utočišta* (*Description of the Retreat: An Institution Near York for Insane Persons of the Society of Friends*) 1813. godine. Kao što navodi u *Opisu*, „moralno“ lečenje, naziv kojim bi trebalo da se podvuče razlika u odnosu na „fizičko“ i „medicinsko“, se sastojalo se od raznovrsnog upošljavanja i zabave i moralo je biti individualno prilagođeno svakom pacijentu (Tuke 1813: 113). Međutim, čitanje književnih dela ne spada u „oslobađajuće“ aktivnosti rekreativne i radne terapije: „[d]ela mašte generalno, iz očiglednih razloga, treba izbegavati [...]. Različite oblasti matematike i prirodnih nauka pružaju najkorisniju vrstu literature kojom se mogu uposliti umovi duševno obolelih“¹ (114–115). Nasuprot Tjukovom stavu, Krodersov Bagster pre naglašava terapijske

¹ “The works of imagination are generally, for obvious reasons, to be avoided; [...]. The various branches of the mathematics and natural science, furnish the most useful class of subjects on which to employ the minds of the insane; and they should, as much as possible, be induced to pursue one subject steadily.”

vrednosti književnog teksta, tog produkta fikcije kao što je i on sâm. Ova dva, naizgled drugačija, pristupa proističu iz sredine zasnovane na društvenoj korisnosti: Utočište djeluje pod okriljem društva kvekerâ za dobrobit i oporavak njegovih obolelih članova (Tuke 1813: 20–21), dok se Bagsterov model razvija uz crkvu kako bi se pružila uteha i pomoć duhovno iscrpljenim i rezigniranim pojedincima (Crothers 1916: 291). Ali, ukazivanje veće čovečne i/ili medicinske pažnje može biti i samo izgovor kojim se, kao što Fukoovo pažljivo čitanje *Opisa Utočišta* pokazuje, uspostavlja novi vid utamničenja putem posmatranja, upravljanja, religije i njenih moralnih taktika. Ukidanjem okova i drugih sredstava obuzdavanja, bolesnik se uvodi u moralnu sredinu gde, prema načelima vrline, truda i društvenog života, započinje „raspravu sa sobom i svojom okolinom“ (Fuko 1980: 217). Podsećanje na pravila te sredine kao uslova oslobađanja od utamničenja je ništa drugo do pretnja kaznom, čin kojim se oboleli poziva na odgovornost za sve što može ugroziti moral i društvo, da bi sticanjem svesti o krivici mogao da kroti ludilo. Ovde se uočava i važnost figure koja podseća, opominje i uređuje taj prostor, a na temelju znanja i moći prerasta u čuvara društvenog i moralnog reda:

Homo medicus stiće vlast u azilu ne kao naučnik, već kao mudrac. Ako se traže lekari kao struka, onda se oni traže kao moralno i pravno jemstvo, a ne u ime nauke. Lekara bi lako mogao da zameni neki veoma savestan čovek, neokrnjene vrline, s dugim iskustvom u azilu. Jer posao lekara samo je deo jednog golemog moralnog zadatka koji se u azilu mora obaviti i koji jedini može da obezbedi ozdravljenje bezumnika. (242)

Razlog Bagsterovog preobražaja iz sveštenika u terapeuta počiva na uvidu o značaju jednog takvog zadatka koji on formuliše ovako: „Svi bismo morali biti zdraviji nego što jesmo. Ako bismo mogli da dođemo do pravih misli i da ih se pridržavamo, mogli bismo da se oslobodimo mnogih bolesti“¹ (Crothers 1916: 292). Način kojim bi taj zadatak da se organizuje u legitimni sistem bliže je određen odmah ispod natpisa „Bibliopatski institut“: kompetentni stručnjaci nude knjigoterapiju na zakazivanje; besplatno savetovanje od 14 do 16 časova; za one koji nisu u mogućnosti da dođu obezbeđeno kućno lečenje; Klub čitalaca za mlade „Udelite misao“ nedeljom u 7.30 časova; grupna terapija za iscrpljene poslovne muškarce; individualna terapija za iscrpljenje žene iscrpljenih poslovnih muškaraca; za decu iscrpljenih majki koje čitaju zbog zdravlja obezbeđen dnevni boravak (291). Po svemu sudeći, u pitanju je razvijena struktura koja pokriva decu, mlade, stare i onemoćale, radno aktivne, i roditeljke i supruge, ali i povezuje sfere finansijskog i duhovnog profita, angažovanja i iscrpljenosti. U natpisu se intuitira ono što je Kristofer Bigzbi nazvao kontradiktornim imidžom Amerike – svetovnu državu prožetu religijom, zemlju koja veliča pojedinca dok pojedinci teže da pripadaju klubovima i kultovima (Bigsby 2006: 9–10) – a uočava preovlađujuća iscrpljenost, prezasićenost i bezvoljnost. Ponavljanjem prideva „iscrpljeno“ dosledno se sprovodi slika jednog doba ili tačnije boljke od koje je i sâm Bagster patio: odazivajući se na Zov Modernog, prepustio se neprestanom sprovođenju bezbrojnih zahteva u dela koja su prevazilazila njegove dužnosti (Crothers 1911: 163). Uspevajući da prevaziđe gotovo insomnično i, posledično,

¹ “We ought all to be healthier than we are, and if we could get the right thoughts and hold on to them, we should get rid of a good many ills.”

neurastenično stanje kroz povlačenje i osamu, vratio se crkvi baš u trenutku kada su sveštenici počeli da prepoznaju celishodnost psihoterapije. Njegova kompetentnost za biblioterapiju leži upravo u ličnom iskustvu – samostalno sprovedenoj didaktičkoj analizi na osnovu koje će moći da se okrene sastavljanju uputstava za sticanje otpornosti.

Početna teza da knjiga može biti podesno sredstvo za suočavanje sa izazovima koje nosi vreme kada Bagster drži pred naratorom didaktično mini predavanje o vrlinama čitanja može biti odgovor na trend podvrgavanja knjige i čitanja pedagogiji razuma i morala deceniji unazad. Naime, rasprave o pitanju da li i kako čovek pomoću knjige može doprineti sopstvenom spasenju a time i boljem društvu nastavile su se i u XX veku, posebno u prvoj deceniji o čemu svedoče tekstovi kritičara, urednika i pisaca bliskih unitarijaničkim krugovima, kojima je pripadao i Kroders. Kako prenosi Miler na osnovu istraživanja Barbare Hokman, ti tekstovi, objavljivani u dnevnoj štampi i časopisima, zagovaraju „zdrave“ navike čitanja: umesto fikcije koja se, zbog emocionalnog uživanja i podsticanja eskapizma, smatra potencijalno opasnom, preporučuju se knjige sa jasnom moralnom poukom koje čitaoca podučavaju vrlinama produktivnosti i uzdržanosti (Miller 2018: 23–24). Književni kritičari, smatra Bagster, bezrazložno negoduju zbog rastućeg broja bezvrednih ili štetnih knjiga jer ne postoji ništa bezazlenije od štampane knjige prepuštene samoj sebi (Crothers 1916: 292), što njegovi eksperimentalni zahvati i pokazuju. Knjige po sastavu i hemijskim procesima mogu biti jednostavne ili složene: Emerson je, na primer, emulzija, Meterlink obiluje nestabilnim elementima, Česterton je penušava mešavina zdravog razuma, a Swift istina u obliku kiseline. Neke je potrebno dobro promućkati, a neke netremice posmatrati... Na osnovu interakcije između čitaoca i sastojaka knjige vrši se procena ličnosti, prilagođavanja i razvoja te otuda funkcija kritičara ne bi trebalo da se zasniva na procenjivanju knjige već stanja pacijenata nakon čitanja. Međutim, njegova uputstva za interakciju ispostavljaju se prezahtevnim za pacijente koji bi radije da dobiju gotov odgovor. Knjige se stoga odlažu – prepuštaju stisku korica – te i ne čudi što će Bagster, kako saznajemo iz Krodersovog kasnijeg oglada (1925: 442), evoluirati u trgovca mislima i preći iz spiritualnog (šoping) centra u finansijski skladno svojoj (opet) novoj ulozi.

Budući da se tok razgovora između naratora i Bagstera ovde naglo prekida Bagsterovim odlaskom zbog pacijenta koji se predozirao ratnom književnošću, narator biva uskraćen za objašnjenje o knjigama koje su istovremeno stimulansi i sedativi. U tom trenutku ogled poprima vidno drugačiji ton i to pozivanjem na epigram Emersonovog oglada „Knjige“ (“Books”), stihove koji se mogu parafrazirati na sledeći način: knjiga je dobra ukoliko nas postavlja u radno raspoloženje koje iziskuje sadejstvo misli i volje (Crothers 1916: 301). Citiranjem se odaje počast Emersonu za ono što je američki transcendentalista svojevremeno ugledao te sâm čin, Emersonovim rečima (1987: 73), predstavlja uživanje u istini tuđih reči koje opisuju ono što je činjenica za onog koji citira. Nakon citata, glas – sada u trećem licu množine – dodaje da baš takvu knjigu koja se određuje kao dejstvo sila akcije, imaginacije, i volje nikada ne uspevamo da pročitamo do kraja (Crothers 1916: 301). Nezavršen proces čitanja, kako se ovde postavlja, ne može biti mehanički napor upijanja i oponašanja ustanovljenog poretka napisanog već oblik stvaralačkog čitanja koji Emerson u „Američkom učenjaku“ opisuje kao delanje koje počinje nadahnućem, prolazi

kroz periode samoće, preispitivanja i samootkrovenja, i uz kretanje i iskustvo približava pravom stanju svakog čoveka – sposobnosti da se na sebe osloni i ne pokori imenima, mišljenjima, profesijama, običajima i dogmama. Čitanje odvraća čitaoca od uobičajenih relacija – privlači ga osami i kontemplaciji istovremeno ga nadahnjujući da napusti stranice i vrati se životnoj praksi, iskustvu bez kojeg misao ne može sazreti u istinu (Emerson 1987: 85). Ali čim radno raspoloženje utihne čitaoci se ponovo prihvataju velikodušnosti dela koje ih, kako Emerson kaže (2006: 214), postavlja na noge i omogućava da stvore originalni sud o svojim dužnostima.

Naglim prelazom sa uslovno rečeno dijaloga, jer Bagsterovo didaktično izlaganje tek je podstaknuto šturim potpitanjima naratora, na sada poslovično kreativan monolog pričanje prelazi iz prvog lica jednine u treće lice množine. Glas naratora u prvom licu jednine može da nas navede da to „ja“ izjednačimo sa autorom. Potporu takvom čitanju bismo lako pronašli u autorovoj biografiji: Krodersovo delanje prevazilazilo je njegov poziv unitarijanističkog sveštenika te on nije bio prepoznatljiv samo po nedeljnim propovedima već i po predavanjima o istoriji, književnosti i biblioterapiji koja je držao na univerzitetima, u školama i bibliotekama (Miller 2018: 21). Taj glas pak ne doprinosi nikakvom shvatanju biblioterapijske prakse već to isključivo prepušta Bagsteru. Podsmesljiv ton, s druge strane, parodira Bagsterov bezuspešan, ponekad kontraefektivan, pristup, pa se ogled pre može smatrati kliničkim pregledom književnosti ali ne i uputstvom niti povodom za institucionalizaciju takve jedne prakse. Stoga i ne čudi što Bagsterova književna farmacija, ili knjiga kao farmakološko dostignuće, biva uz pomoć Emersona odbačena i zamenjena poverenjem u kreativan i preobražavajući čin čitanja kao pouzdaniji izvor duhovnosti u odnosu na versko-terapijskog službenika. Upravo na tom mestu prelaza iz jednog u drugi tekst se, prilagođeno Emersonovom shvatanju materijala o kojem je reč, uočava kretanje misli protivno svim strukturama. Kroders može biti jedna anomalija u okviru unitarijanističkih krugova, kako ga vidi Miler (22), jer prkosi ranije pomenutim raspravama o „zdravim“ navikama čitanja. Ali, isto tako, može biti i strategija učitavanja ili umnožavanja glasova kojom se uništava svaki pretpostavljeni empirijski autor. Emerson je veza između zaključnog dela i Bagsterovih obrazloženja iliti Bagster nudi ključ za čitanje završnice: Emersona ne treba prihvatiti kao aforizam (*tiny globules of wisdom*) – možda i smetnju kako će ga T. S. Eliot uskoro nazvati (2014: 23) – već ga treba dobro promešati (Crothers 1916: 293), literalno i literarno. Ako tome dodamo i druge pomenute Krodersove oglede (v. Crothers 1911; 1912; 1925), možemo videti je Bagster, kao i Emerson, tekstualna strategija kojom se ne postavlja samo pseudo-dijalog već se uvodi metakomentar:

Čista satira ne razdražuje. Ona ne pripada medicini, već hirurgiji. Kada se operacija izvede vešto, šok je neznatan. Pacijent često nije ni svestan da se išta dogodilo, kao onaj svetac iz stare martirologije koji, nakon što je obezglavljen, odlazi rasejano noseći glavu pod rukom.¹ (Crothers 1916: 296)

¹ “Pure satire is not irritating. It belongs, not to medicine, but to surgery. When the operation is done skillfully, there is little shock. The patient is often unaware that anything

Glas u trećem licu stoga ne bio glas naratora koji razgovara sa Bagsterom, već glas Krodersa, uzornog autora koji se manifestuje jedino kao strategija koja poziva čitaoce da se pridruže razmišljanju i spoznavanju svojih dužnosti (pažljivog/stvaralačkog čitanja). Vratimo se, pre zaključka ovog rada, na Bagsterov književni recept i njegovo određenje autora i književnog dela u Emersonovom maniru (!). Autor koji zavređuje pažnju se ne pokorava trendovima i vici naroda već se nepokolebljivo oslanja na sopstvene nagone, a delatnost izražavanja – živa misao – čini ga otpornijim na oponašanje. U rezultatu takvog delanja onda, Bagster bi rekao logično, treba tražiti odgovore i upute za otklanjanje nedostataka efikasnosti: „[s] moje tačke gledišta, knjiga je književni recept *pripremljen* [podvukla autorka rada] za dobrobit nekoga kome je potrebna“. Prema odgovorima koje *on* pronalazi u jednom tekstu, Bagster sastavlja recept precizirajući njegov sastojak, adjuvans, korektiv i ekscipijens (293), ne shvatajući da odgovori pacijenata ne moraju nužno da se podudaraju sa njegovim. Ovim putem, paradoksalno, Bagster ne svodi samo estetski fenomen na proverljive indikatore već i sebe na pukog mislioca i papigu mišljenja. Njegov model, stoga, nije nikakav čin altruizma već primer korišćenja – podvrgavanja teksta proizvoljnom zakonu i ličnoj koristi kao i pacijenata kolotečini takvog zanata. Bagster je oličenje prilagođavanja zahtevima modernog vremena, mentalni sklop iz kojeg proizlazi i ograničavajuća praksa čitanja koja ima za posledicu potčinjavanje pacijenata materijalističkim i birokratskim pritiscima.

Svako novo čitanje, možemo reći, pruža dodatnu dimenziju, ali i obrazac. Zaključni deo Krodersovog oglada se može shvatiti kao potraga za Emersonovim potpunim čovekom ili, kako Emerson lepo kaže, doktrinom jedne stare legende „koja će uvek biti nova i uzvišena (Emerson 1987: 78). U suštini, to je potraga za celim i celovitim društvom – jedinstvom, zajedničkim duhom koji prožima ljude i prirodu. Čitanje, kao čin preobražavanja čoveka iz stvari u koje se pretvorio u „dostojanstvo svog poslanstva“ (78), deo je zajedničkog rada, a čitalac – nadahnuti, stvaralački – deo je ili posrednik sveta za kojim se traga. „Književna klinika“ možda nije toliko novo čitanje Emersonovog oglada „Američki učenjak“ koliko podsećanje, ili zahtev (?), u novom ruhu da se otkrije ono što je kod svih *nas* (delimično) prisutno.

Da odbrana tumačenja teksta, kao što navodi Eko (2001: 38), ne znači da tekstovi ne mogu biti upotrebljeni, u našem slučaju, na Bagsterov način, pokazuje sledeće. Suprotno naratorovom komentaru ili možda očekivanju, Bagsterov model je ipak uspeo da se odomaći. Ideja preporučivanja knjige kao leka umesto pilula, prerađivana kroz druge književne tekstove¹ (Brewster 2019: 4–5), postepeno se razvila u jednu granu biblioterapije. „Knjige na recept“ (Books on Prescription) je „najrasprostranjeniji model biblioterapije koji se primenjuje u Velikoj Britaniji“ (11), ali je u manje formalnom obliku dostupan i u Americi. Kao što naziv programa i kaže, model se sprovodi u saradnji lekara opšte prakse ili drugih medicinskih stručnjaka i bibliotekara posredstvom sistema koji

has happened, like the saint in the old martyrology who, after he had been decapitated, walked off absent-mindedly with his head under his arm.”

¹ Primer koji se posebno izdvaja je roman Kristofera Norlija *Ukleta knjižara* (*The Haunted Bookshop*) iz 1919. godine.

sadrži podatke o uputima i receptima (12). Na spiskovima preporučenih knjiga, koji se neprestano revidiraju, ne nalaze se samo knjige iz domena samopomoći (*self-help books*) već i fikcija, uglavnom romani koji podižu raspoloženje i imaju blagotvorna dejstva na psihi. Dok se moć prvih ogleda u čitačevoj veštini prikupljanja informacija – prepoznavanju tehnika i odgovora za ako ne bolji, onda bar drukčiji život, moć drugih zavisi od stepena identifikacije – čitačevog instinktivnog prepoznavanja srodnosti sa junakom. Putanja identifikacija–katarza–uvid, osnova biblioterapijskog procesa (Shrodes 1955: 24), ima za cilj preoblikovanje emocionalnog iskustva čitaoca–pacijenta a time i oslobađanje od zatočeništva koje to iskustvo nameće (26). Oživljavanje aristotelizma za potrebe stvaranja izmenjenog (narativnog) identiteta povlači za sobom i oživljavanje retorike oslobođenja i sve što ona nosi – emocionalno prevaspitavanje, prilagođavanje društveno prihvatljivim porivima i pretvaranje čitaoca u objekat posmatranja: biblioterapija, prema najčešće citiranoj definiciji, je dinamična interakcija između čitaoca i književnog teksta koja može angažovati emocije i osloboditi ih za svesnu i produktivnu upotrebu (24). Upotrebne vrednosti – knjige, čitaoca, čitanja, emocija – umnožavaju se srazmerno obimu Bagsterovog izlaganja u Krodersovom ogledu. Zaključak ogleda ili mogući optimizam u čovekove mogućnosti (oslanjanje na samog sebe/samopouzdanje) ostaje u zapečku.

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**“A LITERARY CLINIC”: INTERPRETATION AND/OR USE OF LITERARY
TEXTS IN BIBLIOTHERAPY**

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ABSTRACT:

The paper employs Umberto Eco's dichotomy interpretation/use to examine different reading experiences and strategies. Eco's dichotomy is suitable for the aim of this paper to demonstrate that the idea of bibliotherapy as a practice of using literary texts according to a predetermined path and with specific objectives owes to arbitrary readings of Samuel McChord Crothers's essay "A Literary Clinic" (1916). In this essay, Crothers uses a dialogue between the narrator and his friend Bagster to address contemporary debates on the habits and purposes of reading. The gradual unveiling of the narrative strategy tends to illustrate that Bagster's model represents a limited form of reading (using literary texts).

Keywords: Samuel McChord Crothers, reading, bibliotherapy, interpretation, use

MOTIVACIJA U UČENJU ENGLESKOG KAO DRUGOG JEZIKA: STUDIJA SLUČAJA – FAKULTET ZA MENADŽMENT

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SAŽETAK:

Usvajanje stranog jezika je relativno mlada naučno-istraživačka disciplina. Riječ je o teorijskom i eksperimentalnom području istraživanja koje nastoji da unaprijedi razumjevanje razvoja svih onih jezika koji nisu prvi usvojeni, maternji jezik, bez obzira na to kada su se oni usvajali i kontekst u kojemu su učeni. U usvajanju stranog jezika izuzetno značajnim faktorima smatraju se individualne razlike među učenicima, i pored strategije učenja, motivacija se smatra jednom od najznačajnijih. Ovaj rad, pored određenih teorijskih razmatranja motivacije u učenju jezika, predstavlja i studiju slučaja koja se odnosi na analizu ankete koja je sprovedena među studentima Fakulteta za menadžment Herceg Novi i konačno pruža određene preporuke u pogledu poboljšanja motivacije usvajanja engleskog kao stranog jezika.

Ključne riječi: *usvajanje stranog jezika, engleski kao drugi jezik, motivacija, motivacija u usvajanju jezika*

1. UVOD

Živimo u eri globalizacije u kojoj je engleski jezik veoma brzo postao međunarodni jezik. Kako bi se ovakvi zahtjevi ispoštovali, engleski jezik se izučava gotovo svuda u Crnoj Gori, pa i regionu, a to se posebno odnosi na škole, fakultete, univerzitete gdje je engleski jezik uglavnom obavezan predmet.

Međutim, usvajanje i reprodukcija engleskog jezika predstavlja problem za veliki broj onih koji ga uče a posebno za studente na fakultetima. Uprkos činjenici da većina studenata engleski jezik uči od osnovne škole, ipak se javljaju brojni nedostaci kada se radi o reprodukciji engleskog jezika.

Iz obzervacija ali i iz sopstvenog iskustva u predavanju na fakultetima, uočeno je da je tokom časova i vježbi koje podrazumjevaju reprodukciju usvojenog znanja interakcija ograničena. Samo se određeni, mali, broj studenata uključuje u aktivnosti koje vodi predavač dok ostali ostaju nijemi ili se bave nekim drugim stvarima. Prema tome, jedan

od izazova za predavače jeste iznalaženje odgovora na pitanje „Zbog čega se mali broj studenata aktivno uključuje u reprodukciju usvojenog tokom predavanja na kursovima engleskog jezika?“.

Kako bi se odgovorilo na ovo pitanje, neophodno je istražiti šta je to što motiviše i demotiviše studente da usvajaju engleski jezik. Brojni predavači i istraživači sada vjeruju da je motivacija jedan od najznačajnijih faktora koji određuju stopu i uspješnost usvajanja engleskog jezika – motivacija obezbjeđuje primarnu pobudu za početno usvajanje jezika a kasnije predstavlja pokretača za istrajavanje u dugom i nerijetko zamornom procesu usvajanja jezika. Bez dovoljno motivisanosti, čak i pojedinci koje odlikuju izuzetne sposobnosti nisu u mogućnosti ostvariti dugoročne ciljeve. Ipak, odgovarajući plan i program rada kao i dobri predavači mogu osigurati motivaciju koja obezbjeđuje uspjeh studenata.

Ovaj rad ispituje faktore motivacije studenata u usvajanju engleskog jezika u funkciji struke, sa nadom da će pomoći predavačima jezika da iznađu odgovarajuće metode kako bi motivisali svoje studente.

2. POJAM MOTIVACIJE – KRATAK PREGLED DOSADAŠNJIH TEORIJA I ISTRAŽIVANJA

Brojni su istraživači koji su se bavili definisanjem motivacije. Sve teorije koje se bave motivacijom, uopšteno govoreći, teže da objasne osnovna pitanja koja se odnose na to zbog čega se ljudi ponašaju na način na koji se ponašaju, pa se prema tome ovdje ne može pretpostaviti jednostavan i prost odgovor.

Burden (1997) pretpostavlja da se „iz kognitivne perspektive, motivacija bavi takvim pitanjima kao što su razlozi iz kojih ljudi odlučuju da djeluju na određeni način kao i faktorima koji utiču na ljude da donesu odluke kakve donose. Ona takođe obuhvata odlučivanje o tome koliko su ljudi spremni da se razvijaju kako bi ostvarili svoje ciljeve. Uloga je nastavnika, prema tome, da pomogne i omogući učenicima da donesu odgovarajuće odluke.“

Dornye (2001) definiše motivaciju kao „opšti način upućivanja na ono što prethodi, tj. Na uzroke i porijeklo“. Takođe navodi da se „motivacijom objašnjava zbog čega ljudi odlučuju da nešto urade, koliko su istrajni u tome kao i koliko dugo su spremni da istraju u tim aktivnostima“. Ovaj autor pominje dvije dimenzije ljudskog ponašanja – smjer */direction/* i intenzitet */intensity/* koje se tiču motivacije.

Iz navedenog se može zaključiti da je motivacija psihološka odlika koja navodi ljude da ostvare cilj. Motivacije predstavlja ono što pokreće ljude da se „ponašaju“ na određeni način ili da započnu određenu aktivnost.

2.1. Motivacija u usvajanju stranog jezika

U novije vrijeme, motivacija postaje čest termin u izučavanju usvajanja stranog jezika. Motivacija u učenju stranog jezika je definisana na različite načine.

Shodno Dornyeu (1998), motivacija se odnosi na napore koje učenici ulažu kako bi naučili strani jezik, te je, samim tim, motivacija jedan od ključnih faktora koji utiču na stopu i uspješnost usvajanja stranog jezika.

Park (2006) vjeruje da je motivacija oblikovana kao „...set vjerovanja o učenju jezika, ciljnoj kulturi, njihovoj kulturi, nastavniku, itd.“ Sa druge strane, Holt (2001), upućujući na Crookesa i Schmidta (1991), definiše motivaciju kao „orijentaciju učenika u odnosu na ciljeve učenja drugog jezika“.

Gardner (1985) dalje podrazumjeva da motivacija obuhvata želju za učenjem jezika, intenzitet napora koji se ulaže da se ovo ostvari, i stava prema učenju jezika.

Shodno okviru koji je postavio Dornyei (1994), motivacija se sastoji iz tri osnovna nivoa a koji su jezički nivo, nivo učenika i nivo situacije u kojoj se učenje odvija. Jezički nivo se odnosi na integrativni motivacioni pod-sistem i instrumentalni motivacioni pod-sistem. Nivo učenika zavisi od potreba za ostvarenjem, samopouzdanja, percepcije sopstvenih kompetencija, i sl. Nivo situacije u kojoj se učenje odvija se odnosi na specifične motivacione komponente kursa, motivacione komponente nastavnika i specifične motivacione komponente grupe.

Prikaz Dornyeiovog (1994) okvira motivacije usvajanja stranog jezika izgleda ovako:

Nivo jezika	Integrativni motivacioni podsistem Instrumentalni motivacioni podsistem
Nivo učenika	Potreba za postignućem samopouzdanje Strah od upotrebe jezika Percipirana kompetencija u stranom jeziku Kauzalne atribucije Samodjelotvornost
Nivo konteksta učenja	
<i>Nastava</i>	Interes (za nastavu) Relevantnost (nastave za potrebe učenika) Očekivanje (uspjeha) Zadovoljstvo (ishodom)
<i>Nastavnik</i>	Želja za ugađanjem nastavniku Tip autoritativnosti Direktna socijalizacija motivacije Modeliranje Prezentacija zadatka Povratna informacija
<i>Grupa</i>	Usmjerenost cilju Sistem normi i nagrada Grupna kohezija Struktura ciljeva grupe

Tabela 1. Dornyeiov okvir motivacije za usvajanje stranog jezika

Drugi sveobuhvatni pokušaj sumiranja motivacionih komponenti koje su relevantne za učenje stranog jezika su načinili Marion i Burden (1997) kao dio šireg pregleda psihologije za predavače jezika. Ukratko, motivacione komponente se sastoje od unutrašnjih faktora i spoljašnjih faktora. Komponente navedenih faktora su sumirane u tabeli ispod.

Unutrašnji faktor	Spoljašnji faktor
Unutrašnji interes za aktivnost Radoznalost Optimalni nivo izazova	Značajni drugi: Roditelji Nastavnici Kolege
Uočena vrijednost aktivnosti Lični značaj Pretpostavljena vrijednost ishoda Unutrašnja vrijednost koja se pripisuje aktivnosti	Priroda interakcije sa značajnim drugima Posredno iskustvo učenja Priroda povratne veze Nagrade Priroda odgovarajuće pohvale Kazne, sankcije
Osjećaj djelovanja Položaj kauzalnosti Položaj kontrole procesa i ishoda Mogućnost postavljanja odgovarajućih ciljeva	Okruženje u kojem se učenje odvija Udobnost Izvori Doba dana, nedelje, godine Veličina razreda, škole Etos razreda i škole
Vještina Osjećaj sposobnosti Svijest o razvijanju vještina i ovladavanje vještinama u odabranoj oblasti Samoeфикаsnost	Širi kontekst Šire porodične mreže Lokalni obrazovni sistem Sukobljeni interesi Kulturološke norme Društvena očekivanja i stavovi
Slika o sebi Realistična svijest o ličnim vrlinama i slabostima u neophodnim vještinama Lične definicije i sudovi o uspjehu i neuspjehu Vrednovanje samog sebe Naučena bespomoćnost	
Stavovi Prema učenju jezika uopšteno Prema jeziku cilju Prema zajednici i kulturi jezika cilja	

Druga afektivna stanja Samopouzdanje Nervoza, strah	
Razvijene godine i faze	
Rod	

Tabela 2. Marion i Budrenove motivacione komponente relevantne za učenje stranog jezika

U zaključku, može se reći da je motivacija jedna promjenljiva, koja, kombinovana sa drugim faktorima, utiče na uspjeh učenja.

2.2. Vrste motivacije u učenju stranog jezika

Motivacija se može klasifikovati na različite načine. U nekim studijama, motivacija se kategorise na dvije vrste, a to su **intrinzička motivacija** i **ekstrinzička motivacija**.

Intrinzička motivacija potiče iz samog učenika. Kada se radi o učenju, može se reći da pobuda ili stimulacija za učenje potiče od samog učenika, prema tome, predavač ili nastavnik ne mora da „manipuliše“ studentom kako bi ga natjerao na učenje, odnosno usvajanje. Intrinzička motivacija predstavlja unutrašnju želju učenika da ispuni pozitivan ishod učenja. Sama intrinzička motivacija je vezana za cilj, prema tome, ona je nezavisna od ma koje vrste spoljašnje vrijednosti.

Ekstrinzička motivacija se može posmatrati kao suprotnost intrinzičkoj motivaciji. Cilj koji je povezan sa intrinzičkom motivacijom je pozitivan efekat učenja koji traje dugo, dok je cilj ekstrinzički motivisanog učenika potpuno drugačiji.

Dalje je, motivacija u usvajanju stranog jezika, šire kategorisana u dvije vrste, i to: **integrativnu motivaciju** i **instrumentalnu motivaciju**.

U svojoj pionirskoj studiji, Gardner i Lambert (1972) naglašavaju „integrativnu motivaciju“ koja ističe „iskreni i lični interes za ljude i kulturu koju predstavlja druga grupa“ i „instrumentalnu motivaciju“ koja naglašava „praktičnu vrijednost i prednosti učenja novog jezika“. Gardner (1982) kasnije u svom socio-edukativnom modelu dodaje tri aspekta motivacije učenika: napor (vrijeme i pokretač), želju (stepen jezičke vještine koju želi) i efekat (emotivne reakcije na učenje jezika). Integrativna motivacija predstavlja želju učenika da osjeti bliskost sa ljudima, društvom i kulturom jezika koji uči, i ona se obično odnosi na kontekst života u zajednici ciljnog jezika (Falk, 1978).

Instrumentalna motivacija se, sa druge strane, bavi praktičnim i konkretnim nagradama koje učenik želi (Hudson, 2000). Ovo se odnosi na ostvarenje određenih ciljeva kao što je na primjer polaganje ispita ili dobijanje određene ocjene. Mišljenje studenta o datom jeziku oblikovano je njegovom percepcijom koristi koju može imati od usvajanja tog jezika za buduće ciljeve u karijeri (Chambers, 1999).

3. STUDIJA SLUČAJA – FAKULTET ZA MENADŽMENT HERCEG NOVI

U svrhu ovog istraživanja, izvršena je anketa među studentima Fakulteta za menadžment u Herceg Novom sa ciljem istraživanja stavova ispitanika o korisnosti znanja engleskog jezika u njihovoj struci kao i konkretne potrebe za određenim jezičkim vještinama u profesionalnom životu. Istraženi su, takođe, stavovi i očekivanja studenata o znanjima i vještinama u okviru engleskog jezika kao jezika struke u oblasti menadžmenta koji će im biti od koristi u obavljanju njihovog budućeg ili sadašnjeg poziva.

Jedan od ciljeva sprovedene ankete bilo je i utvrđivanje stvarne potrebe za određenim znanjima i vještinama u okviru engleskog jezika kao jezika struke u oblasti menadžmenta, ali i, analiziranjem postojećeg stanja, utvrditi nivo postignuća nastave engleskog jezika kao jezika struke kako u srednjim školama tako i na fakultetima u Crnoj Gori.

Svrha ove ankete jeste određivanje smjernica za bolje motivisanje studenata, kao i koncipiranje ciljeva i zadataka nastave engleskog jezika kao jezika struke u oblasti menadžmenta koji će biti usklađeni sa praktičnim potrebama i interesima budućih menadžera.

Uzorak čini 288 studenata Fakulteta za menadžment, koji su mahom studenti prve ili druge godine studija. Ispitanici su podjeljeni u dvije grupe – prvu grupu čine studenti, tek svršeni srednjoškolci, dok drugu grupu čine studenti koji su zaposleni u svojoj struci sa značajnim radnim iskustvom iza sebe, a rezultati ankete se temelje na analiziranju odgovora datih na 25 pitanja tri generacije studenata, a za svrhe ovog rada mi nećemo predstaviti cjelokupnu analizu dobijenih odgovora na upitnik, već samo nalaze koji su u datom kontekstu najprimjenljiviji.

Kao što je navedeno iznad, upitnik se sastoji od 25 pitanja podjeljenih u tri grupe. Prvu grupu čine pitanja koja se odnose na nastavu jezika u srednjoj školi te procijenjeni nivo znanja koji student posjeduje. Druga grupa pitanja odnosi se na fakultetsku nastavu engleskog jezika sa ciljem analize potreba, očekivanja i želja studenata u vezi sa nastavom engleskog jezika za posebne potrebe u oblasti menadžmenta. Konačno, treću grupu pitanja, a na koju su odgovarali samo studenti sa radnim iskustvom, unutar koje se analizom trenutno zapravo vrši analiza ciljne situacije sa željom dobijanja podataka o „tekućoj“ upotrebi engleskog jezika na radnom jestu, te na taj način dobijanje slike o ciljanim segmentima upotrebe jezika.

Iz navedene ankete proizilazi da je 98% studenata fakultet upisalo sa određenim predznanjem engleskog jezika, a što dalje govori o značaju koji se poklanja nastavi engleskog jezika u srednjoj školi. Od ovog procenta 22% studenata je, uviđajući značaj engleskog jezika za buduće zaposlenje, koristilo i druge metode učenja engleskog jezika (pohađali su dodatne kurseve, boravili u inostranstvu, učili jezik uz pomoć medija, i sl). Ono što je, takođe, zanimljivo iz ove grupe pitanja jeste i odgovor na pitanje koje se odnosi na osnovne nedostatke nastave engleskog jezika kroz srednju školu, a koji smatraju nepridavanje značaja predmetu u srednjoškolskom sistemu obrazovanja osnovnim nedostatkom, kao i odsustvo tema koje su bliske savremenim generacijama, osnovnim

problemima kada je njihova motivacija za usvajanje engleskog jezika kroz srednju školu u pitanju.

Druga grupa pitanja, odnosno pitanja koja se odnose na fakultetsku nastavu engleskog jezika daje nam bliži uvid u očekivanja studenata prve godine, sa jedne strane, ali i uvid u to koliko su očekivanja studentima druge godine ispunjena, sa druge strane. Ono što se ovdje posebno ističe jeste stav 88,63% ispitanih da bi predmet engleski jezik trebalo da je zastupljen na svim godinama, odnosno nivoima studija kontinuirano.

U okviru ove grupe pitanja, ističe se i to da velika većina ispitanika, njih čak 61,73%, smatraju da je verbalna komunikacija ona jezička vještina koju je najneophodnije savladati a radi potreba budućeg, odnosno sadašnjeg posla, dok rezultati odgovora na pitanje šta bi po njihovom mišljenju najviše doprinijelo podsticaju ovladavanja poslovnim engleskim jezikom, ukazuju na to da gotovo polovina ispitanika, njih 49,52%, smatra da bi mogućnost obavljanja prakse u inostranoj firmi/inostranstvu predstavljala najveći podsticaj za ovladavanje poslovnim engleskim jezikom, kao i rješavanje konkretnih zadataka i istraživačkih projekata potrebnih za poslovanje na engleskom jeziku. Osim toga, velika većina, 76,13% ispitanika, smatra da kurs treba da obuhvati metode rada koje podrazumjevaju simuliranje stvarnih situacija, što bi podrazumjevalo prezentacije, simuliranje poslovnog pregovaranja, telefonsku komunikaciju, intervju, i dr.

Treća grupa pitanja predviđena je za ispitanike koji osim studiranja imaju određeno radno iskustvo. Kao što je ranije navedeno, 138 ispitanika, odnosno 43,18% svih ispitanih, jeste u radnom odnosu. Cilj ovog dijela upitnika jeste da ustanovi u kojoj formi, u smislu učestalosti upotrebe jezičkih vještina, ispitanici najčešće koriste engleski na radnom mjestu. U tabeli ispod dat je pregled odgovora:

	Ne koristim često	Koristim rijetko	Koristim prosječno	Koristim često	Koristim vrlo često
Govor	15,78%	15,78%	15,78%	13,15%	39,47%
Čitanje	50,00%	2,63%	18,42%	10,52%	15,78%
Pisanje	39,47%	5,26%	7,89%	18,42%	28,94%
Razumjevanje slušanja	21,05%	10,52%	15,78%	7,89%	52,63%

Tabela 3. Zastupljenost osnovnih jezičkih vještina

Na osnovu analize upitnika, odnosno sprovedenog istraživanja, dolazi se do zaključka da najveći broj ispitanika, odnosno studenata smatra jezik prilično korisnim kako za zapošljavanje u nekoj od oblasti za koje se školuju, tako i kasnije za sam rad, što po sebi predstavlja ogroman motiv za bolje učenje i usvajanje znanja i vještina engleskog kao stanog jezika. Navedeni podaci su potrebni radi ukazivanja na najučestalije vještine komunikacije, odnosno pravce komunikacije na koje je potrebno fokusirati se kada je riječ o izvođenju nastave engleskog jezika na fakultetima.

Uvid u cijelo istraživanje je dostupan na upit.

4. ZAKLJUČAK

Kao što je rečeno, glavni cilj ovog istraživanja bio je istražiti faktore koji utiču na motivisanost studenata da usvajaju engleski jezik u funkciji struke u oblasti menadžmenta, a proizašlo je iz potrebe za rasvjetljavanjem procesa usvajanja stranih jezika, imajući u vidu da je mali broj istraživanja, i kod nas i u svijetu, koji se bave sveobuhvatno faktorima koji utiču na motivaciju studenata da usvajaju engleski jezik u funkciji struke, a rezultati analize su iskorišteni u pokušaju izrade preporuka za organizovanje nastave engleskog jezika u funkciji struke u oblasti menadžmenta na fakultetima.

S obzirom na izražene stavove studenata o učenju jezika kao i motivaciju za pojedine oblike izvođenja nastave, došlo se do određenih zaključaka. U prvom redu, studenti neprestano naglašavaju značaj govorne komunikacije, razgovora i diskusije. Oni, međutim, ove oblike rada vežu više uz opšte, aktuelne teme, manje uz stručne. To, kao i stavljanje naglasaka na slušanje audiomaterijala, pa i gledanje video materijala, može ukazivati na opšti stav o jeziku koji se školovanjem, prije akademskog nivoa, više povezuju sa neobaveznim i ugodnim svakodnevnim sadržajima pa se i ovaj nastavni predmet doživljava gotovo kao „predah od svakodnevnih školskih obaveza“. Shodno tome, studenti bi radije usavršavali idiomatske fraze tipične za govor nego proučavali i usvajali jezička obilježja stručnog teksta (internacionalizmi, pasivne konstrukcije, i sl). sa druge strane, ovakav stav možemo objasniti i potrebom za upoznavanjem i razumjevanjem kulturoloških i civilizacijskih sadržaja koji uvijek prate učenje stranog jezika i čine njegov neizostavan dio.

Prelaskom na akademski nivo, studenti su, međutim, svjesni potrebe za jezikom struke, jer se od početka studija, na primjer, sreću sa literaturom na stranom, uglavnom engleskom, jeziku. Stoga studenti u okviru jezika struke naglašavaju značaj čitanja i razumjevanja stručnih tekstova i usvajanja stručne terminologije.

Dalje, dok rad na usavršavanju gramatike većina studenata smatra potrebnim ili potrebnim u određenoj mjeri, rezultati koji se odnose na usvajanje akademskih principa pisanja na engleskom jeziku upućuje na to da studenti ne pokazuju izraženu motivaciju za ovakvu vrstu nastavnog rada.

S obzirom na sve navedene komponente jezika struke kao i rezultate istraživanja, čini se da uloga nastavnika jezika struke nije ni malo laka niti jednostavna kao i da bi osnovni kvalitet koji nastavnik struke treba da posjeduje trebalo da bude fleksibilnost. Ova osobina se odnosi na sposobnost nastavnika da podučava različite vidove jezika, od opšteg do stručnog, kao i uvažavanje različitih grupa studenata.

Cilj ovog istraživanja jeste, između ostalog, i sumiranje nekih od osnovnih principa koji se odnose na izradu nastavnog plana i programa za engleski jezik u funkciji struke u oblasti menadžmenta na fakultetima, nastavnog materijala, ali i onih koji se odnose na karakteristike nastavnika koji predmet predaju. Naime, implementacija osnovnih principa predstavlja preduslov za poboljšanje kvaliteta i efikasnosti nastave engleskog jezika u funkciji struke, uopšte, pa i u oblasti menadžmenta, a samim tim i za unapređenje motivacije u usvajanju istog.

S obzirom da je nastava engleskog jezika u funkciji struke kao takva relativno mlada disciplina, metodika nastave jezika i primjenjene lingvistike, koja se izuzetno i brzo razvija, razvoj ovih principa je ključan za razvoj nastavnog plana i programa, kao i nastavnog materijala engleskog jezika u funkciji struke (Vuletić, Joković, 2013).

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**MOTIVATION IN LEARNING ENGLISH AS A SECOND LANGUAGE: CASE
STUDY – FACULTY OF MANAGEMENT
MOTIVACIJA U UČENJU ENGLESKOG KAO DRUGOG JEZIKA: STUDIJA
SLUČAJA – FAKULTET ZA MENADŽMENT**

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ABSTRACT:

Foreign language acquisition is rather young scientific discipline. It is theoretical research area on one side and experimental one on the other, tending to improve understanding of development of all those languages that are not first acquired, or mother tongue, regardless of the manner of their acquisition or context of it. In acquiring foreign language, individual differences among students are considered to be rather important, and apart from learning strategies, motivation is considered to be one of the most important ones. This paper, apart from certain theoretical considerations of motivation in learning language, also presents a case study encompassing research based on the survey conducted among students of the Faculty of Management Herceg Novi and provides certain recommendations regarding improvement of motivation to acquire English as a foreign language.

Keywords: *foreign language acquisition, English language as a second language, motivation, motivation in language acquisition*

***ODRŽIVI RAZVOJ, EKOLOGIJA, ENERGETSKA
EFIKASNOST I OBNOVLJIVI IZVORI ENERGIJE***

***SUSTAINABLE DEVELOPMENT, ECOLOGY, ENERGY
EFFICIENCY AND RENEWABLE ENERGY SOURCES***

ZNAČAJ PRIMENE SAVREMENE MEHANIZACIJE NA ŽIVINARSKIM FARMAMA U FUNKCIJI ODRŽIVOG RAZVOJA U SRBIJI

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SAŽETAK:

Strategija održivog razvoja je ciljani dugoročni proces koji utiče na ekonomske, socijalne i ekološke aspekte života jedne zemlje. Razvojni prioriteti poljoprivrede kao i celokupnog agrobiznisa u Srbiji usmereni su ka profitabilnosti, potencijalu, raspoloživim resursima i tražnji na globalnom tržištu. Tako su ciljevi razvoja održive poljoprivrede na farmama u Srbiji, bazirani na međunarodnim, ekonomskim i ekološkim standardima. S obzirom da je održivo upravljanje resursima, jedan od permanentnih razvojnih prioriteta, cilj ovog rada je da ukaže na značaj primene savremene tehnologije na živinarskim farmama u Srbiji, u funkciji održivog razvoja.

Živinarstvo je jedna od najrazvijenijih grana poljoprivrede. Kako uzgoj brojlera, tako i proizvodnja konzumnih jaja predstavljaju jednu od najindustrijalizovanijih grana poljoprivrede u Srbiji. Za održivo poslovanje modernih farmi potrebna su kako značajna materijalna ulaganja, tako i edukacija o inovacijama u ovoj oblasti za vlasnike i zaposlene.

Moderne živinarske farme opremljene su mehanizacijom koja osim dobrobiti za uzgoj živine, doprinosi povećanju produktivnosti rada, uštedi radne snage i poboljšanju opšteg stanja životne sredine na farmama. Oprema se odlikuje visokim stepenom automatizacije, a upotreba informacionih tehnologija sve više je u primeni. Pri projektovanju novih i proširenju postojećih živinarskih farmi koriste se smernice za primenu čistih tehnologija u funkciji održivog razvoja.

Rad se sastoji iz tri dela. Prvi deo rada ukazuje na potencijal održivog razvoja agrobiznisa u Republici Srbiji. Drugi deo analizira važnost živinarskih farmi za sektor agrobiznisa u Srbiji, dok treći deo rada ukazuje na značaj primene savremene mehanizacije na živinarskim farmama.

Ključne riječi: primena, mehanizacije, živinarske farme, održivi razvoj

1. UVOD

Strategija održivog razvoja smatra se ciljanim procesom koji se odražava kako na ekonomske tako i na socijalne i ekološke aspekte života u jednoj zemlji. S obzirom da su razvojni prioriteti celokupnog agrobiznisa u Srbiji usmereni na profitabilnost, potencijal, raspoložive resurse i tražnju na tržištu, ciljevi razvoja održive poljoprivrede na farmama u Srbiji, bazirani su na međunarodnim, ekonomskim i ekološkim standardima.

Danas se agrarna područja širom sveta, pa samim tim i u Republici Srbiji, suočavaju sa brojnim internim i eksternim izazovima, naročito ekološkim, tehničko-tehnološkim,

institucionalnim, ekonomsko-finansijskim, socijalnim, regionalnim, globalnim i slično. [1]. Prema Strategiji poljoprivrede i ruralnog razvoja Republike Srbije 2014-2024. godine, kao ključni izazovi navode se [2]:

- održivo upravljanje resursima;
- transfer znanja i tehničko-tehnološki napredak;
- povećanje konkurentnosti;
- razvoj prehrambenog lanca, uz logističku podršku sektoru;
- razvoj ruralnih područja i jačanje socijalne strukture ruralnih zajednica.

Agrobiznis u Srbiji je zasnovan na porodičnim gazdinstvima sa niskom produktivnošću rada i malim viškovima u proizvodnji, gde nedostaje organizovanost, preduzetnički duh, marketing pristup i edukacija [3].

Savremene živinarske farme u Srbiji odlikuje upotreba kvalitetne mehanizacije i opreme što je usklađeno sa odgovarajućim standardima i propisima Evropske unije (EU). Parametri koji su važni za njihov izbor zavise od osnovne namene farme, kapaciteta proizvodnje na farmi i raspoloživih finansija vlasnika. Uz prethodne uslove, moraju pratiti pooštrene zahteve vezane za zaštitu životne sredine, čime doprinose održivom razvoju u ovoj oblasti.

Kako je održivo upravljanje resursima jedan od permanentnih razvojnih prioriteta, cilj ovog rada je da ukaže na značaj primene savremenih tehnologija na živinarskim farmama u Srbiji, u funkciji održivog razvoja. Rad se sastoji iz tri dela, gde prvi deo rada ukazuje na potencijal održivog razvoja agrobiznisa u Republici Srbiji. Drugi deo analizira važnost živinarskih farmi za sektor agrobiznisa u Srbiji, dok treći deo rada ukazuje na značaj primene savremene mehanizacije na živinarskim farmama.

2. POTENCIJAL ODRŽIVOG RAZVOJA AGROBIZNISA U REPUBLICI SRBIJI

S obzirom na klimatske promene, kao i to da su uzrokovane ljudskim faktorom, globalna zajednica je počela inicijativu ka održivom razvoju. Opšteprihvaćena definicija pojma održivi razvoj ne postoji [4]. U literaturi se najčešće navodi definicija UN World Commission on Environment and Development, odnosno Bruntland komisije, gde je „Održivi razvoj razvoj koji zadovoljava potrebe sadašnjice, ne dovodeći u pitanje sposobnost budućih generacija da zadovolje vlastite potrebe” [5]. Prema Nacionalnoj strategiji održivog razvoja Republike Srbije, održivi razvoj se objašnjava kao ciljno orijentisan, dugoročan, neprekidan, sveobuhvatan i sinergetski proces koji utiče na sve aspekte života [6].

Zelena tranzicija [7] inicirala je potrebu za ponovnim pokretanjem tradicionalnih oblika poljoprivrede pomerajući granice njenog poimanja [3]. Evropska unija je primer izražene težnje ka održivom razvoju poljoprivrede, kroz sprovođenje Zajedničke poljoprivredne politike, u okviru programskog perioda 2014-2020. godine, a i prema novom konceptu predviđenom za period nakon 2020. godine [8].

Globalna prehrambena kriza je pokazala značaj poljoprivrede ili agrobiznis sektora, koji kao grana privrede predstavlja veoma važan faktor ukupnog privrednog razvoja skoro

svake zemlje [9]. Iako Republika Srbija ima poljoprivredne resurse, oni se ne koriste u dovoljnoj meri, te stoga, oni predstavljaju značajan ekonomski potencijal za dalji održivi razvoj celokupne privrede kao i za nacionalnu ekonomiju Republike Srbije.

Zajednička osobenost poljoprivrede Srbije, ali i zemalja u okruženju, jeste znatan broj malih gazdinstva sa malim posedom, što značajno smanjuje produktivnost poljoprivrede, poljoprivrednu proizvodnju, utiče na primanja gazdinstava, što dalje umanjuje životni standard [10].

Tasić (2015) smatra da je Strategija razvoja poljoprivrede i ruralnog razvoja Srbije koncipirana i delimično preuzeta iz Strategije poljoprivrednog i ruralnog razvoja Evropske unije [11]. Na osnovu toga Strategija poljoprivrede i ruralnog razvoja Republike Srbije za period 2014-2024. godine, definiše nekoliko ključnih ciljeva:

- pravce budućeg razvoja poljoprivrede i prehrambene industrije, zasnovane na konceptu održivog razvoja, koji afirmiše očuvanje životne sredine i održivo upravljanje prirodnim resursima;
- model podrške koji bi vodio ubrzavanju razvoja poljoprivredno-prehrambenog sektora, koji ima značajne potencijale za povećanje obima proizvodnje i dugoročno održiv rast konkurentnosti u okruženju širem od lokalno-regionalnog;
- pravce budućih reformi poljoprivredne politike i institucionalnog okvira.

Ipak, prema Stevanović i Đorović (2009), ključni problemi agrobiznisa u Srbiji su i dalje veličina poljoprivrednog gazdinstva, nizak nivo produktivnosti rada, kao i slaba povezanost poljoprivrednog i prerađivačkog sektora [12].

Moderne koncepcije upravljanja održivim razvojem u agrobiznisu zahtevaju promenu tradicionalnih organizaciono-upravljačkih struktura i veza, gde upravo javno-privatna partnerstva, zajedničkim delovanjem mogu unaprediti lokalni razvoj [13].

3. SAVREMENA ŽIVINARSKA PROIZVODNJA NA FARMAMA U SRBIJI

Program odgajivačkog rada u živinarstvu Republike Srbije obuhvata odgajivačke mere usmerene na kvantitativno i kvalitativno unapređenje proizvodnje živinskog mesa i konzumnih jaja. Na obim i proizvodnju živinskog mesa i konzumnih jaja utiču zahtevi tržišta, mere ekonomske politike, obim i izvori sredstava za nove investicije i planiranu proizvodnju. Za realizaciju ovakve proizvodnje veoma je značajan i stručno razrađen odgajivački program, koji će uvažiti specifičnosti živinarske proizvodnje u Srbiji i omogućiti potpunije uključivanje glavne i regionalnih odgajivačkih organizacija. Kako bi se bolje iskoristio genetski potencijal hibrida teškog i lakog tipa, težište ovog uključivanja je u primeni savremenih metoda selekcije i odgajivanja na farmama za reprodukciju. To podrazumeva i primenu savremenih mašina i opreme kao i zoohigijenskih postupaka, kako u inkubatorskim stanicama, tako i na farmama za proizvodnju brojlera i konzumnih jaja [14].

Vlasnici živinarskih farmi u Srbiji trenutno se susreću sa brojnim problemima kada je u pitanju plasman njihovih proizvoda na tržište EU. Jedan od problema odnosi se na

zamenu kaveza za koke nosilje, odnosno postepeni prelazak na slobodni uzgoj. Sa ekološkog aspekta to je prihvatljiviji način uzgoja ali bi mogao da dovede do znatne redukcije u proizvodnji jaja, pa čak i do gašenja farmi. Ministarstvo poljoprivrede, šumarstva i vodoprivrede izmenilo je Pravilnik o uslovima za dobrobit životinja čime je rok za zamenu kaveza pomeren sa 1. januara 2021. godine na 31. decembar 2023. godine [15].

4. MAŠINE I OPREMA NA SAVREMENIM ŽIVINARSKIM FARMAMA

Pod mašinama i opremom na modernim živinarskim farmama podrazumevaju se na hranilice, pojilice, sistemi za ventilaciju i grejanje, osvetljenje, oprema i mašine za izdubavanje. Oprema je automatizovana, uz minimalno korišćenje ljudske radne snage [16].

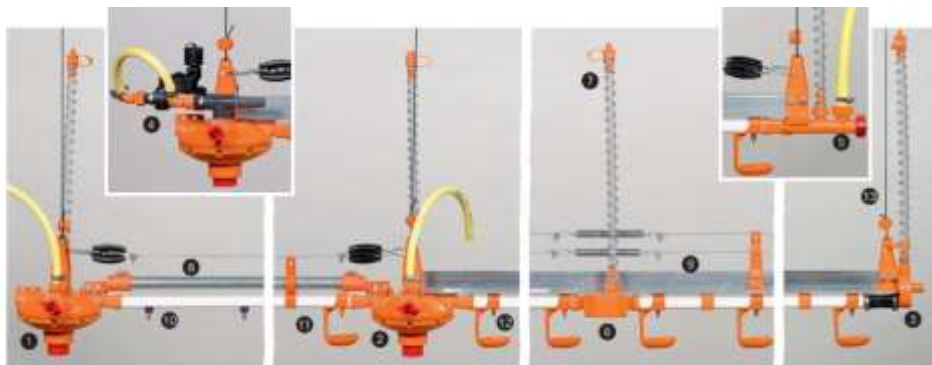
4.1. Automatizovani sistemi za hranjenje i napajanje vodom

Farmeri najviše ulažu u automatizovane sisteme za hranjenje i napajanje vodom kao i opremu za kontrolu klime. Na Slici 1. prikazan je jedan od automatizovanih sistema hranjenja čija se osnovna prednost ogleda u lakom odvajanju gornjeg dela usipnog koša (1), sa ili bez produžetka (2), od donjeg dela koša za hranu (3). Na taj način ceo sistem se može podići svaki put do plafona, čime se postiže maksimalna visina ispod hranilice tokom izdubavanja. Dozvoljena transportna dužina je 150 m, a omogućavaju je jaka pogonska jedinica (4) i jaka spirala dozoljava. Sve hranilice se u isto vreme pune hranom, senzor (5) i kontrolna hranilica (6) automatski isključuju jedinicu [16].



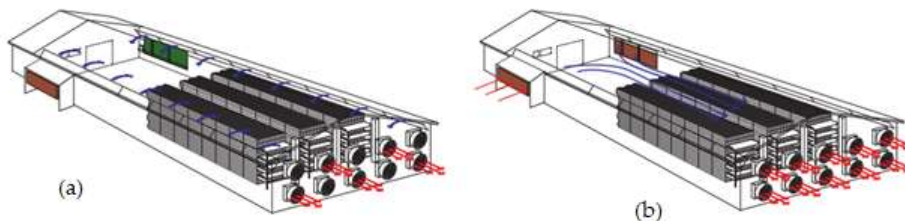
Slika 1. Sistem hranjenja AUGERMATIC [17]

Voda za pojenje živine mora biti raspoloživa u dovoljnim količinama, bez kontaminacije i da je živina lako dohvata. Nipl-pojilice su pouzdano i higijensko rešenje za snabdevanje vodom za pojenje (Slika 2.).



Slika 2. Sistem za pojenje živine [18]

Primer inteligentnog sistema regulisanja klime na živinarskoj farmi je kombi - sistem ventilacije firme Big Dutchman (Slika 3.). U jednom objektu se kombinuju dva različita sistema ventilacije (bočna i tunelska ventilacija) kako bi se obezbedilo stabilno upravljanje klimom i optimalnim ambijentalnim uslovima za živinu. Primena ovog rešenja preporučuje se u krajevima gde se klima odlikuje velikim temperaturnim kolebanjima [16].



Slika 3. Kombi-sistem ventilacije (a-ventilacija u bočnom režimu, b- ventilacija u tunelskom režimu) [16]

4.2. Održivo korišćenje otpadnog materijala na živinarskim farmama

Na živinarskim farmama stvara se veća količina izmeta - otpadnog materijala koji, ako se njime ne upravlja na adekvatan način, predstavlja značajan izvor zagađivanja životne sredine [19]. Jedan od načina da se problem reši je kompostiranje (Slika 4.), nakon čega

nastaje kvalitetno organsko đubrivo koje se može koristiti za opšte poboljšanje kvaliteta zemljišta u hortikulturi i poljoprivredi. Takođe se može i peletizirati.



Slika 4. Komposter za živinski stajnjak [20]

5. ZAKLJUČAK

Povoljni klimatski uslovi i agro resursi bitne su pretpostavke za razvoj poljoprivrede, kao dela ekonomije Republike Srbije. Ipak, ograničenja se odnose na finansijska sredstva za investicije u agrar, nedovoljne primene savremenih tehnologija u poljoprivrednom sektoru, zatim nedovoljno razvijena infrastruktura.

Primena savremene mehanizacije – mašina i opreme, na živinarskim farmama doprinosi povećanju produktivnosti i ekonomske dobiti ali pažnju treba posvetiti i boljoj zaštiti životne sredine kako bi se dostigli temeljni ciljevi održivog razvoja.

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THE IMPORTANCE OF THE APPLICATION OF MODERN MECHANISM ON POULTRY FARMS AS A FUNCTION OF SUSTAINABLE DEVELOPMENT IN SERBIA

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ABSTRACT:

A sustainable development strategy is a targeted long-term process that affects the economic, social and environmental aspects of a country's life. The development priorities of agriculture as well as the entire agribusiness in Serbia are directed towards profitability, potential, available resources and demand on the global market. Thus, the goals of developing sustainable agriculture on farms in Serbia are based on international, economic and ecological standards. Given that sustainable management of resources is one of the permanent development priorities, the aim of this work is to point out the importance of applying modern technology on poultry farms in Serbia, as a function of sustainable development. Poultry farming is one of the most developed branches of agriculture. Both the breeding of broilers and the production of table eggs represent one of the most industrialized branches of agriculture in Serbia. The sustainable operation of modern farms requires both significant material investments and education about innovations in this area for owners and employees. Modern poultry farms are equipped with machinery that, in addition to the welfare of poultry farming, contributes to increasing labor productivity, saving labor and improving the general state of the environment on farms. The equipment is characterized by a high degree of automation, and the use of information technologies is increasingly being applied. . When designing new and expanding existing poultry farms, guidelines for the application of clean technologies are used in the function of sustainable development. The paper consists of three parts. The first part of the paper indicates the potential of sustainable development of agribusiness in the Republic of Serbia. The second part analyzes the importance of poultry farms for the agribusiness sector in Serbia, while the third part of the paper indicates the importance of applying modern mechanization on poultry farms.

Keywords: application of mechanization, poultry farms, sustainable development

COMPARISON FUZZY AND INTERVAL TYPE-2 FUZZY SETS APPROACH IN DECISION FOR DEVELOPING SMART CITIES

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ABSTRACT:

A growing number of challenges that cities in the 21st century face lead to the need for a new model of urban development. The population rise, migrations, climate changes, environmental degradation, exploitation of non-renewable resources, and digitalization are just some of the problems and changes of today, which set new requirements that need to be tackled. The paper's subject is ranking the various indicators in the management field, economics, livability, and mobility, placing in the center people and their environment. A comparative application of the Analytic Hierarchy Process (AHP) methods, triangular and trapezoidal Fuzzy Analytic Hierarchy Process (FAHP) methods, and corresponding hybrid Interval Type-2 Fuzzy Sets (IT2FS) methods in the field of smart city development were carried out. By studying thirty five indicators and their evaluation, the ranking, which could facilitate the development logistics of smart city models, is carried out.

Keywords: smart city, AHP, FAHP, IT2FS

1. INTRODUCTION

Cities are centers of culture, science, and education, but despite this, they are more often mentioned negatively concerning rural areas. First of all, because of the problems that accompany urban environments - from the major environmental polluters to the most significant energy consumers, they are in the public's focus [1]. Sustainable progress is crucial and dependent on qualitative management based on sustainable strategies, accountability, transparency, and citizen participation, as well as lowering emissions and improving energy efficiency, waste management, and mobility [2]. One step in that direction is the idea of a smart city. Information and communication technologies (ICT) are developing into a remarkable tool in the evolvent of future smart networks in the hunt

for solutions that will quicken the monitoring of urban activities and enhance infrastructure systems [3]. Depending on the various political, social, and economic considerations, the Smart City model changes from one country to the next. While advanced countries are proud of innovations that widely use available resources, sensors, artificial intelligence, and almost no manual human control, many developing nations are still far from creating policies that accurately implement the smart city concept in future urban development. Besides, the pandemic has substantially altered our perspectives on sustainable development and the priority for building sustainable living environments. Urban planning specialists have identified the following crucial factors in developing new urban areas and redesigning old ones that are currently regarded as the primary tenets of urban development: the creation of mixed-use urban centers, the separation of motor traffic from pedestrians in congested city centers, and other public areas, the promotion of healthy living and the reduction of emissions, the socioeconomic diversity of the population with planning that provides all social classes with the same urban conditions and amenities, without the possibility of gentrification, and the efficient use of all resources [4]. The definition of a "Smart City" in the literature varies, ranging from entities wholly reliant on contemporary technology to a type of sustainable city with a clearly defined planning strategy, quality management, good citizen-government communication, and an "intelligent" path for resilience and self-improvement [5]. Smart buildings certainly stand out as part of a smart city [6].

This study looks at the potential for Multi-criteria decision-making (MCDM)-based smart city development. The research aims to pinpoint influential indicators that are significant preconditions for the development of smart cities, using multi-criteria analysis. We choose to apply the AHP method, the triangular FAHP, the triangular IT2FS, the trapezoidal FAHP, and the trapezoidal IT2FS as the fuzzy logic methods due to the complexity and multidimensionality of the topic we are studying.

2. IDENTIFYING INDICATORS FOR SMART CITY CREATION

A smart city is defined by Griffing [7] as having six characteristics: "smart" governance, "smart" economics, "smart" citizens, "smart" livability, "smart" mobility, and "smart" environment." When formulating development strategies for smart cities, it is influential to consider many indicators that are associated with each facet of a smart city. Based on the literature review in Table 1, we identified the criteria and sub-criteria of smart city creation.

Table 1. Definition of criteria and sub-criteria

Main criteria of smart city	Sub - criteria
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Governing - A [8,9]	<ul style="list-style-type: none"> • Creating a legal and strategic framework for the smart city platform and putting it into practice in the event of a pandemic - A₁; • Standardization of ICT and ICT management - A₂; • Collaboration between public and private stakeholders, with active citizen participation - A₃; • More openness and transparency of data - A₄.
Economy - B [10,11]	<ul style="list-style-type: none"> • Innovation and entrepreneurship - B₁; • The growth of the IT industry and job opportunities therein - B₂; • Increased financing for "smart" solutions and programs at the municipal, state, and federal levels - B₃; • Increased commercialization of innovative technologies assessment - B₄; • Increased technological rivalry in the domestic and global market - B₅; • Increased external investment for smart city platforms - B₆; • Building e-business and e-commerce platforms - B₇; • Flexibility and changes in the market - B₈.
Citizens - C [12,13]	<ul style="list-style-type: none"> • A higher level of community awareness - C₁; • The high degree of education and qualification - C₂; • Expressed adaptability, originality, and a willingness to try new things - C₃; • Public trust in contemporary options - C₄; • More civic participation - C₅; • Ethnic and social variety - C₆.
Livability - D [14,15]	<ul style="list-style-type: none"> • Personal safety - D₁; • Affordable housing - D₂; • Infrastructure equipment, resource availability, and utilities - D₃; • All people have access to jobs - D₄; • Strengthening of the health, education, tourism, and culture sectors - D₅; • Privacy protection policy - D₆; • Social integration - D₇.
Mobility - E [16,17]	<ul style="list-style-type: none"> • Integration of ICT infrastructure - E₁; • An innovative transportation system that prioritizes non-motorized vehicles - E₂; • International and domestic accessibility - E₃.
Environment - F [18,19]	<ul style="list-style-type: none"> • Going to consider sustainability - F₁; • Environment protection and quality monitoring - F₂; • Recycling in cities - F₃;

	<ul style="list-style-type: none"> • Using renewable energy - F₄; • Building smart, energy-efficient facilities - F₅; • The reduction in energy use brought on by modern technologies - F₆; • Natural resource management and preservation - F₇.
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3. METHODOLOGY

In this study, triangular and trapezoidal fuzzy numbers are employed while applying the Fuzzy Analytic Hierarchy Process (FAHP) approach [20,21] in addition to the crisp numbers used in the Analytic Hierarchy Process (AHP) method [22-24].

The fuzzy number is a unique fuzzy set $F = \{(x, \mu_F(x)), x \in \mathbb{R}\}$, where $\mu_F(x): \mathbb{R} \rightarrow [0, 1]$ is a continuous function. The denotation for the triangular fuzzy number (TFN) $\tilde{T} = (l, m, u)$ and the membership function for TFN is [21]:

$$\mu_F(x) = \begin{cases} \frac{x-l}{m-l}, & x \in (l, m) \\ \frac{u-x}{u-m}, & x \in (m, u) \\ 0, & \text{otherwise.} \end{cases} \quad (1)$$

Trapezoidal fuzzy number (TrFN) indicated by $\tilde{M} = (l, m^l, m^h, u)$ are utilized in the trapezoidal FAHP algorithm [24]. The associated membership function is now:

$$\mu_F(x) = \begin{cases} \frac{x-l}{m^l-l}, & x \in (l, m^l) \\ 1, & x \in (m^l, m^h) \\ \frac{u-x}{u-m^h}, & x \in (m^h, u) \\ 0, & \text{otherwise.} \end{cases} \quad (2)$$

The rules of operations for two chosen randomly trapezoidal fuzzy numbers, $\tilde{M}_1 = (l_1, m_1^l, m_1^h, u_1)$ and $\tilde{M}_2 = (l_2, m_2^l, m_2^h, u_2)$, are like in [25]:

Table 2. The laws for operations for an arbitrary two trapezoidal fuzzy numbers

Operation	Expression
Addition	$\tilde{M}_1 \oplus \tilde{M}_2 = (l_1 + l_2, m_1^l + m_2^l, m_1^h + m_2^h, u_1 + u_2)$
Subtraction	$\tilde{M}_1 \ominus \tilde{M}_2 = (l_1 - u_2, m_1^l - m_2^h, m_1^h - m_2^l, u_1 - l_2)$
Multiplication	$\tilde{M}_1 \odot \tilde{M}_2 = (l_1 \cdot l_2, m_1^l \cdot m_2^l, m_1^h \cdot m_2^h, u_1 \cdot u_2)$
Division	$\tilde{M}_1 \oslash \tilde{M}_2 = (l_1/u_2, m_1^l/m_2^h, m_1^h/m_2^l, u_1/l_2)$
Scalar multipl.	$k\tilde{M}_1 = (kl_1, km_1^l, km_1^h, ku_1)$

nth root	$\sqrt[n]{\widetilde{M}_1} = \left(\sqrt[n]{l_1}, \sqrt[n]{m_1^l}, \sqrt[n]{m_1^h}, \sqrt[n]{u_1} \right)$
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The trapezoidal fuzzy number becomes the triangular fuzzy number if $m^l = m^h$. Similar definitions apply to the operations for triangular fuzzy numbers. Fuzzy set $G = \{(x, u), \mu_G(x, u) \mid \forall x \in X, \forall u \in I_x \in [0, 1], 0 \leq \mu_G(x, u) \leq 1\}$ is the definition of a type-2 fuzzy number (T2FN), where I_x signifies an interval in $[0, 1]$. See more about interval mathematics [26, 27]. When the membership function is $\mu_G(x, u) = 1$, interval type-2 fuzzy number (IT2FN) is a special case of T2FN. Trapezoidal IT2FN is

$$\widetilde{M} = \left(\left(\widetilde{M}^U; H_1(\widetilde{M}^U), H_2(\widetilde{M}^U) \right), \left(\widetilde{M}^L; H_1(\widetilde{M}^L), H_2(\widetilde{M}^L) \right) \right), \quad (3)$$

where $\widetilde{M}^U = (l^U, (m^l)^U, (m^h)^U, u^U)$ and $\widetilde{M}^L = (l^L, (m^l)^L, (m^h)^L, u^L)$ are trapezoidal fuzzy numbers, while $H_1(\widetilde{M}^U), H_2(\widetilde{M}^U), H_1(\widetilde{M}^L)$ and $H_2(\widetilde{M}^L) \in [0, 1]$, are left and right heights of the upper and lower trapezoid, respectively. Arithmetical operations for two trapezoidal IT2FNs are:

Table 3. The laws for operations for an arbitrary two trapezoidal fuzzy numbers

Operations for two trapezoidal numbers	
$\widetilde{M}_1 \oplus \widetilde{M}_2 =$	$\left(\left(\widetilde{M}_1^U \oplus \widetilde{M}_2^U; \min(H_1(\widetilde{M}_1^U), H_1(\widetilde{M}_2^U)), \min(H_2(\widetilde{M}_1^U), H_2(\widetilde{M}_2^U)) \right), \right. \\ \left. \left(\widetilde{M}_1^L \oplus \widetilde{M}_2^L; \min(H_1(\widetilde{M}_1^L), H_1(\widetilde{M}_2^L)), \min(H_2(\widetilde{M}_1^L), H_2(\widetilde{M}_2^L)) \right) \right)$
$\widetilde{M}_1 \ominus \widetilde{M}_2 =$	$\left(\left(\widetilde{M}_1^U \ominus \widetilde{M}_2^U; \min(H_1(\widetilde{M}_1^U), H_1(\widetilde{M}_2^U)), \min(H_2(\widetilde{M}_1^U), H_2(\widetilde{M}_2^U)) \right), \right. \\ \left. \left(\widetilde{M}_1^L \ominus \widetilde{M}_2^L; \min(H_1(\widetilde{M}_1^L), H_1(\widetilde{M}_2^L)), \min(H_2(\widetilde{M}_1^L), H_2(\widetilde{M}_2^L)) \right) \right)$
$\widetilde{M}_1 \odot \widetilde{M}_2 =$	$\left(\left(\widetilde{M}_1^U \odot \widetilde{M}_2^U; \min(H_1(\widetilde{M}_1^U), H_1(\widetilde{M}_2^U)), \min(H_2(\widetilde{M}_1^U), H_2(\widetilde{M}_2^U)) \right), \right. \\ \left. \left(\widetilde{M}_1^L \odot \widetilde{M}_2^L; \min(H_1(\widetilde{M}_1^L), H_1(\widetilde{M}_2^L)), \min(H_2(\widetilde{M}_1^L), H_2(\widetilde{M}_2^L)) \right) \right)$
$\widetilde{M}_1 \oslash \widetilde{M}_2 =$	$\left(\left(\widetilde{M}_1^U \oslash \widetilde{M}_2^U; \min(H_1(\widetilde{M}_1^U), H_1(\widetilde{M}_2^U)), \min(H_2(\widetilde{M}_1^U), H_2(\widetilde{M}_2^U)) \right), \right. \\ \left. \left(\widetilde{M}_1^L \oslash \widetilde{M}_2^L; \min(H_1(\widetilde{M}_1^L), H_1(\widetilde{M}_2^L)), \min(H_2(\widetilde{M}_1^L), H_2(\widetilde{M}_2^L)) \right) \right)$
$k\widetilde{M}_1 =$	$\left(\left(k\widetilde{M}_1^U; H_1(\widetilde{M}_1^U), H_2(\widetilde{M}_1^U) \right), \left(k\widetilde{M}_1^L; H_1(\widetilde{M}_1^L), H_2(\widetilde{M}_1^L) \right) \right)$

$${}^n\sqrt{\tilde{M}_1} = \left(\left({}^n\sqrt{\tilde{M}_1^U}; H_1(\tilde{M}_1^U), H_2(\tilde{M}_1^U) \right), \left({}^n\sqrt{\tilde{M}_1^L}; H_1(\tilde{M}_1^L), H_2(\tilde{M}_1^L) \right) \right)$$

The linguistic definitions of triangular and trapezoidal fuzzy numbers and triangular and trapezoidal IT2FNs are provided in Tables 4 and Table 5.

Table 4. Crisp value, TFN and TrFN with linguistic variables

Crisp Value	TFN	TrFN	Linguistic variables (LV) and denotation
1	(1,1,3)	(1,1,1,3)	Equally important (E)
2	(1,2,3)	(1,1.5,2.5,3)	Equally to weakly important(EW)
3	(1,3,5)	(1,2,4,5)	Weakly important (W)
4	(3,4,5)	(3,3.5,4.5,5)	Weakly to strong important (WS)
5	(3,5,7)	(3,4,6,7)	Strong important (S)
6	(5,6,7)	(5,5.5,6.5,7)	Strong to very strongly important (SV)
7	(5,7,9)	(5,6,8,9)	Very strongly important (V)
8	(7,8,9)	(7,7.5,8.5,9)	Very strongly to absolutely important (VA)
9	(7,9,9)	(7,9,9,9)	Absolutely important (A)

Table 5. Definition of interval type-2 fuzzy scale of the linguistic variables for the triangular and trapezoidal IT2FN in IT2FS (Interval type-2 fuzzy set)

Triangular interval type-2 fuzzy scale		Trapezoidal interval type-2 fuzzy scale		LV
(1,1,3;1)	(1,1,2;0.9)	(1,1,1,3;1,1)	(1,1,1,2;0.9,0.9)	E
(1,2,3;1)	(1.5,2,2.5;0.9)	(1,1.5,2.5,3;1,1)	(1.5,1.75,2.25,2.5;0.9,0.9)	EW
(1,3,5;1)	(2,3,4;0.9)	(1,2,4,5;1,1)	(2,2.5,3.5,4;0.9,0.9)	W
(3,4,5;1)	(3.5,4,4.5;0.9)	(3,3.5,4.5,5;1,1)	(3.5,3.75,4.25,4.5;0.9,0.9)	WS
(3,5,7;1)	(4,5,6;0.9)	(3,4,6,7;1,1)	(4,4.5,5.5,6;0.9,0.9)	S
(5,6,7;1)	(5.5,6,6.5;0.9)	(5,5.5,6.5,7;1,1)	(5.5,5.75,6.25,6.5;0.9,0.9)	SV
(5,7,9;1)	(6,7,8;0.9)	(5,6,8,9;1,1)	(6,6.5,7.5,8;0.9,0.9)	V
(7,8,9;1)	(7.5,8,8.5;0.9)	(7,7.5,8.5,9;1,1)	(7.5,7.75,8.25,8.5;0.9,0.9)	VA
(7,9,9;1)	(8,9,9;0.9)	(7,9,9,9;1,1)	(8,9,9,9;0.9,0.9)	A

In comparison matrices $A = (a_{ij})_{i=\overline{1,n}}$, a_{ij} is a crisp number in the AHP method or corresponding triangular fuzzy number \tilde{T} , trapezoidal fuzzy number \tilde{M} (in FAHP) triangular $\tilde{\tilde{T}}$, and trapezoidal $\tilde{\tilde{M}}$ (in FAHP with IT2FS). The averaging approach is used to calculate the sum of various experts' viewpoints. The consistency ratio $CR = \frac{CI}{RI}$ and

consistency index $CI = \frac{\lambda_{max} - n}{n-1}$ are then calculated. The maximal eigenvalue of the comparison crisp matrix A is represented by the value λ_{max} . The matrix's dimension is n , and RI is the known random index. If $CR < 0.1$, the comparison matrix is consistent and the estimates of the relative importance of the criteria are counted as acceptable. For assigned a_{ij} the geometric mean of each row is calculated as follows:

$$r = [a_{11} \odot a_{12} \odot \dots \odot a_{1n}]^{\frac{1}{n}}, i = \overline{1, n} \quad (4)$$

According to that, fuzzy weights of each criterion are obtained

$$w_j = r \odot [r_1 \oplus r_2 \oplus \dots \oplus r_n]^{-1}, j = \overline{1, n}. \quad (5)$$

The center area approach is used to obtain the defuzzified values in the FAHP procedures. In the case of triangular fuzzy number $\tilde{T} = (l, m, u)$, the defuzzified value is $\frac{1}{4}(l + 2m + u)$. When $\tilde{M} = (l, m^l, m^h, u)$ is a trapezoidal fuzzy number, the defuzzified value is $\frac{1}{4}(l + m^l + m^h + u)$. For the triangular IT2FN, denoted by $\tilde{\tilde{T}}$, the defuzzified value is $\frac{1}{8}(l^u + u^u + l^l + u^l + 2H(\tilde{T}^u)m^u + 2H(\tilde{T}^l)m^l)$ and for the trapezoidal IT2FN, denoted by $\tilde{\tilde{M}}$ the defuzzified value is $\frac{1}{8}(l^u + u^u + l^l + u^l + H(\tilde{M}^u)((m^l)^u + (m^r)^u) + H(\tilde{M}^l)((m^l)^l + (m^r)^l))$.

4. RESULTS

In this part, we've used the above-described techniques to compare fuzzy matrices of expert-sourced criteria and sub-criteria. One can conclude that all comparison matrices are consistent (Table 6 – Table 8).

Table 6. Evaluation matrices of main criteria and sub-criteria C, (CI= 0.00827004, CR= 0.00666939; CI= 0.0289418, CR= 0.0233402)

	A	B	C	D	E	F
A	E	EW	W	W	WS	WS
B	1/EW	E	EW	EW	W	W
C	1/W	1/W	E	EW	EW	EW
D	1/W	1/EW	1/E	E	EW	EW
E	1/WS	1/W	1/EW	1/EW	E	E
F	1/WS	1/W	1/EW	1/EW	1/E	E
	C1	C2	C3	C4	C5	C6
C1	E	EW	W	W	S	V
C2	1/EW	E	EW	EW	WS	SV
C3	1/W	1/EW	E	E	W	S
C4	1/W	1/EW	1/E	E	W	S

C5	1/S	1/WS	1/W	1/W	E	W
C6	1/V	1/SV	1/ S	1/S	1/W	E

Table 7. Evaluation matrices of sub-criteria A and E (CI= 0.0034543, CR= 0.00383811; CI= 0.00914735, CR= 0.0157713)

	A ₁	A ₂	A ₃	A ₄
A ₁	E	EW	W	W
A ₂	1/ EW	E	EW	EW
A ₃	1/W	1/EW	E	EW
A ₄	1/W	1/ EW	1/EW	E
	E ₁	E ₂	E ₃	
E ₁	E	EW	WS	
E ₂	1/EW	E	W	
E ₃	1/WS	1/W	E	

Table 8. Evaluation matrices of sub-criteria B, D and F (CI= 0.0140206, CR= 0.0099437; CI= 0.014781, CR= 0.0111977; CI= 0.0280297, CR= 0.0212346)

	B ₁	B ₂	B ₃	B ₄	B ₅	B ₆	B ₇
B ₁	E	EW	EW	W	WS	WS	S
B ₂	1/ EW	E	E	EW	W	W	WS
B ₃	1/ EW	1/E	E	EW	EW	WI	WS
B ₄	1/W	1/ EW	1/ EW	E	EW	EW	W
B ₅	1/WS	1/W	1/W	1/EW	E	E	EW
B ₆	1/WS	1/W	1/W	1/EW	1/E	E	EW
B ₇	1/S	1/WS	1/WS	1/W	1/EW	1/EW	E
	D ₁	D ₂	D ₃	D ₄	D ₅	D ₆	D ₇
D1	E	EW	EW	W	WS	S	S
D2	1/EW	E	E	EW	W	WS	WS
D3	1/EW	1/E	E	EW	EW	WS	WS
D4	1/W	1/EW	1/EW	E	EW	W	W
D5	1/WS	1/W	1/W	1/EW	E	EW	EW
D6	1/S	1/WS	1/WS	1/W	1/EW	E	E
D7	1/S	1/WS	1/WS	1/W	1/EW	1/E	E
	F1	F2	F3	F4	F5	F6	F7
F1	E	EW	W	W	WS	S	V

F2	1/EW	E	EW	EW	W	WS	SV
F3	1/W	1/EW	E	E	EW	WS	S
F4	1/W	1/EW	1/E	1/E	EW	W	S
F5	1/WS	1/W	1/EW	1/EW	E	EW	WS
F6	1/S	1/WS	1/W	1/W	1/EW	E	W
F7	1/V	1/SV	1/S	1/S	1/WS	1/E	E

The weights of key indicators obtained using the AHP method, triangular FAHP, triangular IT2FS, trapezoidal FAHP, and trapezoidal IT2FS as a fuzzy logic method are in Fig. 1.

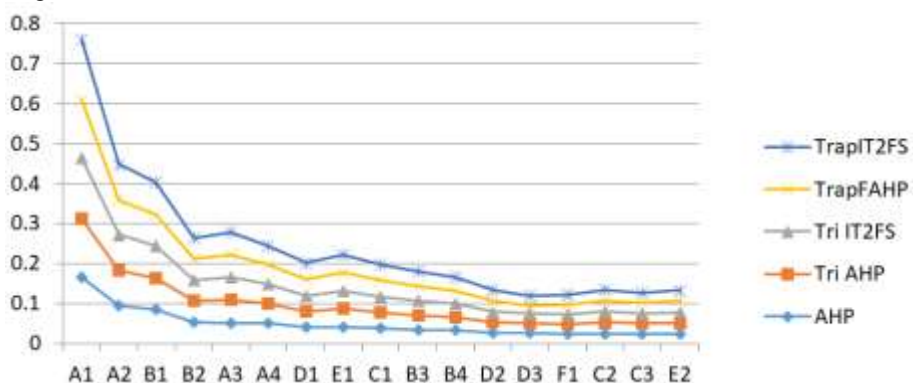


Fig. 1. Weights of key indicators for smart city

3. CONCLUSION

Rigorous changes in the way of life in cities, which are happening every day, have made us think of ways to build a more sustainable society that can resist the rapid development of our environment. The task was to provide a theoretical overview of current scientific insights into the development and application of the Smart City concept, developing a discussion of a possible obstacle. In terms of applied methodology, the contribution lies in the comparative application of AHP methods, triangular and trapezoidal FAHP methods, and the corresponding hybrid IT2FS methods in the Smart City development field. Based on six criterion groups and thirty-five sub-criteria, the dominant indicators were the development of a legislative and strategic framework of the smart city platform and its implementation in pandemic circumstances, standardization of ICT and ICT management, entrepreneurship and innovation, public-private stakeholder partnership with active citizen's participation and higher data openness and transparency. This research could be the basis for further research efforts relying on results related to the key indicators.

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BIOPLIN KAO ENERGETSKI RESURS

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SAŽETAK:

Biomasa je obnovljivi izvor energije, koji kao biljna masa bez obzira kako je dobijena; uzgojom, prikupljanjem na stočnim farmama ili izrasla divlje, predstavlja značajan obnovljivi izvor energije, sa oko 70 miliona tona godišnje produkcije i oko 1800 milijardi tona postojeće biomase na Zemljinoj površini. Procjenjuju se ukupni energetske potencijali globalne godišnje produkcije biomase na 2.740 Quad¹ (1Quad = 10¹⁶ Btu=1,055 10¹⁹ J). Prema tome, produkcija biomase oko osam puta je veća od procjenjene ukupne svjetske potrošnje energije iz svih resursa (oko 340 Quad. Biomasa je organska tvar koja nastaje rastom bilja i drugih živih organizama. Od svih obnovljivih izvora energije, najveći doprinos u budućnosti se očekuje od biomase. Od biomase se mogu proizvoditi obnovljivi izvori energije kao što su bioplin, biodizel, biobenzin (etanol), a suha masa se melje u sitne komadiće pelete, koji se spaljuju i troše za proizvodnju toplotne i električne energije. Bioplin se može koristiti za dobivanje električne energije, grijanje vode i prostora, te u industrijskim procesima. U radu će biti prikazan primjer bioplina koji se koristi za proizvodnju električne energije i grijanja na jednom poljoprivrednom dobru „Spreča“ u BiH.

Ključne riječi: biomasa, bioplin, električna energija, poljoprivredno dobro.

1.UVOD

Biomasa je obnovljivi izvor energije, koji kao biljna masa bez obzira kako je dobijena: uzgojom, prikupljanjem na stočnim farmama ili izrasla divlje, predstavlja značajan obnovljivi izvor energije, sa oko 70 miliona tona godišnje produkcije i oko 1800 milijardi tona postojeće biomase na Zemljinoj površini. (1)

Na osnovu podataka; *The U.S.Department of Energy's National Renewable Energy Laboratory* (2) procjenjuju se ukupni energetske potencijali globalne godišnje produkcije biomase na 2.740 Quad¹ (1Quad = 10¹⁶ Btu=1,055 10¹⁹ J). Prema tome, produkcija biomase oko osam puta je veća od procjenjene ukupne svjetske potrošnje energije iz svih resursa (oko 340 Quad).(3)

Trenutno, svjetsko stanovništvo troši samo oko 7% produkcije biomase, dok je njeno učešće u globalnom energetske bilansu oko 17%, s tim da treba uzeti u obzir činjenicu

da biomasa predstavlja osnovu energetskeg bilansa nerazvijenih zemalja Azije i Afrike, te da je ovako visok udio biomase u ukupnom globalnom energetskeg bilansu direktna posljedica te činjenice.

Prema Direktivi EU 2018/2001 (4), o afirmiranju upotrebe energije iz obnovljivih izvora energije, biomasa je definisana kao: "biorazgradivi dio proizvoda, otpada i ostataka biološkog porijekla iz poljoprivrede (uključujući i tvari biljnog i životinjskog porijekla), šumarstva i sa njim povezanih djelatnosti uključujući; ribarstvo i akvakulturu te biorazgradivi udio komunalnog i gradskog otpada". To je npr. ogrijevno drvo, grane i drveni otpad iz šumarstva, kora i drveni ostatak iz industrije, slama, kukuruzovina, stabljika biljke, životinjski izmet i ostaci iz stočarstva, komunalni i industrijski otpad. Biomasa općenito se može razvrstati u tri kategorije prema vrsti otpada:

- a) šumska ili drvna biomasa (otpad iz šumarstva i drvne industrije),
- b) nedrvna bio masa (otpad iz poljoprivrede, energetske nasadi) i
- c) biomasa životinjskog porijekla (životinjski otpad i ostaci).

2.BIOPLIN

Biomasa je organska tvar koja nastaje rastom bilja i drugih živih organizama. Od biomase se mogu proizvoditi obnovljivi izvori energije kao što su bioplin, biodizel, biobenzin (etanol), a suha masa se melje u sitne komadiće, pelete, koji se spaljuju i troše za proizvodnju toplote i električne energije.

Bioplin je zapaljivi plin bez boje, čiji miris podsjeća na jaja (bez obzira što je uklonjen H₂S), a nastaje razgradnjom organskog materijala u anaerobnim uvjetima (6). Ubraja se u alternativna goriva. Ekološki je prihvatljiv i relativno povoljan energent, koji se može koristiti za proizvodnju električne i toplinske energije u plinskim turbinama te kao gorivo u transportu. Kao sirovina za proizvodnju bioplina koriste se životinjski otpad, stajski gnoj, otpadna jestiva ulja, kao i neki prehrambeni proizvodi, koji više nisu za upotrebu (istek roka i sl.), kanalizacijski mulj i dr. (7)

Bioplin se dobiva anaerobnom razgradnjom ili fermentacijom organskih tvari, uključujući gnojivo, kanalizacijski mulj, komunalni otpad ili bilo koji drugi biorazgradivi otpad. Sastoji se uglavnom od metana i ugljikovog dioksida. Bioplin je smjesa plinova koji se može dobiti iz svake biomase. Može se koristiti kao pogonsko gorivo za vozila, a njegovim prečišćavanjem može se dobiti plin čist kao prirodni.

Bioplin se može koristiti za dobivanje električne energije, grijanje vode i prostora, te u industrijskim procesima. Ako se komprimira, može zamijeniti prirodni plin koji se koristi u automobilima .

U radu će biti prikazan i primjer dobivanja bioplina koji se koristi za proizvodnju električne energije i grijanja na jednoj stočnoj fami u BiH .

Bioplin se uglavnom sastoji od metana (50-75%) i ugljen dioksida (20-25%) dok manji udio čine spojevi: vodonik, azot, vodena para i sumpor vodonik. Treba napomenuti da iznosi pojedinih procentualnih udjela ovisi o sirovini i uvjeta u kojima se odvija proces anaerobne digestije (6)

Tabela 1. Prikaz sastava bioplina u ovisnosti o komponentama koje ulaze u process (Korbag i saradnici, 2020)

SPOJ	HEMIJSKI SIMBOL	PROCENTUALNI UDIO (%)
Metan	CH ₄	50-75
Ugljik dioksid	CO ₂	25-50
Vodena para	H ₂ O	5-10
Kiseonik	O ₂	<2
Azot	N ₂	<10
Amonijak	NH ₃	<1
Vodonik	H ₂	<1
Sumporvodonik	H ₂ S	<3

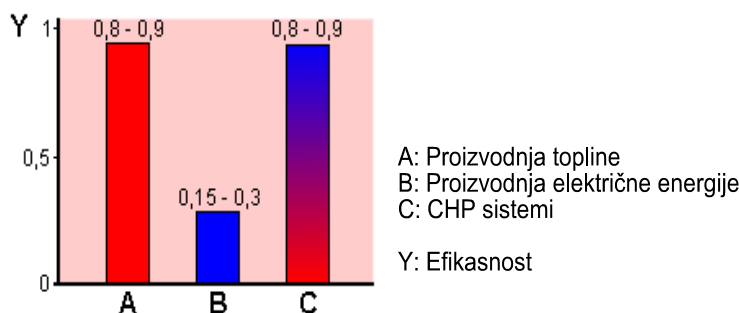
2.1. Energetski sistemi

Konačni produkt energetskih sistema projektovanih i izgrađenih na bazi termičkog tretmana biomase jeste energija u svojim različitim pojavnim oblicima. Oblik u kome će se energija isporučivati potrošaču prvenstveno je ovisan o potrebama tog potrošača i njegovim mogućnostima da tu energiju iskoristi na što je moguće efikasniji način.

Svi aktualno funkcionalni energetski sistemi ovog tipa, na osnovu oblika svog konačnog produkta, energije, mogu se klasificirati u jednu od narednih kategorija:

- Sistemi za proizvodnju isključivo toplinske energije,
- Sistemi za proizvodnju isključivo električne energije,
- Sistemi za simultanu proizvodnju električne i toplinske energije (CHP sistemi).

Ono po čemu se suštinski razlikuju ove tri kategorije sistema, jeste njihova efikasnost u pogledu iskorištenja toplinske moći goriva, što je pokazano na slici 1.



Slika 1. Energetski sistemi (Izvor; Energija i okolina , Donlagić,2006.g)

2.2. Proizvodnja bioplina

Biopliniska postrojenja mogu varirati svojim kapacitetom, veličinom i dizajnom, ali je princip rada sličan u svim postrojenjima. Tipsko bioplinisko postrojenje se sastoji od sljedećih jedinica:

- a) prihvatne jedinice,
- b) dijela za kondicioniranje sirovine i skladišni prostor,
- c) glavnog dijela postrojenja tj. fermentora (digestor),
- d) spremnika za bioplin i digestat te
- e) kontrolne jedinice.

Primjer jednog takvog postrojenja prikazan je na slici 2.

U ovisnosti od sadržaja suhe tvari u supstratu razlikujemo "mokru" i "suhu digestiju". Proces anaerobne digestije može se odvijati kontinuirano ili obročno. Sirovine koje ulaze u proces anaerobne digestije iz kojeg se dobiva bioplin su raznovrsne, a u ovisnosti od njihovog odnosa ovisit će i udio metana u proizvedenom bioplinu.

Bioplinisko postrojenje prikazano je na slici 2, dok je šematski proces dobivanja bioplina prikazan je na slici 3.



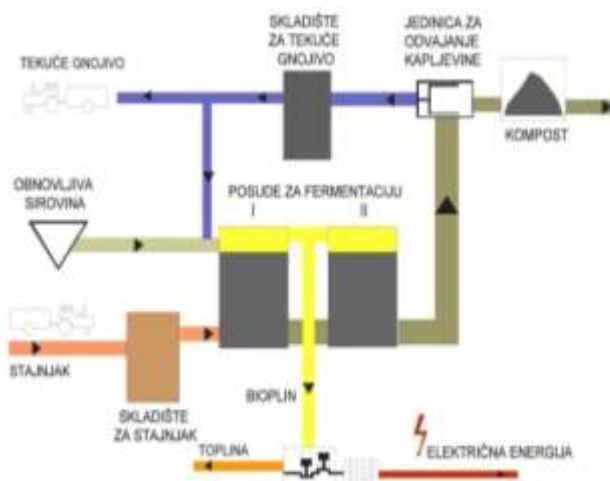
Slika 2. Snimak postrojenja za anaerobnu digestiju (Wikipedia, Anaerobna digestija)



Slika 3. Šema interakcije nutrijenata u nutry2cycle projektu (Izvor;nutry2cycle.eu)

2.3. Primjena bioplina

Prvi primjeri dobivanja i korištenja bioplina datiraju iz 10. vijeka prije Krista na području Asirije, gdje je dobiveni plin korišten za zagrijavanje vode. Nakon 18. vijeka je počelo intenzivnije istraživanje bioplina i njegovih svojstva te ga se predlagalo za korištenje kao energenta za uličnu rasvjetu, a kako se danas bioplin može koristiti i za druge energetske potrebe čini ga zaista značajnim i vrlo upotrebljivim energentom pred kojim je zaista značajna budućnost.



Slika 4. Osnovna šema bioplinskog postrojenja(Izvor; www.menea.hr.2013.g.)

3.KOGENERACIJA

Zbog visokog udjela metana smatra se alternativnim gorivom i mogao bi biti zamjena za prirodni plin te na taj način doprinijeti smanjenju emisija stakleničkih plinova i osigurati opskrbu energijom u EU koja većinu svojih potreba za plinom zadovoljava iz uvoza. Primjena bioplina ima brojne prednosti u odnosu na fosilna goriva, jer doprinosi: zaštiti okoliša, „zelenom“ energetske sektoru, učinkovitom gospodarenju otpadom i dr.

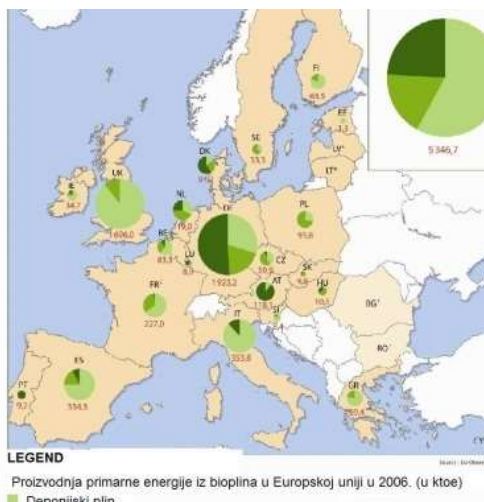
Upotreba bioplina koristi se uglavnom za proizvodnju električne energije, toplinske energije, odnosno za njihovu kombiniranu proizvodnju (kogeneracija, engl. Combined Heat and Power, CHP), a ukoliko je dehidriran i pročišćen od H_2S i CO_2 , koristi se i kao gorivo u transportu. Iako je upotreba bioplina zaista višestruka smatra se da je njegova

upotreba u CHP postrojenjima najefikasnija. Upotreba bioplina u kogeneracijskim postrojenjima za proizvodnju toplinske i električne energije smatra se visoko efikasnim postupkom. Dobivena električna energija se može koristiti za pogon postrojenja i na taj način postiže se energetska neovisnost. No, često se u slučaju, kada je propisana povlašćena cijena za otkup električne energije iz OIE, proizvedena električna energija predaje u mrežu, a iz mreže se preuzima električna energija po nižoj cijeni. Potrebno je istaći da proizvodnja bioplina kao i njegova upotreba u EU stalno raste i posebno se ističe njegova proizvodnja kogeneracijskim postupkom. To se jasno vidi na slikama 5. i 6.



Slika 5. Proizvodnja energije iz biogasa u EU u 2007.g.(ktoe) (Izvor literaturni navod , 12)

- 2007. = 5901,2 ktoe
- Dominira deponijski plin...
- Njemačka: električna i toplinska energija, energent (poput prirodnog plina)
- Švedska: energent, gorivo za vozila, električna i toplinska energija
- Zajedno sa politikom zbrinjavanja otpada



Slika 6. Proizvodnja primarne energije iz bioplina u Eu u 2006.g. (ktoe) (Izvor literaturni navod,12)

Na slikama je jasno pokazano koliko se električne i toplinske energije više dobije u procesu kogeneracije u elektranama nego procesu proizvodnje električne energije u elektranama ili toplinske toplanama (slika 5.) dok se na slijedećoj slici vidi koliko je proizvedeno primarne energije u EU u 2006.g.(6) u ktoe. Time se jasno potvrđuje perspektiva proizvodnje i korištenja bioplina.

4. PROIZVODNJA ENERGIJE IZ BIOPLINA NA POLJOPRIVREDNOM DOBRU „SPREČA“ U KALESIJI

Primarna djelatnost farme Spreča u Kalesiji je proizvodnja svježeg kravljeg mlijeka a od nedavno su pokrenuli i proizvodnju električne energije koja se temelji na organskom otpadu, odnosno, biogasu koji nastaje od kukuruzne silaže te goveđeg i pilećeg stajnjaka. Ovo nije jedinstveni projekat proizvodnje energije nego se temelji na pozitivnim iskustvima u sličnim proizvodnjama širom svijeta .

Postrojenje je nedavno dobilo odobrenje od Regulatorne agencije Federacije Bosne i Hercegovine (FERK) za proizvodnju električne energije.

U krugu pomenute firme instalirano je postrojenje za proizvodnju električne energije iz biogasa, a koji se dobija iz različitih sirovina kao što je naprijed navedeno.

Navedene sirovine se prema određenim recepturama ubacuju u jamu za mješanje te se putem pumpe prebacuju u fermentor gdje se stvara biogas koji se producira prema CHP jedinicama. U procesu njegovog sagorjevanja nastaje električna energija. Tačnije, proces počinje u jami za miješanje u koju se ubacuje silaža, te goveđi i pileći stajnjak. Nakon

miješanja, smjesa se prebacuje u fermentore, gdje se odvija prirodna reakcija anaerobne digestije te se potom izdvaja bioplin, koji se odvodi prema agregatima koji pokreću generatore te nastaje proces proizvodnje električne energije.

Proizvodni proces je u potpunosti siguran za okolinu jer nema emisije CO₂ u okolinu. U slučaju prestanka rada motora iz bilo kog razloga u krugu postrojenja je instalirana baklja koja služi za spaljivanje plina u slučaju incidenta. Postrojenje je kapacitirano na proizvodnju 600 kilovata po satu a sastoji se od četiri motora kapaciteta 150 kilovata po satu. Predviđeno vrijeme rada fermentora je osam hiljada sati na godišnjem nivou. Količina proizvedene struje i isporučene struje pokriva troškove proizvodnje. Trenutno proizvedena električna energija u postrojenje se ne koristi na farmi nego se isporučuje distributeru. Tokom procesa proizvodnja električne energije nastaje i toplotna energija koju je moguće koristiti u objektima na farmi (u stakleničkoj proizvodnji i dr.). Cijeli proces je automatiziran kojim se upravlja iz kontrolne sobe. Potrebe postrojenja za proizvodnju bioplina zadovoljavaju raspoložive sirovine a postrojenje je u pogonu 24 sata (11).



Slika 7. Instalirano postrojenje (Izvor :Klix.ba)



Slika 8. Rezervoari plina



Slika 9. Postrojenje, transportni sistemi



Slika 10. Transportni sistemi



Slika 11: Kontrolna soba iz koje se upravlja procesom

Ovakav primjer zaokruženog proizvodnog procesa na farmi P.D. Spreča je primjer dobre prakse korištenja otpadnih materijala iz primarne proizvodnje za proizvodnju bioplina, koji je, sopstveni, pogonski energent za sve dijelove proizvodnog procesa, od čega se dio ovako proizvedene električne energije isporučuje i u električnu mrežu.

5. ZAKLJUČAK

Promjene na svjetskoj razini su slojevite snažne i nepovratne. Osjeti se to svuda i na okolinskom stanju a posebno dolazi do izražaja kada govorimo o energiji. Činjenica je da energija više nikada neće biti jeftina kao i da će je na svjetskom tržištu iz raznih razloga biti sve manje. Da je stanje izuzetno ozbiljno, upozoravajuće i da poziva na potpune promjene ponašanja prema energentima svih vrsta je neosporna činjenica koja se potvrđuje u svakodnevnom životu a tome svakako snažan pečat daje i agresija Rusije na Ukrajinu. Evropa je energetske ugrožena što za sobom povlači niz izazovnih postupaka ali i cijeli svijet se našao u situaciji da je do energenata teško doći i da njihova cijena predstavlja teret za brojne zemlje. Takvi negativni procesi dovode do povećanje inflacije, recesije, globalne energetske krize i ugrožavanja dosadašnjeg načina života i proizvodnih procesa. Dakle, cijeli svijet se preispituje i nastoji prilagoditi novim i složenim okolnostima kako bi u procesima promjene našao rješenje za očuvanje stabilnosti održivih uvjeta funkcioniranja i životnog standarda.

Prema Direktivi EU 2018/2001 promovisanje obnovljivih izvora energije (OIE) ima ključnu ulogu u opskrbi energijom po pristupačnim cijenama, smanjuje ovisnost o uvozu, potiče tehnološki razvoj i inovativnost te time stavlja Europu na vodeću poziciju u sektoru proizvodnje energije iz OIE. (12) Također se pri prelasku na OIE osiguravaju održivi ekološki, zdravstveni i društveni doprinosi te se omogućava veća zaposlenost u ruralnim dijelovima, koji su često slabo naseljeni, što je slučaj u većini zemalja u našem okruženju. Iako bioenergija često nailazi na prepreke, smatra se važnim intenziviranje korištenja OIE, te se očekuje da će bioplin imati bitnu ulogu u postizanju zadanih energetskih i okolinskih ciljeva do 2050. Godine.

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BIOGAS AS AN ENERGY RESOURCE

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ABSTRACT:

Biomass is a renewable source of energy, which, as plant mass, does not matter how it was obtained; cultivated, collected on livestock farms or grown wild, represents a significant renewable energy source, with about 70 million tons of annual production and about 1800 billion tons of existing biomass on the Earth's surface. Based on the data; Estimates the total energy potential of global annual biomass production at 2,740 Quad¹ (1Quad = 1016 Btu=1,055 x 10¹⁹ J). Therefore, biomass production is about eight times higher than the estimated total world consumption of energy from all resources (about 340 Quad). Biomass is organic matter that is created by the growth of plants and other living organisms. Of all renewable energy sources, biomass is expected to make the biggest contribution in the future. Renewable energy sources such as biogas, biodiesel, biogasoline (ethanol) can be produced from biomass, and the dry mass is ground into small pieces of pellets, which are burned and used to produce heat and electricity. Biogas can be used to obtain electricity, water and space heating, and in industrial processes. The paper will present an example of the use of biogas from a cattle farm, which is used for the production of electricity and heating on agricultural property "Spreča" in Bosnia and Herzegovina.

Keywords: Biomass, bioplin, electricity, agricultural property

THERMO-HYDRAULIC PERFORMANCE OF A SOLAR DOMESTIC WATER HEATER

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ABSTRACT:

Solar collectors are very important for the thermal utilization of solar energy in low-temperature conditions. In order to determine the optimal constructive and operating parameters of a solar domestic water heating system, a parametric dynamic simulation using the System Advisor Model simulation tool was developed. The analyzed solar system consists of flat collectors, a water storage tank, a heat exchanger, and a source of auxiliary energy. The developed model enables simulation of system operation and determination of appropriate thermo-hydraulic characteristics of the solar system. In this research, data from the typical meteorological year for Kragujevac, Serbia, is used to perform parametric simulation. The optimal size of collector areas, storage water tank volume, delivery water temperature, and average daily hot water consumption effects on the annual solar fraction were evaluated using the developed simulation model. Results show the optimal parameters of a south-facing solar water domestic heating system, which enable the maximal annual solar fraction for a specified demand.

Keywords: solar water heater, flat plate collector, thermo-hydraulic performance, System Advisor Model, simulation

1. INTRODUCTION

During the last two centuries, energy has been and remains a key factor of economic change and a pillar of economic development in every country. All data and analysis clearly show that humanity's energy needs are increasing day by day, and all forecasts indicate that they will continue to increase. Energy resources are limited, mostly non-renewable, and unevenly distributed. At the end of the last century, the availability and sufficiency of energy, especially oil and its acceptable prices, resulted in humanity turning towards accelerated industrial development without much thought about the implications for other sectors and the environment in general. Today, energy is becoming more expensive due to declining oil production, as most countries have reached their own national peak in oil production. The most successful strategy used to ensure enough energy in the globe is the increased usage of renewable energy sources.

One of the applications of solar energy is in heating processes. For this means, mostly, water-heaters are in use. A solar water heating (SWH) system is a technology that uses solar collectors and concentrators to capture energy from the sun's radiation and use it to heat water for domestic, commercial, or industrial purposes. SWH systems are a renewable energy technology that is free for use, has high potential, and is available all over the world. SWH systems are the most common applications of solar energy utilization systems because they provide environmentally favorable heat for various areas such as household water heating, swimming pool heating, and other areas where hot water is needed [1]. SWH is a clean, reliable, and cost-effective method of harnessing solar energy effectively to satisfy hot water needs. Solar energy is an alternative to conventional water heating energy for different applications, and in the future, due to the increasing demand for energy and the rising cost of fossil fuels, it will be a more focused source of energy. Many countries today use SWH technologies to minimize utility costs in the commercial and residential sectors. With the advancement of technology, SWH systems can be operated efficiently in any geographical area and climatic region in the world.

Solar energy development in Serbia traces back in 1973 following the energy crisis in the world. Solar energy is being researched in Serbia in several university centres. Several private companies produce solar radiation flat-plate collectors with water. The flat-plate collectors for water heating of the domestic or foreign production, vacuum tube collectors and the solar cells of the foreign production are to be found on the Serbian market. Many solar radiation flat-plate collectors with water and a small number of vacuum tube collectors have been installed on the buildings of private houses and community facilities in Serbia [2].

In recent years, many group of researcher focus on theoretical and experimental research of SWH systems using different approaches and methods [3-7]. In this paper, the optimum thermo-hydraulic characteristics of the solar system with a flat plate collector and storage tank were determined using the typical meteorological data for Kragujevac, Serbia. The System Advisor Model (SAM) simulation program was used to model the system for the prediction of a full year's worth of system performance. In this paper, the parametric simulation, which includes the effects of the collector area, the storage tank volume, the daily average delivery temperature, and the average daily hot water consumption on the solar fraction, is presented.

2. MATERIALS AND METHODS

2.1. Solar water system description

The system consists of a solar flat plate collector that has a working fluid glycol which has a mass flow rate m_c , running through it. The fluid in the collector is heated from $T_{f,i}$ at the collector's entrance to $T_{f,o}$ at the collector's exit. The temperature rise across the collector $T_{f,o} - T_{f,i}$ depends on the incident radiation. The fluid enters a heat exchanger after passing through the collector, where it transfers heat to colder water, which has a

mass flow rate of \dot{m}_{draw} . The water heats up and is stored in a tank. The pumps are integrated into the system to force circulation of the working fluid and water. The schematic diagram of the solar water system is shown in Figure 1.

The technical specifications and the performance ratings of the solar collector used in the simulation were taken from the SAM database and given in Table 1. A flat plate collector is designed for applications at moderate temperatures up to 100 °C that use both beam and diffuse solar radiation and does not require any tracking of the sun. A collector is mounted in a stationary position (typically on a roof), and the orientation is set to the best operating position facing south with a solar tilt angle of 39 degrees, and azimuth of 180 degree.

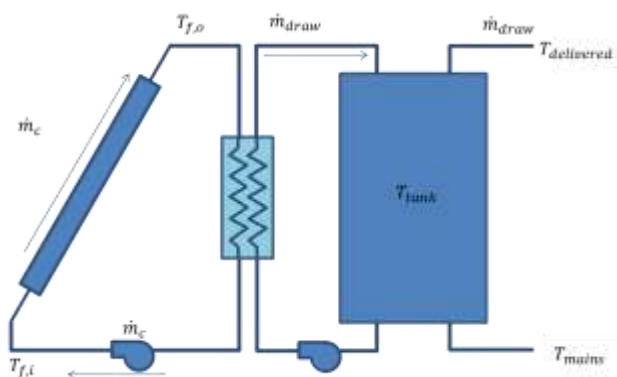


Fig. 1. Schematic diagram of the domestic solar water system

Table 1. Solar collector specification

<i>Bosch Thermotechnology FCC-1S</i>	
Collector type	Glazed flat plate
Test fluid	Water
Test mass flow rate	0.0428 kg/s
Area	2.08 m ²
Absorber area	1.92 m ²
Absorber volume	0,8 liter
Optical efficiency of the collector	0.686
Incidence angle modifier	0.03

2.2. Solar water system simulation

In this study, the National Renewable Energy Laboratory's SAM was used to simulate the transient behavior of the SWH system. SAM's model represents a one-tank glycol system with an auxiliary electric heater. The model estimates the energy savings of using solar water heating system relative to a conventional water heater using a thermodynamic energy balance formulation [8]. The model was developed at the National Renewable Energy Laboratory for SAM.

The thermo-hydraulic characteristics of the solar system are estimated for a set of meteorological parameters for Kragujevac, Serbia (Latitude 44.03° N, Longitude 20.93° E, 180 m from sea level). The daily average variation of the global and diffuse irradiance (W/m^2) at the collector location are given at Figure 2.

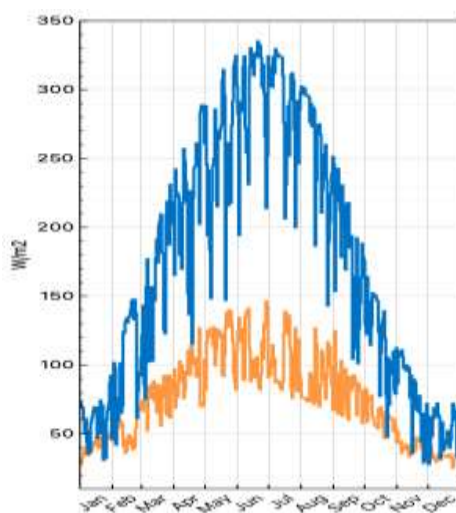


Fig. 2. Yearly variation of daily average global and diffuse irradiation over the period of 2004-2018

The simulation modeling constructed in SAM has computed the outputs for the system. The analysis of system operation was conducted for the flat solar collectors of a known manufacturer for which the input data are known. Solar tank parameters used in the simulation are: solar tank height to diameter ratio is set to 2, tank heat loss coefficient of $1 \text{ W/m}^2\text{°C}$, and maximum water temperature is 82°C . Pump and pipe parameters used in the simulation are: pump power of 45 W, pump efficiency of 0.75, total piping length in the system of 10 m, pipe diameter of 19 mm, pipe insulation conductivity of 0.03 W/m°C , and pipe insulation thickness is set to 6 mm. Other parameters used in parametric simulation are changed in the next range: collector area $1\text{--}5 \text{ m}^2$, tank volume $20\text{--}400$ liters, delivery temperature from the tank $40\text{--}60 \text{ °C}$, and average daily hot water consumption $100\text{--}200 \text{ kg/day}$. Since the best orientation for solar collectors in the

northern hemisphere is south facing, the simulation was made for a south-facing collector over the whole year.

The main parameter for maximizing energy savings is the solar fraction f . Solar factor is ratio of solar energy saved by the solar system \dot{Q}_{saved} to the total energy needed to maintain the delivery temperature with an auxiliary heater \dot{Q}_{need} , which is estimated by:

$$f = \frac{\dot{Q}_{saved}}{\dot{Q}_{need}} = \frac{\dot{Q}_{need} - \dot{Q}_{aux} - P_{pump}}{\dot{Q}_{need}} \quad (1)$$

$$\dot{Q}_{need} = \dot{m}_{draw} C_p (T_{set} - T_{mains}) \quad (2)$$

$$\dot{Q}_{aux} = \dot{m}_{draw} C_p (T_{set} - T_{delivered}) \quad (3)$$

where are:

- \dot{Q}_{aux} – the auxiliary energy required to bring the water to the set temperature after solar collection;
- T_{set} - the mean value of delivery set temperature in domestic usage;
- T_{mains} - the temperature of the cold water entering the tank;
- $T_{delivered}$ - the delivery temperature supplied by the tank;
- C_p - the specific heat of the water;
- P_{pump} – pump power required to drive the collector and tank flow.

For calculating the optimum thermo-hydraulic characteristics of the solar water heating system, maximization of the solar fraction was considered through the parametric simulation analyses.

3. RESULTS

Based on variations in the storage tank volume, the results of the simulation show that the collector area has an impact on the solar fraction, as is shown in Figure 3. In the first simulation, the delivery temperature supplied by the tank is set at 50 °C and the average daily hot water usage is 120 kg/day.

The solar fraction is increased by increasing tank volume, but tanks larger than 100 liters have minimal effect on it. This indicates that increasing the tank volume size above this value will result in a larger and more expensive system. Increasing the water storage tank volume may lead to an increase in the mass of hot water in the tank. Because the heat losses from the tank increase due to the increased surface area, the average tank temperature falls, especially on cold days. In this case, the auxiliary heating power, which in turn lowers the annual solar fraction, will increase.

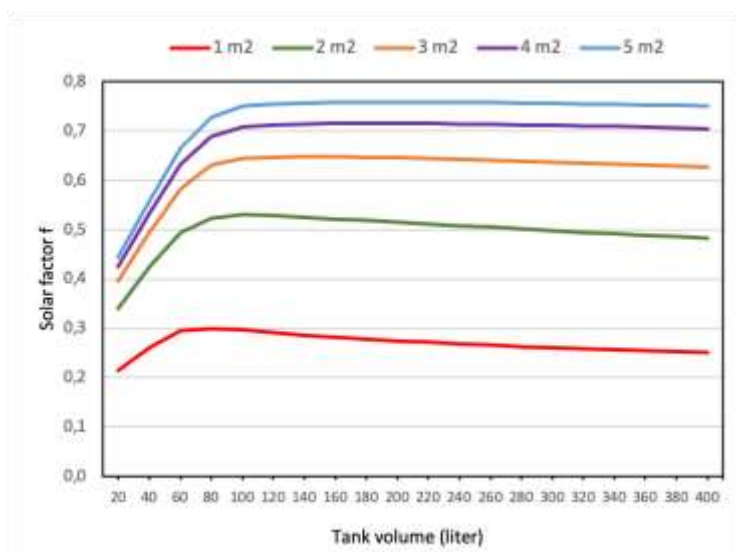


Fig. 3. Effect of tank volume on solar fraction for different collector area

On the other hand, increasing the collector area has a significant positive impact on the solar fraction. Due to higher heat losses from the larger tank surface areas, the solar fraction decreases at the 1 m² collector area as the tank volume increases. The solar fraction has been significantly increased by increasing the collector area, but its rise decreases gradually after 3 m². According to the obtained results and the surface area of the selected solar collector (Table 1), the optimal number of collectors is two. The results of the simulation of the SWH system with 4.16 m² collectors area show that an annual saving of 1250 kWh of energy can be achieved with a solar fraction of 0.72. The simulation results clearly indicate that the size of the practical systems is larger than the optimum values and should be analyzed from the perspective of cost reduction.

According to numerous studies, the optimum range for domestically usable hot water is between 40 °C and 60 °C [9]. The effects of the delivery set temperature on the solar fraction is shown in Figure 4. In the second simulation, the collector area is set to 4.16 m² and the average daily hot water usage is 120 kg/day. The simulation results show that the solar fraction decreases with increasing delivery temperatures. A higher delivery temperature means that the temperature of the fluid in the storage tank is also high. In that case, thermal loss from the tank increases, which decreases collector efficiency and solar fraction. Based on the results, for a tank volume of 100 liter, it can be concluded that increasing the delivery temperature within the analyzed temperature range does not cause a significant decrease in the solar fraction because each 5 °C increment in the delivery temperature results in an approximately 2 % drop in the solar fraction. As it was shown in

the previous simulation, increasing the tank volume over 100 liters is not an effective way to increase the solar fraction.

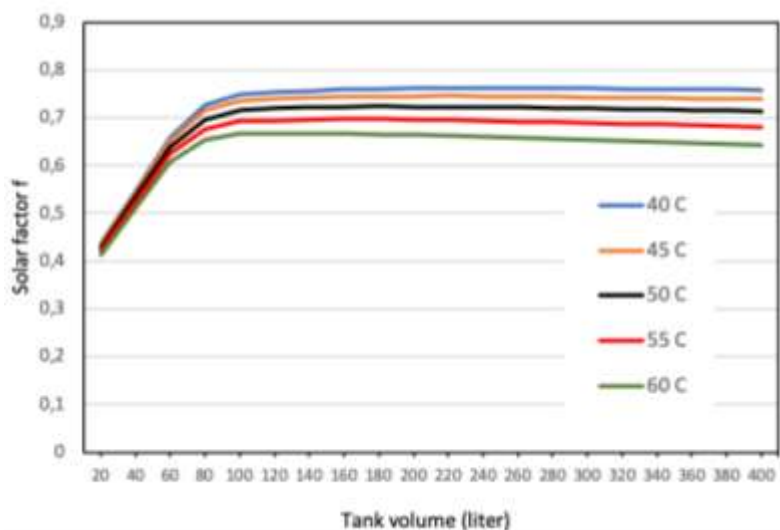


Fig. 4. Effect of delivery temperature on solar fraction for different tank volumes

The effects of average daily hot water usage on solar fraction is shown in Figure 5. Although there are few countries that exceed the average of 150 liters per person per day for EU countries, with a surprising figure of 300 liters in the case of Switzerland, most of them are between 78 liters in Slovakia and 150 liters per person per day in Greece [10]. Therefore, the average daily hot water usage, ranging from 100 kg/day to 200 kg/day was analyzed.

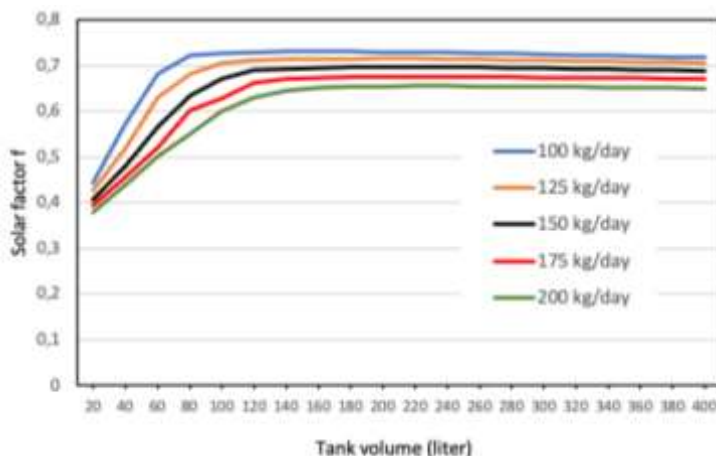


Fig. 5. Effect of average daily hot water usage on solar fraction for different tank volumes

In the third simulation, the delivery temperature supplied by the tank is set at 50 °C and the collector area is set to 4.16 m². As is noticeable, reducing on daily hot water usage significantly raises the solar fraction. This may enable a lower collector area in case the daily hot water demand, i.e., the number of occupants, is low. It is also shown that, for a tank volume of 100 liters, each 25 kg/day increment in the daily hot water consumption results in approximately a 3% drop in the solar fraction.

4. CONCLUSION

The parametric analysis of a thermo-hydraulic characteristics of the solar water heating system based on a solar flat plate collector is presented in this research. The meteorological data for Kragujevac, Serbia, were used to improve the solar fraction of the SWH system. Simulation results show that increase of water storage tank volume improves the solar fraction but it has little effect for the size greater than 100 liter. Also increasing the collector area improves the solar fraction remarkably but its rise decreases gradually after 4 m². The solar fraction decreases as the delivery set temperature and daily hot water consumption increase. The annual solar fraction decreases at about 2 % for every 5 °C increase in the delivery set temperature and by about 3 % for every 25 liter per day increase in daily hot water consumption. The obtained results show how to select the optimal thermal and hydraulic parameters for a solar domestic water heating system, according to specified demands.

ACKNOWLEDGEMENTS

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ANALIZA MJERNE KAMPANJE ZA VJETROELEKTRANU VUČIPOLJE

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SAŽETAK:

Za potrebe projektiranja vjetroelektrane prvo je potrebno opisati lokaciju i vremenske prilike karakteristične za poziciju gradnje. Uz ispitivanje vjetropotencijala na lokaciji, navesti će se opravdanost izvedivosti vjetroelektrane te doprinos u elektroenergetskom sustavu Republike Hrvatske.

Ovisno o mjerenjima i analizama vjetropotencijala predviđene lokacije iznijeti će se zaključci o utjecaju na okoliš planirane vjetroelektrane. Budući da geomorfološki prostor općine Gračac participira u tri regionalno prostorne jedinice: gorski masiv Velebit, ličko sredogorje i dolina Zrmanje do padina Plješivice u pounskom području, prostor na kojem je planirana izgradnja vjetroelektrane smatra se brdsko-planinskom područjem kojeg odlikuje uglavnom goli i stjenoviti krš, te neplodno tlo. To je iznimna prednost početnog planiranja gradnje.

Zaključno ćemo se osvrnuti na bitne stavke i činjenice. Obradom podataka i saznanjima na terenu navesti će se činjenice te prokomentirati opravdanost gradnje ove vjetroelektrane.

Ključne riječi: vjetar, vjetropotencijal, energija, vjetroelektrana,

1. UVOD

U ovom radu prikazat će se analiza izvedivosti i ispitivanje vjetropotencijala za vjetroelektanu Vučipolje. VE Vučipolje je projekt tvrtke wpd Adria d.o.o.[1] Nakon izrade dokumentacije kao što su: idejna rješenja, studije i analize vjetropotencijala na predviđenoj lokaciji za buduću VE iznijeti će se sve činjenice i informacije koje se smatraju bitnim za izvedbu ovog projekta.

Prvo je potrebno odabrati lokaciju te ispitati vremenske prilike karakteristične za to podneblje. [2] Nadalje, postaviti će se zaključci o utjecaju same VE na okoliš.

Lokacija vjetroelektrane Vučipolje predviđena je Prostornim planom Zadarske županije kao potencijalna makrolokacija za izgradnju vjetroelektrane. Pozicija VE Vučipolje faza 1 nalazi se 100% na zemljištu u državnom vlasništvu. Vjetroelektrana Vučipolje 1 sastoji se od 12 vjetroagregata ukupne instalirane snage 72 MW. Prema idejnom rješenju izrađenom 2021. na temelju vjetroresursa, urbanističkog planiranja i ekoloških smjernica, vjetroelektrana Vučipolje se planira spojiti na 220 kV prijenosnu mrežu Hrvatskog operatora prijenosnog sustava (HOPS) preko trafostanice Vučipolje.

Lokacija planiranog vjetroparka nalazi se 16 km istočno od naselja Gračac, na nenaseljenom prostoru između naselja Vučipolje, Velika Popina i Glogovo. Izgradnja vjetroparka planira se na nadmorskoj visini od 950 m do 1163 m.

Lokacija za izgradnju planirane vjetroelektrane je odabrana temeljem prostorno planskih odrednica, povoljnog vjetropotencijala lokaliteta, te blizine pristupnih puteva i postojeće elektroenergetske mreže. Prostor na kojem je planirana izgradnja vjetroelektrane smatra se brdsko-planinskom područjem (goli i stjenoviti krš te neplodno tlo).

Analize vjetropotencijala su neophodan preduvjet programskom modeliranju utjecaja vjetroelektrane na okoliš i društvo. Stoga je obavljena detaljna analiza vjetropotencijala za VE Vučipolje.

2. PROVOĐENJE MJERNE KAMPANJE NA LOKACIJI VE VUČIPOLJE

Provođenje mjerne kampanje vrši se pomoću mjernog stupa. Potrebno je izvršiti obilazak terena planirane lokacije VE kako bi se dobio uvid u stanje pristupnih cesta i mogućnosti instalacije mjernog stupa.

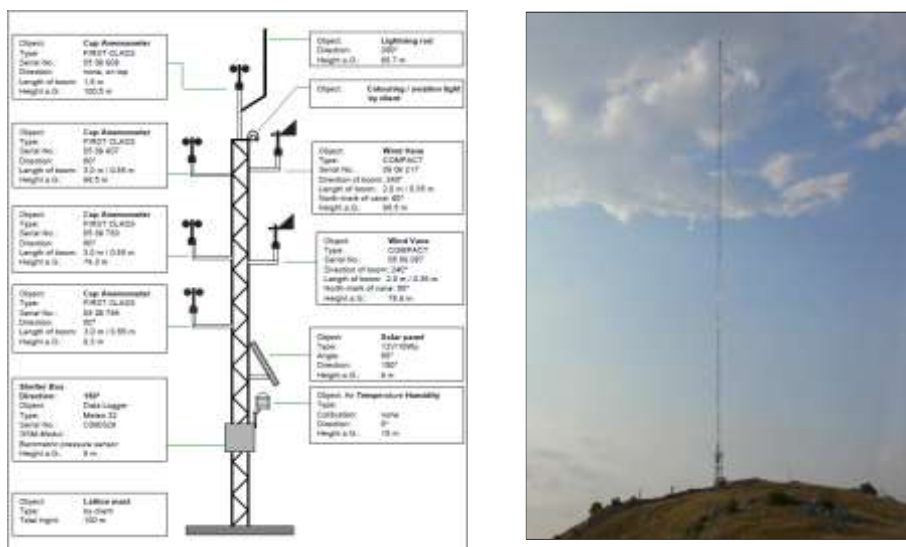
Vjetar nastaje uslijed nejednakosti tlaka u atmosferi. Određen je brzinom, smjerom i jačinom. Brzina vjetra mjeri se pomoću anemometra, a izražava se metrima u sekundi, kilometrima na sat, čvorovima ili beaufort-ima.

Kampanja mjerenja vjetra provodi se na mjernom stupu visine 103m. Stup je statički učvršćen čeličnim sajlama u tri smjera s međusobnim otklonom od 120°. Sajle su pričvršćene za armirano-betonske temelje koji se pravilno rasporede na radijusima od 27 i 45 metara udaljenosti od centra. Mjerna oprema za ispitivanje vjetropotencijala sastoji se od četiri anemometara tipa Thies-fc-advanced II proizvođača Ammonit (mogu biti različite izvedbe, zavisno o specifičnosti lokacije na kojoj se razvija projekt) koji su prije instalacije kalibrirani sukladno propisima u laboratoriju Deutsche Akkreditierungsstelle GmbH. [3] Dva anemometra postavljena su na visini od 100 metra te po jedan na 80 i 60 metara. Jedan ultrasonic anemometar tipa 2D 4.3820.32.503 koji uz brzinu vjetra mjeri i ostale meteorološke prilike kao i smjer vjetra, nalazi se na visini od 98 metara, dva pokazivača smjera vjetra Ammonit tipa Wind vane First class TMR heatable na različitim visinama prilagođenim potrebama mjerenja. Postavljena su i dva temperaturna senzora T-rh-sensor incl. radiationshield proizvođača Ammonit tipa Galltec TP i barometar AB100 proizvođača Ammonit koji se nalazi na visini 95 metara.

Mjerni stup može biti različitih visina i označen je sukladno važećim propisima Pravilnika o aerodromima, Čl.147. „Osvjetljivanje objekata-upotreba jediničnih izvora svjetla za označavanje prepreka“ Opremljen je sa solarom za vlastito napajanje, digitalnim anemometrima, sim karticom ili vlastitim prostorom za pohranu i termičkim senzorom. Podijeljen je na sekcije (odvojena mjerenja za različite visine, 20m, 50m, 75m, 90m i preko 100m) i kompletno je mobilan s fleksibilnim temeljom. Prikaz parametra mjernog stupa može se vidjeti na slici 1.

Mjerenje smjera i brzine vjetra odvija se u stvarnom vremenu i podaci se spremaju na Data logger tipa Ammonit Meteo-40M, koji se nalazi u metalnome ormariću s pripadajućom opremom na visini od 10 metara. Svi podaci prikupljeni na Data loggeru se putem GSM

modema, u 10 minutnim intervalima šalju na centralni server koji prikuplja podatke o svim trenutno aktivnim kampanjama mjerenja vjetro potencijala. Stručnjaci zaposleni u posebnome odjelu za analizu i obradu podataka o vjetru potom vrše analizu dostavljenih podataka. Upravljački sustav mjernog stupa prikazan je na slici 2.



Slika 1. Skica mjernog stupa i instalirani mjerni stup [4]



Slika 2. Upravljački sustav mjernog stupa [5]

Zbog zastarjelih mjernih podataka, na lokaciji je u planu postavljanje novog mjernog stupa, nedaleko od mjesta starog stupa. Novi mjerni stup će imati slične karakteristike, parametre i upravljački sustav kao stari mjerni stup koji je van funkcije. Mjerenje je trajalo više od dvije godine te su podaci pouzdani, osim ako u međuvremenu na toj lokaciji nisu rađeni neki drastični građevinsko mehanički radovi.

Glavni krivac za provođenje novog mjerenja birokracija jer nekolicina dozvola nije odobrena ili nije odobrena na vrijeme. Naime, problem je sporost izrade EOTRPA i po novom zakonu problem je sporost izdavanja energetskeg odobrenja i nedostatak UREDBE koju HERA mora donijeti, a koju čekaju svi projekti u razvoju u RH.

2.1. Analiza mjerne kampanje

Na predviđenoj lokaciji VE Vučipolje bila je provedena mjerna kampanja, ali zbog proteklog vremenskog razdoblja te za potrebe ishođenja dozvola koje nisu dostavljene na vrijeme, morao se postaviti novi mjerni stup i ponoviti mjerenje. Kako mjerni podaci s novog mjernog stupa nisu dostupni, obraditi i analizirati će se mjerni podaci sa starog mjernog stupa. Moguće je da su korišteni programi i mjerni instrumenti različiti od onih koji će se koristiti i postaviti na novom mjernom stupu. Razlog tome je što su programi i mjerni uređaji ažurirani, nadograđeni i poboljšani u proteklom vremenu, ali izmjereni podaci i rezultati trebali bi biti dosljedni.

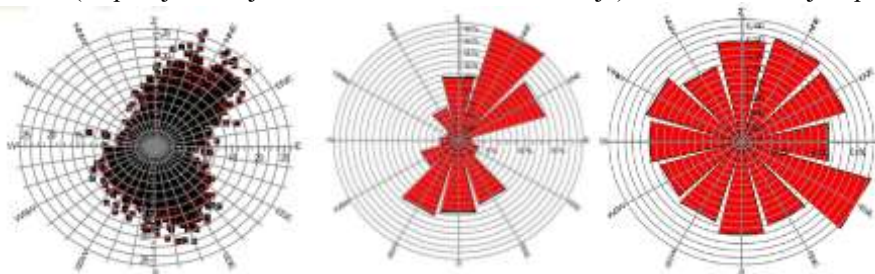
Analizirani su podaci sa stupa koji se nalazio sjeveroistočno od sela Vučipolje. Analize su uključivale procjenu kvalitete podataka prikupljenih tijekom kampanje od 7. listopada 2009. do 11. ožujka 2011. te verifikaciju nacrtu procjene energetskeg prinosa (EYA) na temelju podataka. Montažu stupa izvela je konzultantska tvrtka GEO-NET te izradili nacrt EYA. GEO-NET je naručio Tekol-Teri Consultancy, Construction & Shipbuilding.

U navedenom razdoblju nije bilo prekida mjerenja, tako da su svi podaci prikupljeni i statistički obrađeni. Mjerenja brzine vjetera provode se na tri razine stupa uz 10min zapise koji se redovito prikupljaju i obrađuju licenciranim programima Witem, WAsP i Wind Farmer.

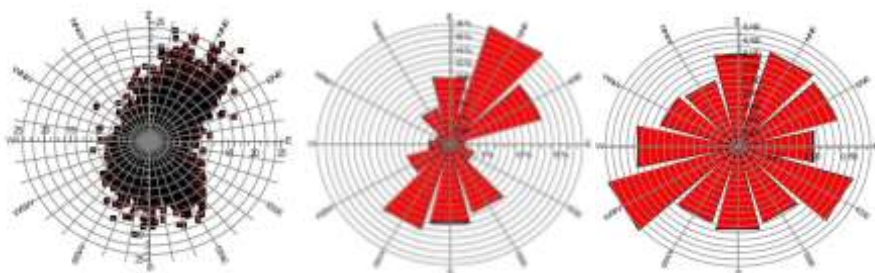
Dokumentacija stupa treba biti temeljita i uključuje nesigurnosti za senzore tlaka i temperature. Provođi se u skladu s IEC 61400-12-1 ed1 iz 2005. Tijekom provedbe mjerenja bilo je problema s anemometrom na 98m. Promijenjen je dva puta tijekom kampanje što je uzrokovalo nekoliko velikih praznina u vremenskoj liniji. Zapaža se kako postoji vremenski pomak između dva skupa podataka. Također, dva vremenska razdoblja preklapaju se za manje od godinu dana. Kampanja za gornje senzore trajala je od 07.10.2009. do 16.10.2010; dok su donji senzori bili operativni od 19.11.2009. do 11.03.2011. Postojali su mali problem s orijentacijom mjernog stupa. GEO-Net je procijenio da je glavni smjer vjetera sjeverozapadni, prema analizi podataka *National Center for Climatic Data*, te je odlučeno orijentirati nosače od 60° do 240°. Međutim, skupovi podataka ponovne analize ERA5 i MERRA imaju glavni smjer vjetera između sjeveroistoka i juga, kako je prikazano na slikama. Distribucija smjera vjetera prikazana je

na temelju jednogodišnjih podataka o mjernom stupu za visine 100,5 m (slika 4), 98,5 m (slika 5), 79,3 m (slika 6) i 9,3 m (slika 7) [3]

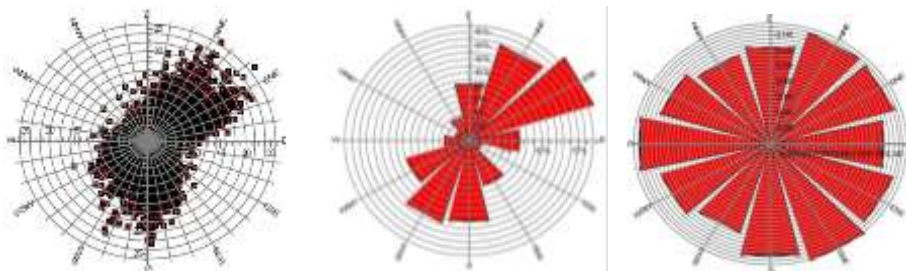
Gornji anemometri su pod jakim utjecajem gromobrana. Ti su učinci najbolje vidljivi iz omjera brzine vjetra i intenziteta turbulencije izmjerenih na 100,5 m i 98,5 m kao funkcija smjera vjetra (sl. 4 i 5), ali se također jasno vidi kao smanjenje omjera brzine vjetra i kao povećanje omjera intenziteta turbulencije izmjerenih anemometrima postavljenim na donjem nosaču i jednim anemometrom postavljenim na vrhu (sl. 4 i 5). Za kontinuirane analize (na primjer detaljne analize intenziteta turbulencije) ti se učinci moraju ispraviti.



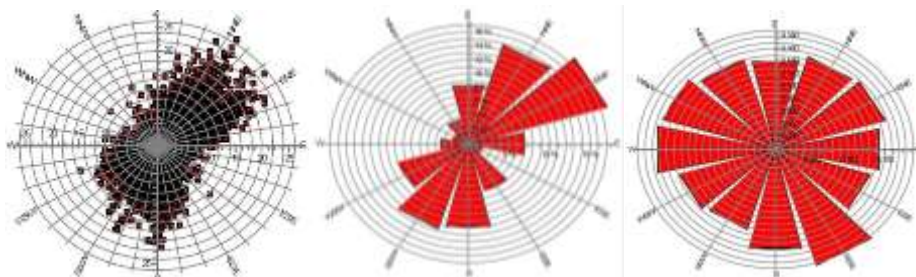
Slika 4. Raspodjela brzine vjetra, frekvencija i turbulencija na 100,5 m [4]



Slika 5. Raspodjela brzine vjetra, frekvencija i turbulencija na 98,5 m [4]



Slika 6. Raspodjela brzine vjetra, frekvencija i turbulencija na 79,3 m [4]



Slika 7. Raspodjela brzine vjetra, frekvencija i turbulencija na 9,3 m [4]

Određivanje standardne nesigurnosti izmjerene brzine i smjera vjetra kao i standardne nesigurnosti temperature zraka, vlažnosti zraka i tlaka zraka provodi se prema internom opisu postupka koji se temelji na IEC 61400-12-1 i ISO zahtjevima za izražavanje mjerne nesigurnosti. Nesigurnost izmjerene brzine vjetra (u_v) proizlazi iz kombinacije sljedećih komponenti: nesigurnost kalibracije anemometra (u_{v1}), nesigurnost radnih karakteristika anemometra (u_{v2}), nesigurnost zbog poremećaja zbog utjecaja instalacije (u_{v3}) i nesigurnost sustava za prikupljanje podataka (u_{v4}). Kombinirana standardna nesigurnost procijenjena je prema sljedećoj jednačbi:

$$u_v = \sqrt{u_{v1}^2 + u_{v2}^2 + u_{v3}^2 + u_{v4}^2}$$

U ovom radu glavni naglasak je na reprodukciji energetske prinosa iz GEO-NET početne procjene. Njihov se izračun temelji na SWT turbini od 3,2 MW s visinom čvorišta od 80 m. Stoga je u analizi razmatrana samo ova visinska razina.

2.2. Procjena dugoročne korekcije

Budući da se u ovoj analizi uglavnom koriste podaci s visine od 80 m, korigiran je poremećaj na brzine vjetra zbog udara vjetra s jugozapada. U tu svrhu sintetiziran je vremenski niz na visini 79,3 m korištenjem anemometra sa 100,5 m. U drugom koraku sve brzine vjetra na 79,3 m zamijenjene su onima iz sintetiziranog vremenskog niza za smjer vjetra s jugozapada. Dakle, korišteni su podaci anemometra na 79.3 m. Prosjek korigirane vremenske serije je 6,6 m/s za vremensko razdoblje između 07.10.2009. i 16.10.2010. što se slaže s prosjekom koji je utvrdio GEO-Net (Tabela 1.). Prosječna brzina veća od 6 m/s je jasan indikator da je ciljana lokacija optimalna za projekte vjetroelektrana.

Podaci ponovne analize MERRA zamijenjeni su MERRA 2 2016.. Kako je od 2010. na tržište plasirano više novih proizvoda za ponovnu analizu su dostupne različite dugoročne referentne vremenske serije, ali je uključena i ona koju koristi GEO-Net. Radi jednostavnosti u Tabeli 2. su prikazane samo dugoročne vrijednosti iz korištene referentne vremenske serije.

Tabela 1. Prosjek korigirane vremenske serije koju je utvrdio GEO-Net za mjerenja na lokaciji Vučipolje [4]

	WMM VUČIPOLJE		
<i>visina točke mjerenja vjetropotencijala (na stupu)</i>	~ 10 m	~ 80 m	~ 100m
<i>vremensko razdoblje izvršenja mjerenja</i>	07. 10. 2009. – 16. 10. 2010.		
<i>period dostupnosti za izvršenje mjerenja</i>	~ 98 %		
<i>prosječna brzina vjetra izmjerena u razdoblju 07. 10. 2009. – 16. 10. 2010.</i>	6.2 m/s	6.6 m/s	6.8 m/s
<i>dugoročno praćenje na temelju MERRA podataka</i>	6.3 m/s	6.7 m/s	6.9 m/s
<i>nesigurnost dugoročnog praćenja prosječne brzine vjetra temeljene na MERRA (projekcija algoritma za modeliranje dosljednosti)</i>	7 %		
<i>FITNAH - simulacija praćenja za razdoblje 1980 - 2010</i>	5.8 m/s	6.7 m/s	6.8 m/s

Tabela 2. Usporedba između različitih dugoročnih ekstrapoliranih brzina vjetra na temelju dva skupa podataka re-analize korištenih u analizi [4]

<i>Visina nmv. mjerenja vjetra</i>	80 m
<i>Razdoblje mjerenja</i>	07.10.2009. – 16.10.2010.
<i>Prosječna brzina vjetra mjernog razdoblja</i>	6,6 m/s
<i>Dugoročna ekstrapolacija na temelju MERRA podataka 1979. - 2010.</i>	6,6 m/s
<i>Dugoročna ekstrapolacija temeljena na podacima ERA5Europe 1990. – 2020.</i>	6,6 m/s

Dok je GEO-Net dobio dugoročnu srednju vrijednost brzine vjetra od 6,7 m/s za visinu od 80 m, vrijednosti temeljene na MERRA i ERA5-Europe niže su za 0,1 m/s. Iz iskustva je poznato da su za procjenu dugoročne brzine vjetra dovoljna razdoblja od 10 godina. Također je važno međusobno usporediti različite dugoročne referentne skupove podataka kako bi se dokazala dosljednost i definirala odstupanja među njima. Prema tome, MERRA je uključena samo kako bi bila što bliža analizama iz GEO-NET-a. Ovo možda nije najbolji izbor kao što će biti detaljnije objašnjeno u nastavku.

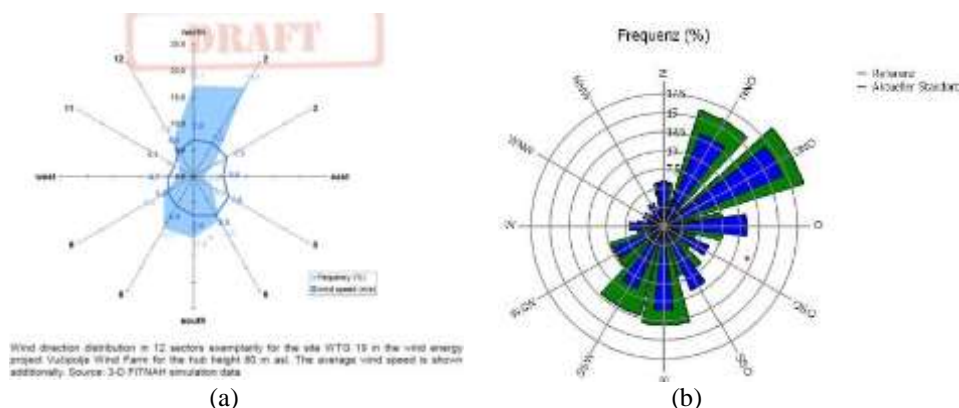
Područje vjetroelektrane nalazi se na vrlo složenom terenu. Temeljni model elevacije temelji se na podacima SRTM Space Shuttlea s razlučivošću od 1 kutne sekunde. Svakako treba naglasiti da su vrijednosti visine iz GEO-NET-a preuzete iz njihovog izvješća.

Položaj mjernog stupa nalazio se nekoliko metara od turbine broj 18. Stoga je interesantno usporediti sve rezultate s ovog položaja. U tabeli 3. prikazan je iznos srednjih brzina vjetra i energetske prinosa za turbinu 18 i cijelu vjetroelektranu.

Tabela 3. Rezultati brzine vjetra i vrijednosti prinosa energije za turbinu na poziciji broj 18 i cijelu vjetroelektranu [4]

Izvor podataka	Brzina vjetra na položaju turbine 18	Brzina vjetra preko svih turbina	Prinos energije na položaju turbine 18	Prinos energije za sve turbine
GEO-Net	6,6 m/s	6,7 m/s	6902 MWh/a	250,812 MWh/a
MERRA	6,6 m/s	6,5 m/s	6969 MWh/a	235,630 MWh/a
ERA5-Europe	6,7 m/s	6,5 m/s	6554 MWh/a	225,065 MWh/a

Srednje brzine vjetra iz WindPRO izračuna na poziciji 18 jednake su dugoročnim vrijednostima iz tabele 2. s izuzetkom ERA5-Europe koji ukazuje na nešto višu vrijednost. Male razlike u brzini vjetra od 0,1 m/s mogu dovesti do značajnih razlika u prinosu energije. Mogu varirati između 3% i 5%. S obzirom da su sve vrijednosti brzine vjetra u izvješću GEO-NET-a navedene samo s jednim decimalnim mjestom, razlike bi mogle biti manje izražene. Ukupna brzina vjetra za sve turbine veća je za oko 3% u GEO-NET izvješću nego u WindPRO izračunu. Možda se objašnjenje može vidjeti u distribuciji frekvencije smjera vjetra na slikama 8. (a) i (b).



Slika 8. Distribucija smjera vjetra za lokaciju turbine 19. iz GEO-NET izvješća (a) i iz WindPRO izračuna (b) (temeljeno na MERRA) [3]

Distribucija iz GEO-NET-a ima sjeverniju komponentu dok za WindPro izračune glavni smjer vjetra dolazi iz istočnog smjera (graf desno). Zbog toga je turbina 19 izložena sili

vjetra, dok se za WindPRO izračun moraju uzeti u obzir znatni učinci zbog drugih turbina. Stoga su brzine vjetra manje za 0,2 m/s.

Razlika u distribuciji smjera vjetra također može biti razlog velikih razlika između GEO-NET i Wind Pro izračuna. Nažalost, to se ne može potvrditi budući da je GEO-NET u svoje izvješće uključio samo ružu vjetrova iz turbine 19.

Prema rezultatima u tabeli 3. turbina broj 18 proizvodi oko 5,3% manje energije za izračun ERA5-Europa od vrijednosti koju je prijavio GEO-NET, ali srednja brzina vjetra na visini čvorišta je 0,1 m/s više za skup podataka ERA5 Europe. Jedno od mogućih objašnjenja, međutim, mogla bi biti dugoročna vremenska serija MERRA-e. Pokazuje čudno ponašanje između godina 2004. i 2009. (nije prikazano) koje se ne može vidjeti u drugim referentnim vremenskim serijama. To bi objasnilo zašto je rezultat temeljen na MERRA prilično sličan onom iz GEO-NET-a za turbinu 18.

Sve u svemu, ukupna energija cijele vjetroelektrane temeljena na MERRA-i je 6,4% manja od one iz GEO-NET-a. Razlika između ERA5-Europe i FITNAH-a je 11,4%. Ovo drugo je danas najvjerojatnije realnije.

3. SAŽETAK MJERNE KAMPANJE

Instalacija jarbola i izvješćivanje u skladu su s IEC 61400-12-1 izdanje 1 (2005). Postavlja se pitanje potencijalnog problema s modelom nadmorske visine. Navedene vrijednosti GEO-NET-a za sve položaje turbine nisu identične onima iz WindPRO-a. Budući da se polje vjetra različito određuje između Wind PRO-a i FITNAH modela iz GEO-NET-a, prilično je teško procijeniti njegov utjecaj. Također nije sigurno jesu li navedene vrijednosti samo pogreške pri upisu.

Vrijednosti brzine vjetra iz MERRA i ERA5 Europe prilično se dobro slažu za turbinu broj 18 koja je bila smještena prilično blizu jarbola. Međutim, razlika u prinosu energije je mnogo veća. To bi moglo biti djelomično povezano s temeljnim dugoročnim serijama podataka. MERRA pokazuje drugačiji obrazac između 2004. i 2009. od ERA5 Europe.

FITNAH proizvodi oko 6,4% više energije nego MERRA iako je temeljna dugoročna vremenska serija ista. Međutim, što se tiče usporedbe između različitih procjena prinosa energije, rezultat od 6,4% je još uvijek prilično dobar i obično unutar procijenjenih nesigurnosti. [6]

Za što pouzdaniji i točniji EYA (Energy yield assesment) poželjno je u daljnjoj fazi znati i uzeti u obzir točne lokacije vjetroagregata. Naime, pored prirodnog resursa snage vjetra, na EYA utječe i tzv. *Wake effect* koji je gubitak koji se akumulira zbog blizine stupova vjetroagregata. Naime, kako vjetar dolazi na jednu turbinu, on ne nastavlja svoj put dalje u istom intenzitetu, već smanjenom i kao takav, sa smanjenim intenzitetom vjetra dolazi na susjednu turbinu. Za ovakvo mjerenje potrebno je odraditi kompleksnu CFD analizu, ona uz sve agregata na projektu koji se promatra, može uzeti u obzir čak i susjedne projekte udaljene i po nekoliko desetaka kilometara. [6] Naravno, da su takvi utjecaji, tj. gubici jako mali ali postoje. Pod određenim uvjetima još uvijek bi bilo prihvatljivo 11% između GEO-NET-a i ERA5.

4. ZAKLJUČAK

Lokacija vjetroelektrane Vučipolje predviđena je Prostornim planom Zadarske županije. Nakon izvršenih mjerenja zadovoljenu su uvjeti potencijalne makrolokacije za izgradnju vjetroelektrane.

Meteorološke i klimatske značajke šire zone Vučipolja uvjetovane su položajem zone u neposrednoj blizini 45 paralele, blizinom mora, ali i povišenom pozicijom područja, te su za prostor karakteristična tri tipa vremena.

Za potrebe projekta provela su se mjerenja za potrebe postavljanja elektrane. Obavila se terenska posjeta na području planirane lokacije kako bi se dobio uvid u stanje pristupnih cesta i mogućnosti instalacije mjernog stupa.

Ali zbog dugog vremenskog razdoblja čekanja dozvola izmjereni podaci su zastarjeli, te se postavio novi mjerni stup i ponovo se izvršilo mjerenje.

U konstrukciji vjetroelektrane planirano je postavljanje brzohodna vjetro turbine s horizontalnom osovinom Siemens Gamesa SG 6.0-170 6000. Sastoji se od rotora s lopaticama i gondole s generatorom i drugom opremom. Okretanje rotora i gondole u smjeru vjetra postiže se pomoću aerodinamičkoga repnoga stabilizatora ili elektromotora. Kada je brzina vjetra iznad dopuštene vrijednosti aktivira se sustav kočenja i rad turbine se usporava, odnosno obustavlja.

Vjetroelektrane su iskoristive na lokacijama gdje je prosječna brzina vjetra veća od 4,5 m/s. Ipak, neke lokacije s povoljnim vjetrovima nisu pogodne za instalaciju vjetrenih turbina zbog narušavanja krajolika, utjecaja buke što ju stvara okretanje krila.

Veće zanimanje za gradnju vjetroelektrana pojavilo se u razvijenim zemljama s vjetrovitim obalama nakon nagloga poskupljenja nafte u 1970-ima. Međutim, trenutno razdoblje daljnjega rasta cijena fosilnih goriva i nastojanja da se smanje emisije štetnih plinova u atmosferu povećao se udjel vjetroelektrana u ukupnoj energetskej proizvodnji.

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WIND POWER PLANT VUČIPOLJE MEASURING CAMPAIGN ANALYSIS

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ABSTRACT:

For the purposes of designing a wind farm, it is first necessary to describe the location and weather conditions characteristic of the construction position. In addition to the examination of the wind potential at the location, the justification of the feasibility of the wind power plant and its contribution to the power system of the Republic of Croatia will be stated.

Depending on the measurements and analyzes of the wind potential of the planned location, conclusions will be drawn about the environmental impact of the planned wind power plant. Since the geomorphological space of the municipality of Gračac participates in three regional spatial units: the Velebit mountain massif, the Lika highlands and the Zrmanja valley up to the slopes of Plješivice in the Poun area, the area where the construction of the wind power plant is planned is considered a hilly-mountainous area characterized by mostly bare and rocky karst, and barren soil. This is an exceptional advantage of initial construction planning.

Finally, we will look into the important items and facts. Based on data processing and field knowledge we will state the facts and comment on the justification for the construction of this wind farm.

Keywords: wind, wind potential, energy, wind power plant

SPAJANJE FOTONAPONSKIH SUSTAVA NA MREŽU

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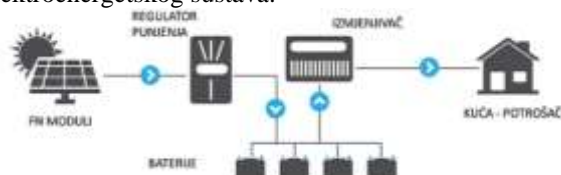
SAŽETAK:

Porastom potreba za „čišćom“ energijom obnovljivi izvori energije dobivaju na značenju. Potiče se razvoj obnovljivih izvora zbog porasta cijene fosilnih goriva i onečišćenja okoliša. Jedan od obnovljivih izvora energije je Sunce. Opisati će se fotonaponski sustavi, njihovo spajanje na mrežu i primjena fotonaponskih sustava u praksi. Fotonaponski sustav je skup opreme koji solarnu energiju Sunca pretvara u električnu energiju. Dijele se u dvije skupine: sustave koji se spajaju na javnu elektroenergetsku mrežu i sustave koji nisu spojeni na javnu elektroenergetsku mrežu. Ekološki su prihvatljivi i nalaze sve veću primjenu. Iskorištavanjem sunčeve energije doprinosi se zaštiti okoliša i smanjenju ugljikova dioksida (CO₂), koji je jedan od uzročnika globalnog zatopljenja. Tehnologija pretvorbe je čista, moguće je napajanje potrošača gdje nema elektroenergetskog sustava, fotonaponski moduli imaju dug vijek trajanje i lako ih je održavati. Uz sve te prednosti treba naglasiti kako proizvodnja energije ovisi o osunčanosti i površini prostora na kojem se nalaze fotonaponski moduli. Republika Hrvatska ima veliki potencijal za iskorištenje sunčeve energije koji se u zadnje vrijeme sve više iskorištava.

Ključne riječi: fotonaponski modul, fotonaponski sustav, elektroenergetska mreža, utjecaj na okoliš

1. UVOD

Da bi se solarna energija Sunca pretvorila u električnu energiju potreban je fotonaponski sustav. Fotonaponske sustave možemo podijeliti u dvije osnovne skupine: fotonaponski sustavi koji nisu priključeni na mrežu (*off-grid*) i fotonaponski sustavi priključeni na javnu elektroenergetsku mrežu (*on-grid*). *Off-grid* ili otočni fotonaponski sustavi, prikazani na slici 1, su samostalni izvor energije. Proizvedena električna energija skladišti se u akumulatorne ili baterije. Primjenjuju se u područjima gdje u blizini nema elektroenergetskog sustava.



Slika 1. Shema spajanja elemenata otočnog fotonaponskog sustava [1]

Kod sustava priključenih na mrežu razlikuju se dva slučaja: fotonaponski sustavi priključeni izravno na javnu elektroenergetsku mrežu i fotonaponski sustavi sa spojem na mrežu putem kućne instalacije. Fotonaponski sustavi priključeni izravno na javnu elektroenergetsku mrežu cjelokupnu proizvedenu električnu energiju predaju u energetske sustav. Instaliraju se na većim površinama u blizini elektroenergetske mreže s većom snagom. Umreženim sustavima omogućeno je usklađivanje proizvodnje i potrošnje električne energije. Slika 2. prikazuje shemu spajanja fotonaponskog sustava izravno na mrežu. Prednost ovakvog sustava je što ograničava emisiju CO₂ te štiti okoliš, povećava kvalitetu električne energije i raspoloživost distribucijske mreže.



Slika 2. Shema spajanja fotonaponskog sustava izravno na mrežu [1]

Fotonaponski sustavi spojeni na mrežu preko kućne instalacije koriste se za pokrivanje energetske potrebe objekta na kojem se sustav nalazi. Akumulatori i baterije nisu potrebni jer elektroenergetska mreža sprema proizvedenu električnu energiju. Višak energije koji se proizvede predaje se mreži.

Kod priključenja fotonaponskih elektrana razlikuju se sljedeće kategorije priključka: SE do 30 kW (priključak na 0,4 kV mrežu), SE od 30 do 100 kW (priključak na 0,4 kV mrežu ili postrojenje), SE od 100 do 500 kW (priključak na 0,4 kV postrojenje) i SE iznad 500 kW (priključak na 10(20) kV postrojenje). Za fotonaponske elektrane snage veće od 30 kW potrebno je izraditi Elaborat podešenja zaštite, prilikom priključenja distribuiranih izvora na mrežu (elektrana), kako bi se sagledali mogući kvarovi i smetnje u paralelnom pogonu mreže i elektrane [2].

U radu je prikazano povezivanje fotonaponske elektrane snage 50 kW na mrežu. Sustav je projektiran za paralelni rad s mrežom preko dvosmjernog brojila, vršne snage iz smjera mreže 115 kW te prema mreži 50 kW. Temelji se na fotonaponskim panelima SV 144 E HC 395 W, nominalnog napona 49,5 V i izmjenjivaču SUN2000 50KTL M0 kompanije Huawei [3].

2. TEHNIČKI OPIS I DIMENZIONIRANJE POSTROJENJA

Fotonaponska elektrana za vlastite potrebe smješta se na krovnu površinu objekta s blagim padom od 1°, korisne površine cca 600 m², južne orijentacije s azimutom od 196°. Unutar objekta na drugom katu smještaju se izmjenjivači s izmjeničnim (AC) i istosmjernim (DC) zaštitnim elementima koji se povezuju na glavni HEP-ov razvodni ormar smješten u

prizemlju zgrade. Na temelju električnih vrijednosti raspoloživih u elektroenergetskoj mreži i krovne površine, moguće je instalirati 138 fotonaponskih panela snage 395 W, što daje ukupnu snagu od 54,5 kWp na DC strani elektrane, odnosno 50 kW (pri $\cos\varphi=1$) na AC strani elektrane. Fotonaponska elektrana se spaja na glavni razvodni ormar (GRO) objekta u kojem je smješteno brojilo električne energije i predstavlja mjesto isporuke električne energije operatoru distribucijskog sustava HEP-ODS d.o.o. – Elektrodalmacija Split.

Fotonaponski paneli slažu se u deset nizova (eng. *string*). Osam nizova sadrži četrnaest panela spojenih u seriju. Spajaju se na izmjenjivač paralelno po dva niza na jednu MPP (eng. *Maximum Power Point*) točku. Dva niza sadrže trinaest panela, a spajaju se zasebno na dvije odvojene MPP točke. Ukupna snaga izmjenjivača je 65 kW, ali će se softverski ograničiti na 50 kW. Potrebno je voditi računa da ukupni ulazni napon na izmjenjivaču ne bude veći od 1000 V. Predviđeni fotonaponski paneli su monokristalni moduli SV144-395-E HC tvrtke Solvis d.o.o. [4]. Tehničke karakteristike panela su navedene u tabeli 1.

Tabela 1. Električni parametri IUL/IUSP

SV144-395 E HC		IUL ¹	IUSP ²
Vršna snaga	[Wp]	395	299,1
Dozvoljeno odstupanje	[%]	-0/+5	-0/+5
Struja kratkog spoja I_K	[A]	10,09	8,15
Napon praznog hoda U_{OC}	[V]	49,5	47
Nazivna struja I_{MPP}	[A]	9,49	7,55
Nazivni napon U_{MPP}	[V]	41,63	39,6
Odstupanje napona i struje	[%]	3	3
Efikasnost	[%]	19,74	19,74

2.1. Proračun vodiča i zaštite na izmjeničnoj (AC) strani

Na temelju izračunate struje opterećenja i razmatranja instalacijskih uvjeta vrši se odabir priključnih kabela. Presjeci kabela određeni su sukladno normi HD 384.5.523 S2 "Električne instalacije zgrada 5. dio: Odabir i ugradba električne opreme - 523. odjeljak: Trajno dopuštene struje u sustavima razvođenja". Važni parametri u proračunu su broj opterećenih vodiča u kabelu, način polaganja i korekcijski faktor zbog dobivanja stvarne dopuštene vrijednosti. Vršna snaga elektrane iznosi 50 kW između RO-AC i GRO. Presjek i tip izoliranih vodiča i kabela određuje se na temelju iznosa trajno dopuštene struje kabela, koja je veća od nazivne struje potrošača (HRN HD 60364). Strujno opterećenje dovodnog kabela dano je izrazom:

¹ Ispitano u laboratoriju (IUL) (eng. *Standard Test Conditions* - STC)

² Ispitano u stvarnom pogonu (IUSP) (eng. *Normal Operating Cell Temperature* - NOCT)

$$I_n = \frac{P}{\sqrt{3} \cdot U_L \cdot \cos \phi} = \frac{50000}{\sqrt{3} \cdot 400 \cdot 1} = 75,967 \text{ A} \quad (1)$$

gdje su: I_n - nazivna struja trošila [A], P - vršno opterećenje [W], U - linijski napon [V] i $\cos \phi$ - faktor snage.

Za navedeno strujno opterećenje potrebno je odabrati vodič presjeka 16 mm². Međutim, zbog duljine kabela i pada napona te planiranog proširenja sustava u budućnosti odabran je vodič presjeka 50 mm².

Izračun stvarno dopuštene struje u vodiču, uzimajući u obzir korekcijske faktore, dan je izrazom:

$$I_d = I_{kab} \cdot F_g \cdot F_t = 168 \cdot 0,95 \cdot 0,9 = 146,64 \text{ A} \quad (2)$$

gdje su: I_d - stvarno dopuštena maksimalna struja vodiča [A], I_{kab} - dopuštena maksimalna struja vodiča [A], F_g - faktor korekcije zbog grupnog polaganja 0,95 i F_t - faktor korekcije zbog temperature 0,9.

Uređaji za automatski prekid napajanja pri kratkom spoju ili preopterećenju dimenzioniraju se tako da prekinu protok struje koja je veća od vrijednosti struje kratkog spoja na mjestu gdje je zaštitni element ugrađen. Na početku strujnog kruga potrebno je instalirati zaštitni nadstrujni uređaj, odnosno na mjestima gdje se dozvoljena struja kratkog spoja smanjuje. Prema dozvoljenom strujnom opterećenju kabela i nominalnom opterećenju odabire se zaštitni uređaj kojemu radne karakteristike moraju zadovoljiti uvjete:

$$I_b < I_n < I_z \quad (3)$$

$$I_2 < 1,45 \cdot I_z \quad (4)$$

Nazivna struja I_b trošila se računa prema izrazu (5) za trofazni i izrazu (6) za jednofazni strujni krug.

$$I_b = \frac{P \cdot f_i}{\sqrt{3} \cdot U_L \cdot \cos \phi} [A] \quad (5)$$

$$I_b = \frac{P \cdot f_i}{U_L \cdot \cos \phi} [A] \quad (6)$$

gdje su: I_b - nazivna struja trošila, I_z - trajno dopuštena struja vodiča, I_n - nazivna struja zaštitnog uređaja, I_2 - struja kod koje zaštitni uređaj sigurno djeluje ($I_2 = k \times I_n$) i k - koeficijent, prikazan u tabeli 2.

Tabela 2. Vrijednost koeficijenta k .

I_n [A]	< 4	4 <...< 10	10 <...< 25	> 25
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k	2,1	1,9	1,75	1,6
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U tabeli 3 prikazan je proračun koji se temelji na prethodno danim uvjetima i formulama.

Tabela 3. Uvjeti zaštite za strujni krug "Izmjenjivač – GRO"

P [kW]	50	I_2 [A]	140
I_b [A]	76	$1,45 \times I_z$ [A]	243,6
I_n [A]	80	$I_b < I_n < I_z$	Zadovoljeno
I_z [A]	168	$I_2 < 1,45 I_z$	Zadovoljeno

Prema tabeli 3 odabrani kabel i zaštitni elementi zadovoljavaju oba uvjeta prema normi HRN.HD 60364 za zaštitu od preopterećenja. Prema normi HRN HD 60364-4 zaštita nadstrujnim prekidačem je efikasna ako je zadovoljen uvjet da nazivni linijski napon veći od napona kvara, prema izrazu (7).

$$Z_s \cdot I_a \leq U_0 \quad (7)$$

gdje su: Z_s - petlja kvara [Ω], I_a - struja kvara [A] (diferencijalna zaštita 300 mA) i U_0 - nazivni linijski napon [V].

Otpor uzemljivača u betonskom temelju dan je izrazom:

$$R_a = \frac{\theta_u}{2 \cdot \pi \cdot l} \cdot \ln \left(\frac{2 \cdot l^2}{a \cdot h} \right) = \frac{200}{2 \cdot \pi \cdot 150} \cdot \ln \left(\frac{2 \cdot 150^2}{0,025 \cdot 1,5} \right) = 2,97 \, \Omega \quad (8)$$

gdje su: θ_u - ukupni specifični otpor (beton + zemlja) 200 [Ω /m], l - dužina trake uzemljivača 150 m, a - širina trake uzemljivača 0,025 m i h - dubina polaganja uzemljivača 1,5 m.

Uvjet zaštite strujnom diferencijalnom sklopkom je da je $R_a \times I_a < 50$ V, gdje je I_a struja djelovanja diferencijalne zaštite.

2.2. Pad napona na izmjeničnoj (AC) strani

Pad napona instaliranih vodiča treba udovoljavati odredbama članka 20 "Pravilnika o tehničkim normativima za električne instalacije niskog napona (NN br. 53/88)". Dozvoljeni pad napona između točke priključenja električne instalacije i bilo kojeg drugog strujnog izvoda ne smije biti veći:

- za elektranu 3 %, za ostala trošila 5 % pri napajanju iz mreže niskog napona i
- za rasvjetu 5 %, za ostala trošila 8 % pri napajanju iz trafostanice (primar na VN).

Za dužine vodiča >100 m dozvoljeno povećanje iznosi 0,005 % po metru dužnome, ali najviše 0,5 %. Pad napona u postotku u jednofaznim strujnim krugovima pri 20° C dan je izrazom (9), a za trofazne strujne krugove izrazom (10).

$$u = \frac{2 \cdot l \cdot P \cdot \rho \cdot 10^5}{U^2 \cdot A} \quad (9)$$

$$u = \frac{l \cdot P \cdot \rho \cdot 10^5}{U^2 \cdot A} \quad (10)$$

gdje su: l -duljina kabela [m], P -radna električna snaga [kW], U -napon [V], A -presjek [mm²] i ρ -specifični otpor vodiča (aluminij 0,02874 [Ωmm²/m], bakar 0,01793 [Ωmm²/m]).

Iz tabele 4 vidi se da odabrani kabeli zadovoljavaju dozvoljeni pad napona.

Tabela 4. Izračun pada napona na vodičima

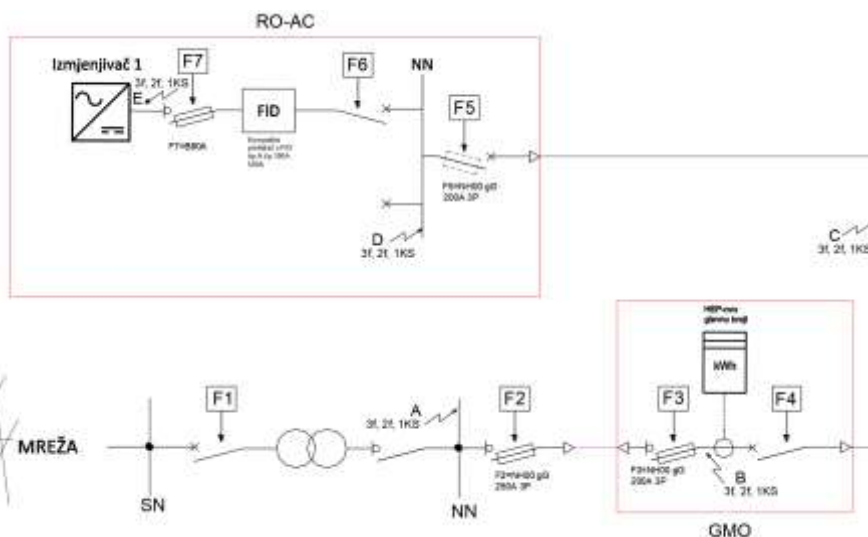
Dionica vodiča		Tip kabela	Presjek [mm ²]	Vodič	Duljina [m]	P [kW]	Napon [V]	Pad napona u [%]	u [%] < 3%
Izmjenjivač	RO-AC	NYY-J 4x50 mm ²	50	Cu	2	50	400	0,022	DA
RO-DC	GRO	NYY-J 4x50 mm ²	50	Cu	40	50	400	0,448	DA

3. SUSTAV ZAŠTITE DISTRIBUTIVNE MREŽE S PRIJEDLOGOM RJEŠENJA

Do odvajanja fotonaponske elektrane od mreže dolazi zbog poremećaja na elektrani ili samoj mreži koje su međusobno u paralelnom režimu rada. U slučaju ispada mreže, elektrana se mora automatski odvojiti kako dio mreže ne bi ostao pod naponom te se time ugrozio život djelatnika koji rade popravke na mreži. U fotonaponsku elektranu se ugrađuju podnaponska i nadnaponska zaštita, te su u upotrebi aktivne zaštite od otočnog režima kao što su: zaštite od pomaka vektora napona, detekcija brze promjene frekvencije i mjerenje impedancije mreže. Aktivna zaštita se koristi iz razloga što pasivna zaštita ne može prepoznati otočni pogon jer nema mogućnost da definira odstupanja na mreži i

- prekid velikih vrijednosti struja KS iz mreže u kratkom vremenu i
- prekid malih vrijednosti struja KS iz elektrane u kratkom vremenu.

an osigurač sa svojom $I-t$ karakteristikom treba zadovoljiti prethodno navedene zahtjeve, što bi značilo da mora izdvojiti samo dio mreže koji je u kvaru što je gotovo nemoguće. Dakle u takvim situacijama, da bi se zadovoljila oba zahtjeva, koriste se dodatne zaštite, koje se pri propadu napona isključuju preko releja. Predviđa se, u slučaju izloženom u određenoj točki mreže, prorada zaštitnih elemenata koji se nalaze na NN i djelom na strani mreže. Otočni pogon za fotonaponsku elektranu s mrežom je gotovo nemoguće, pa je potrebna simulacije i proračuni pri kvarovima na SN dijelu mreže.



Slika 3. Shema spajanja FN elektrane na postrojenje trafostanice

Obveza ODS-a je osigurati selektivnu zaštitu u trafo polju TS Y/SN prema zaštiti (F1). (F1) je u pravilu gG osigurač pod oznakom NH00 visokoučinski ili može biti relejna zaštita čiji impuls ima utjecaj na isklonni krug prekidača u SN dijelu transformatora. Treba paziti na opseg podešenja djelovanja pri odabiru releja koji obično imaju 2 stupnja djelovanja nadstrujne zaštite sa sporim " $I>$ " i brzim " $I>>$ " stupnjem u slučaju kad je " $I>$ " s vremenskim zatezanjem po krivulji $I-t$. (F1) ima funkciju šticećenja do mjesta gdje se nalazi prvi rastalni osigurač (F2). Zaštita (F1) u sporom stupnju ima funkciju nadstrujne zaštite transformatora, te ga štiti od visokih temperatura tokom preopterećenja iznad propisanih vrijednosti. U brzom stupnju zaštite prepoznaje KS na NN i SN djelu transformatora, što je prikazano kvarom A na slici 3. U brzom stupnju zaštite prihvatljiva struja podešenja je minimalna struja KS na NN djelu trafostanice preračunata na SN strani. Osigurač karakteristike gG (F2) se ugrađuje u NN djelu trafostanice. Glavna zona šticećenja je od mjesta ugradnje do dovodnog osigurača koji se nalazi u GMO-e pod oznakom (F3) te isti osigurač (F5). S osiguračima (F3) i (F5) ujedno se štiti i kabel što povezuje RO-AC i GMO. (F2) se dimenzionira prema maksimalnoj i minimalnoj struji KS na kraju strujnog kruga. Dakle selektivnost pri kvaru na kraju dionice mora zadovoljiti osjetljivost i vrijeme prorade.

Na prijelazu elektrane i mreže ugrađuje se prekidač (F4) koji je upravljan od strane ODS-a. Prekidač (F4) ima zaštitnu funkciju odvajanja od mjesta ugradnje pa do prekidača/osigurača SE (F5). Zaštitne funkcije prekidača (F4) su podnaponska " $U<$ " i nadnaponska " $U>$ " zaštita, neusmjerena nadstrujna zaštita (spori " $I>$ " te brzi " $I>>$ " stupanj) i podfrekventna " $f<$ " i nadfrekventna " $f>$ " zaštita. Spori " $I>$ " te brzi " $I>>$ " stupnjevi nadstrujne zaštite (F4) parametriraju se za jedan stupanj više nego kod zaštite (F5). Naravno, takva podešenja moraju izdržati i reagirati na kvar C. S gledišta izmjenjivača na strani fotonaponske elektrane prekidač (F4) predstavlja rezervni stupanj zaštite glede naponske i frekventne zaštite. Podešenja frekventnih zaštita na prekidaču za odvajanje s mreže, poželjno je zaštitu podesiti na jednake vrijednosti kao i u izmjenjivaču. Vremensko odstupanje je dozvoljeno od 0,2 min.

Da ne bi došlo do isklopa tokom poremećaja kao što je tranzijenta pojava u SN mreži, moguće je izvesti produljenje vremena djelovanja prekidača s dodatnih 1,5 s za stupanj podnaponske zaštite. Da bi vrijednost prorade " $U<$ " bila poznata, treba ispitati najkritičnije slučajeve propada napona, dakle odrediti najveću osjetljivost. Kod ovakve zaštite napajanje se ne smije omogućiti preko napona koji se štiti točnije koji je propao jer bi se time dovelo u pitanje funkcionalnost prekidača za odvajanje. Stoga je potrebno stabilno napajanje koje nema velike utjecaje s mrežom. Pri podešavanju nadnaponskih zaštita moguća su dva stupnja prilikom odvajanja: spori stupanj " $U>$ " i brzi stupanj " $U>>$ ". Aktivacijska vrijednost brzog stupnja može se podesiti do $1,15U_n$, s vremenom prorade $\leq 0,5$ sek, dok spori stupanj se parametrira na vrijednost $1,1U_n$, s vremenom djelovanja do 10 sek. Sa tako podešenim stupnjevima moguć je privremeni porast napona koji nema štetnih utjecaja na ostale dijelove mreže, te se onemogućuje povišenje napona na mjestu priključka koji može dovesti do oštećenja. U koliko je samo 1 stupanj zaštite tipa spori, tada ga se podešava tako da ne dozvoljava $\leq 0,5$ sek povišenje napona od

vrijednosti 10 % nazivnog napona. Ako su vrijednosti veće tada se može povećati vrijednost, ali se mora skratiti vrijeme djelovanja.

(F5) je glavni element za odvajanje elektrane od mreže kojem je zona šticeanja od mjesta instalacije pa do kompaktne zaštite (FID-F6) svakog izmjenjivača zasebno. (F5) opcionalno ima dva stupnja ukoliko je relejna nadstrujna zaštite (spora " $I >$ ") i (brza " $I >>$ "). To su uglavnom prekidači s magnetskim i termičkim prekidnim članom s definiranom $I-t$ krivuljom prekidanja (nema podešavanja vremenskih zatezanja). Spori stupanj zaštite se postavlja pri $1,2I_n$ vrijednosti budući da izmjenjivači mogu isporučiti snagu KS koliko dozvoljavaju fotonaponski paneli, a takve snage su male vrijednosti. Ukoliko se podesi na $1,2I_n$ tada se osigurava, ako se mjesto greške napaja iz elektrane, da struja KS na mjestu greške ne ide preko vrijednost prorade " $I >$ " zaštite prekidača (F5). Brzi stupanj zaštite (F5) se podešava na vrijednost minimalnog KS označenog s D. Zaštita (F7) je zadnja zaštita u nizu te se smatra kao rezervni stupanj zaštite pri grešci na strani izmjenjivača.

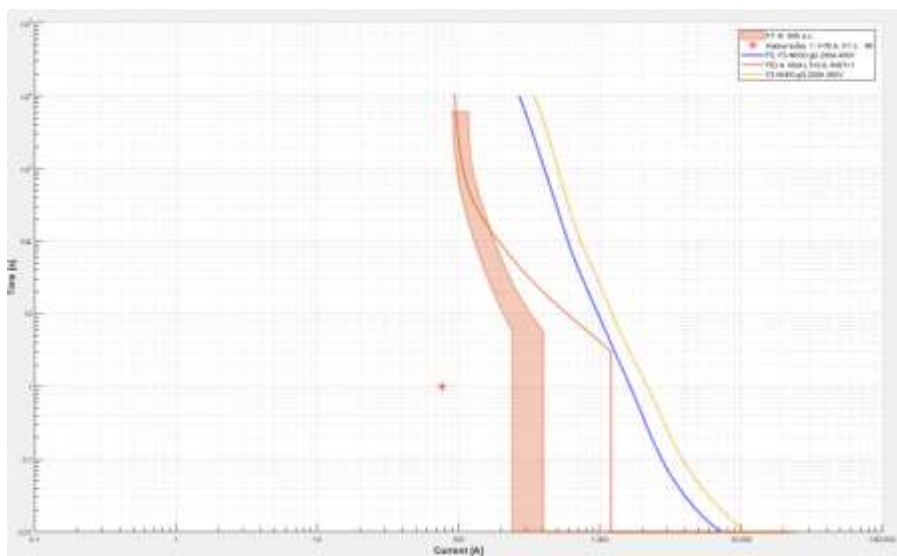
Uglavnom se radi o automatskom osiguraču B ili C karakteristike isključenja. Izmjenjivač ima u sebi integrirane frekventne i naponske zaštite. Frekventne zaštite štite sustav u slučaju da se ravnoteža proizvodnje i potrošnje poremeti.

Što se naponskih zaštita tiče, pokriven je dio sa prenaponima, do isključenja dolazi nakon 10 minutnih mjerenja srednje vrijednosti napona ili momentalno dolazi do odvajanje ako napon pređe 10% nazivnog napona. U slučaju KS na NN sabirnicama u trafostanici, tada treba utvrditi iznos za podnaponsku zaštitu na mjestu izmjenjivača i to je mjesto kvara A. Strujno vremenska karakteristika je prikazana na slici 4. Vidljivo je selektivno podešenje, te se graf koristi i za daljnje provjere. Cilj je postići selektivnost između pojedinih uređaja zaštite pri određenim strujama greške te se mora postići selektivnost za sve kvarove koji su simulirani.

Razlikujemo 3 vrste zaštite:

- frekventna (šticeanje na izmjenjivaču te na prekidaču za odvajanje),
- naponska (šticeanje na izmjenjivaču te na prekidaču za odvajanje) i
- nadstrujna u koliko zataji, tada djeluje podnaponska zaštita.

Ukoliko za neki kvar nije postignuta selektivnost, potrebno u elaboratu pojasniti zašto nije i navesti moguće posljedice.



Slika 4. Karakteristika isključenja zaštitnih elemenata

4. ZAKLJUČAK

U radu je prikazano priključenje fotonaponske elektrane snage 54,5 kW paralelno na mrežu. Kako se radi o elektrani snage veće od 30 kW potrebno je izraditi Elaborat podešenja zaštite u elektrani i mreži. Priključenjem fotonaponske elektrane u distribucijsku mrežu dolazi do promjene tokova struja kvara. Struje kvara osim iz mrežnog izvora sada teku i iz elektrane. Posebnu pažnju treba obratiti na selektivnost zaštita jer postoji veliki broj razina zaštita, a vremena djelovanja su kratka. Nadalje, potrebno je da predviđeni zaštitni sklopovi budu kompatibilni s postojećima.

Nakon detaljne analize i izrade projekta pokazano je da je solarna elektrana isplativa i ekonomski opravdana. Investicija se prema procjeni isplati nakon 8 godina rada elektrane. Ulaskom u Europsku Uniju Republika Hrvatska iskorištava svoje potencijale te ulaže u razvoj obnovljivih izvora davanjem naknada za proizvodnju električne energije iz obnovljivih izvora.

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CONNECTION OF PHOTOVOLTAIC SYSTEMS ON THE NETWORK

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ABSTRACT:

With the increase in the need for "cleaner" energy, renewable energy sources are gaining importance. The development of renewable sources is encouraged due to the increase in the price of fossil fuels and environmental pollution. One of the renewable energy sources is the Sun.

Photovoltaic systems, their connection to the grid and the application of photovoltaic systems in practice will be described. A photovoltaic system is a set of equipment that converts the solar energy of the sun into electricity. They are divided into two groups: systems that are connected to the public power grid and systems that are not connected to the public power grid. They are ecologically acceptable and are increasingly used. Using solar energy contributes to environmental protection and reduced carbon dioxide (CO₂), which is one of the causes of global warming.

The conversion technology is clean, it is possible to supply consumers where there is no power system, photovoltaic modules have a long service life and are easy to maintain. In addition to all these advantages, it should be emphasized that energy production depends on the amount of sunlight and the area of the space where the photovoltaic modules are located.

The Republic of Croatia has a great potential for the use of solar energy, which has been exploited more and more recently.

Keywords: photovoltaic module, photovoltaic system, power grid, environmental impact

UTICAJ POLOŽAJA I ORIJENTACIJE STANA NA NJEGOVE ENERGETSKE PERFORMANSE

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SAŽETAK:

Ovaj rad ima za cilj da utvrdi koliko je značajna orijentacija stana u zgradi u zavisnosti od energetske potrebe za grejanje stana. Prema pravilniku o energetske efikasnosti zgrada u Srbiji postoji mogućnost izdavanja sertifikata za deo zgrade, kao što je stan. Ova mera je postavljena da bi se omogućilo vlasnicima ili zakupcima zgrade ili jedinice zgrade da procene i uporede njene energetske performanse. Iz perspektive korisnika, ova mera je veoma važna jer bi, osim sagledavanja kvaliteta ili nedostataka prostora u kome žive, bila važan parametar ekonomske ocene stana u budućnosti. U radu će se analizirati i uporediti ove vrednosti za različite položaje u horizontalnom i vertikalnom položaju istog stana u zgradi. U radu će biti korišćen projekat postojeće stambene zgrade u Novom Pazaru, koja je tipično građena osamdesetih godina prošlog veka. U skladu sa tim, kvantitativno će se pokazati u kojoj meri dispozicija i orijentacija stana utiču na njegove energetske performanse.

Ključne riječi: energetske karakteristike, zgrada, individualni stan, dispozicija, orijentacija, zakonodavstvo

1. UVOD

Ovaj rad ima za cilj da ispita energetske performanse zgrade i njenih nezavisnih delova. Naime, prema važećem nacionalnom pravilniku o uslovima, sadržaju i načinu izdavanja sertifikata o energetske svojstvima zgrada iz 2011. godine u članu 13, naglašeno je da se energetske pasoš izdaje za celu zgradu ili deo zgrade kada je definisana kao zgrada sa više energetske zona [1]. U skladu sa tim, kupac ili zakupac stana kao nezavisnog dela stambene zgrade ili kupac poslovnog prostora u okviru poslovne ili stambeno-poslovne zgrade ili bilo koje zgrade mešovite namene, treba da ima uvid u energetske svojstva dela objekta koji kupuje ili iznajmljuje. Sertifikat o energetske svojstvima uključuje energetske performanse zgrade i referentne vrednosti, kao što su minimalni zahtevi energetske performansi, kako bi se omogućilo vlasnicima ili zakupcima zgrade ili građevinske jedinice da uporede i ocene njegove energetske performanse [2]. Kupac ili zakupac prostora u skladu sa tom informacijom treba da donese adekvatnu ekonomsku odluku o svojoj investiciji. Orijetacija objekta, pozicija i procenat transparentnih površina na fasadi i zoniranje unutrašnjeg prostora predstavljaju bitan faktor uticaja na energetske potrebe zgrade [3].

Na ovaj način postoji mogućnost energetske sertifikacije stanova, kao zasebnih delova zgrade, ali se takva praksa retko primenjuje. U Novom Pazaru (Republika Srbija) je trenutno u ekspanziji građevinski sektor, gde je primetna izgradnja velikog broja stambenih objekata. Sami objekti su različite pozicije u odnosu na strane sveta. Ono što bitno utiče na energetska svojstva stambenih jedinica jeste pozicija stana u horizontalnom i vertikalnom planu. Pozicija stana stambene zgrade skeletne konstrukcije jeste istražena tema [4], gde postoji veliki procenat zastakljenja na fasadi. U ovom radu biće ispitan položaj stana kod zgrade u masivnom konstruktivnom sklopu, sa manjim procentom zastakljenja. U skladu sa tim, u radu su ispitana energetska svojstva jednog stana u zgradi, koji je multiplikovan kroz projekat i izgradnju zgrade. Na ovom jednom konkretnom primeru analiziran je jedan stan koji je tretiran tipološki prema orijentaciji u odnosu na strane sveta (istok, zapad, sever, jug) i u odnosu na vertikalni položaj u zgradi (prizemlje, između spratova, poslednji sprat). Prema tome vrednovani su 12 tipova jednog stana prema njegovim energetske svojstvima.

2. REFERENTNI TIP STAMBENE ZGRADE

Za potrebe ovog istraživanja potrebno je bilo odabrati referentan tip stambene zgrade u Novom Pazaru koji bi poslužio kao model za ispitivanje energetske svojstva stambene jedinice. Obzirom da je posle drugog svetskog rata nastupila intenzivna stambena gradnja zgrada za kolektivno stanovanje, odabran je tip zgrade iz perioda sa kraja sedamdesetih i početka osamdesetih godina vrlo prepoznatljive arhitekture za Novi Pazar i okolinu.

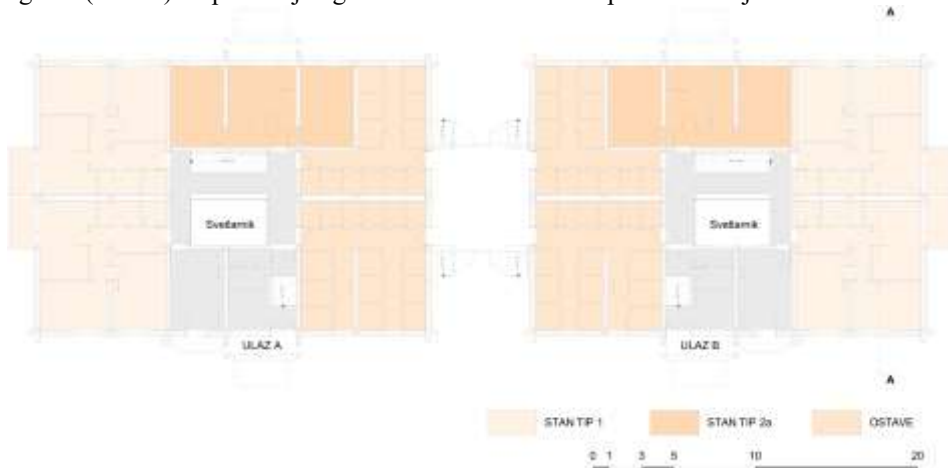
Činjenicom da je sa povećanom industrijskom proizvodnjom i otvaranjem velikog broja fabrika i preduzeća posredstvom migracija lokalnog stanovništva iz sela u grad, kao posledica javlja se potreba za rešavanjem stambenog pitanja u gradu. Prema tome nastala je izgradnja tipoloških zgrada koje su bile namenjene prvenstveno za radnike. Važno je istaći da je to bio period kada u domaćem zakonodavstvu nije bilo toplotnih propisa, što stvara potrebu da se ovaj stambeni fond razmotri u kontekstu energetske sanacije u narednom periodu. Stoga bi ova studija mogla predstavljati smernicu za buduće intervencije.

Ovaj tip stambenog objekta građen je kao slobodnostojeća zgrada sa jednim ili dva ulaza u zavisnosti od površine građevinske parcele na kojoj je predviđena gradnja ovakvog tipa objekta. Zajedničko za sve objekte jeste to da su u urbanističkom pogledu pozicionirani u pravcu sever-jug, zarotirani prema istoku za 8° (Fig. 1). Svi objekti, bilo sa jednim ili dva ulaza na uglu sadrže stambenu jedinicu iste strukture i istog programskog rešenja.



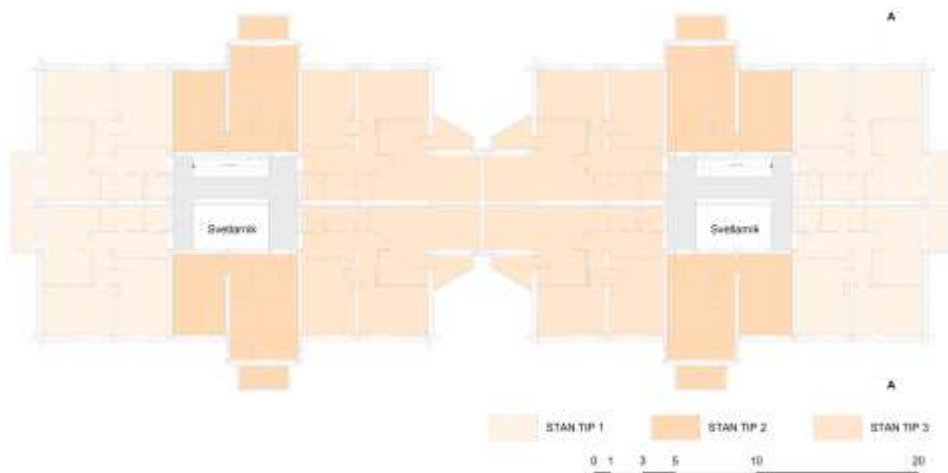
Slika 1. Situacioni plan, pozicija i orijentacija referentnih objekata

Zgrade su čisto stambene namene spratnosti P+4. Ulaz u objekat je sa istočne strane zgrade koji vodi do jednokrakog stepeništa koje je osvetljeno svetlarnikom u sredini zgrade (slika 2). U prizemlju zgrade nalaze se tri stana i prostor za zajedničke ostave.



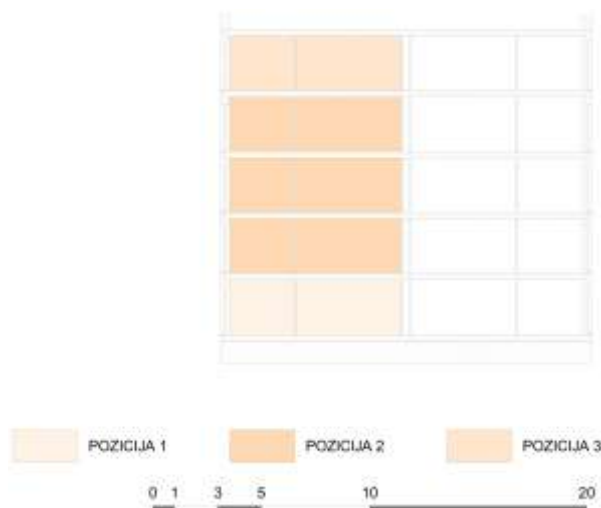
Slika 2. Osnova prizemlja

Zgrada sa jednim ulazom poseduje dve različite strukture stana (dvosoban i trosoban), odnosno dva tipa stana koji su multiplikovani rotacijom ili postavljeni u ogledalu čime se formira 6 stanova po spratu. Zgrada sa dva ulaza poseduje tri različite strukture stana (dvosoban i dva trosobna), odnosno tri tipa stana koji su multiplikovani rotacijom ili postavljeni u ogledalu čime se formira 12 stanova po spratu (Slika 3).



Slika 3. Osnova sprata

Obzirom da se stanovi tip 2 i tip 3 ne nalaze u prizemlju, odnosno, ne nalaze se na ploči na tlu već iznad prostora zajedničkih prostorija ostava i horizontalnih komunikacija, nije bilo moguće u potpunosti i njih uključiti u ovakav način poređenja energetskih svojstava stambenih jedinica. Stan koji je odabran za analizu u ovom radu jeste stan tip 1 koji se nalazi na uglu zgrade, po strukturi trosoban i nalazi se na svim etažama zgrade bez strukturnih promena (Slika 4). Ova stambena jedinica se sastoji od: dnevne sobe sa kuhinjom i trpezarijom, dve spavaće sobe, hodnika, kupatila, ostave i balkona. Dnevna soba sa kuhinjom i trpezarijom i spavaće dobe imaju dnevno osvetljenje dok ostale prostorije nemaju. U radu će biti ispitane karakteristike stambenih jedinica sa pozicijom stana u prizemlju, zatim stana između spratova i stana na poslednjem spratu.



Slika 4. Osnova sprata

Objekat je građen u masivnom konstruktivnom sistemu sa nosećim zidovima od opeke, sa spoljnim zidovima debljine 38cm i unutrašnjim debljine 25 cm, dok su pregradni zidovi od opeke debljine 6,5cm svi malterisani u produžnom malteru sa unutrašnje ili sa obe strane. Međuspratna konstrukcija jeste TM3 konstrukcija sa finalnom oblogom poda parketom ili keramičkim pločicama, u zavisnosti od namene prostorije. Krovna konstrukcija je rešena kao ravan krov sa hidroizolacionim slojem i tarolitim 5cm kao termoizolacionim slojem. Spoljna stolarija jeste rešena sa prozorima i balkonskim vratima izrađenim u drvetu i dvostrukim zastakljenjem u sistemu krilo na krilo. Zastor prozora i balkonskih vrata jeste platnena roletna sa unutrašnje strane. Ploča na tlu je bez termoizolacionog sloja.

Obzirom da je zgrada u funkciji već više decenija i da su vlasnici stanova vršili izmene stolarije i rekonstrukcije zgrade u smislu zastakljenja balkona i slično (Slika 5), u radu su korišćeni podaci iz projektne dokumentacije Istorijaskog arhiva Ras [5].

3. REZULTATI I DISKUSIJA

Formiranje modela za proračun energetske efikasnosti zasniva se na Pravilniku o energetske efikasnosti zgrada RS [6] čime se prvenstveno definiše da je stepenišni prostor negrejan dok su stambene jedinice grejan prostor. Svi tipovi stanova jesu iste funkcionalne strukture i iste površine toplotnog omotača, površine i zapremine stambene jedinice, ali se razlikuju u orijentaciji prozora i balkonskih vrata i strukturi netransparentnih elemenata u omotaču zgrade prvenstveno u strukturi podne i međuspratne konstrukcije. Različitost položaja, orijentacije i strukture omotača stanova treba da ukažu na različitosti

transmissionih gubitaka kroz omotač i različitosti solarnih dobitaka, što predstavlja osnov za ovaj istraživački rad.

Na osnovu definisanih kriterijuma izračunate su energetske potrebe za sve položaje uspostavljenih stanova (horizontalno i vertikalno) i moguće orijentacije.

U tabeli 1 prikazane su karakteristike termičkog omotača prema Pravilniku o energetskej efikasnosti zgrada Republike Srbije.

Tabela 1. Karakteristike termičkog omotača, koeficijent transmisisionog gubitka toplote H_T (W/K)

Konstrukcija	Poz. 1 (m ²)	Poz. 2 (m ²)	Poz. 3 (m ²)	U (W/m ² K)	F_{xi}	H_T Poz. 1 (W/K)	H_T Poz. 2 (W/K)	H_T Poz. 3 (W/K)
Spoljni zid opeka 38cm	34,33	34,33	34,33	1,233	1	42,33	42,33	42,33
Unutrašnji zid 1	19,53	19,53	19,53	1,533	0,8	23,95	23,95	23,95
Unutrašnji zid 2	12,6	12,6	12,6	1,502	0,8	15,14	15,14	15,14
Unutrašnji zid 3	4,43	4,43	4,43	1,397	0,5	3,09	3,09	3,09
MK između stanova	58,5	117	58,5	1,306	0,8	61,12	122,24	61,12
MK ravan krov	0	0	58,5	0,581	1	0	0	33,99
Ploča na tlu	58,5	0	0	1,575	0,5	46,07	0	0
Prozor 140/220	6,16	6,16	6,16	2,73	1	16,82	16,82	16,82
Prozor 60/60	0,36	0,36	0,36	2,48	1	0,89	0,89	0,89
Prozor 80/220	1,76	1,76	1,76	2,71	1	4,77	4,77	4,77
Prozor 80/140	1,12	1,12	1,12	2,67	1	2,99	2,99	2,99
Ulazna vrata	2,3	2,3	2,3	1,6	1	3,68	3,68	3,68
Ukupno	199,59					240,81	255,86	228,73

U tabeli 2 prikazan je specifičan transmisisioni gubitak H'_T .

Tabela 2. Karakteristike termičkog omotača, specifičan transmisisioni gubitak H'_T (W/m²K)

Poz. 1 H'_T (W/K)	Poz. 2 H'_T (W/K)	Poz. 3 H'_T (W/K)
1,21	1,28	1,15

Prema podacima iz Tabele 1 možemo konstatovati da stan tip 1 ukoliko se nalazi na poslednjem spratu imaće najmanje transmisisionih gubitaka, zatim stan u prizemlju i na kraju ukoliko se nalazi između spratova imaće najviše gubitaka.

U Tabeli 3 prikazani su solarni dobitci kroz transparentne površine omotača. Prozore i balkonska vrata karakteriše dvostruko zastakljenje sa stepenom propuštanja solarnog zračenja $g=0,72$.

Tabela 3. Solarni dobitci (kWh)

<i>Orijentacija stana</i>	Severo-zapad (kWh)	Severo-istok (kWh)	Jugo-zapad (kWh)	Jugo-istok (kWh)
Prozor 140/220	742,45	742,45	742,45	742,45
Prozor 60/60	11,16	11,16	35,03	35,03
Prozor 80/220	99,22	99,22	311,35	311,35
Prozor 80/140	57,88	57,88	181,62	181,62
Ukupno	910,72	910,72	1270,45	1270,45

Prema podacima iz Tabele 3 možemo konstatovati da se ostvarena količina solarne energije bitno razlikuje u zavisnosti od orijentacije stana tipa 1. Stanovi južne orijentacije ostvaruju 39,5% više solarnih dobitaka od stanova severne orijentacije.

Na osnovu svega navedenog energetske najpovoljniji stanovi tipa 1 ove zgrade jesu stanovi na poslednjem spratu jugozapadne i jugoistočne orijentacije.

3. ZAKLJUČAK

Orijentacija zgrade, kao i pozicija i orijentacija zasebnih funkcionalnih celina zgrade imaju jako bitan uticaj na energetske karakteristike zgrade. Ukoliko je omotač funkcionalnih jedinica isti, orijentacija i položaj imaju presudan uticaj na energetske potrebe zgrade. Ovde je diskutovana zgrada koje je građena u masivnom sistemu gradnje, sa prozorima i balkonskim vratima minimalne veličine i sa malim procentnim transparentnim površinama na fasadi zgrade. Zgrada koja u prizemlju ima stanove, perionicu i ostave, zatim svetlarnik kao rešenje osvetljenja horizontalnih i vertikalnih komunikacija, u današnjoj graditeljskoj praksi u Republici Srbiji redak je slučaj. Obzirom na aktuelne cene nekretnina racionalno korišćenje prostora svakom investitoru jeste prioritet. U skladu sa povećanom cenom energenata svakom kupcu ili zakupci je prioritet da kupi ili iznajmi stan za koji je potrebna što manja količina toplotne energije a da se ne naruši toplotni komfor. Ovim radom se ukazuje na energetskej različitosti istog stana i poziva na bolju informisanost kupaca pri kupovini stanova.

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THE INFLUENCE OF THE POSITION AND ORIENTATION OF THE APARTMENT ON ITS ENERGY PERFORMANCE

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ABSTRACT:

This paper aims to determine how important the orientation of the apartment in the building is depending on the energy needs for heating the apartment. According to the rulebook on energy efficiency of buildings in Serbia, there is a possibility to issue a certificate for a part of the building, such as an apartment. This measure was set in order to make it possible for owners or tenants of the building or the building unit to assess and compare its energy performance. From the user's perspective this measure is very important since, apart from reviewing the quality or the deficiencies of space in which they live, it would be an important parameter of economic evaluation of the apartment in the future. The paper will analyze and compare these values for different positions in the horizontal and vertical position of the same apartment in the building. The paper will use the project of the existing residential building in Novi Pazar, which was built as a typical in 1980s. In accordance with that, it will be quantitatively shown to what extent the disposition and orientation of the apartment affect its energy performance.

Keywords: energy performance, building, individual dwelling, disposition, orientation, legislation

THE BUILDING TECHNOLOGY OF PASSIVE AND LOW-ENERGY HOUSEHOLDS

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ABSTRACT:

The buildability in an energy-efficient (passive) design is crucial. Low-energy and passive household designs are getting ubiquitous. The target is to design sustainably urban quarters, and residential and social housings, which are led by climate protection and less energy consumption principles. These building principles get deeper with the years passing by. The new building materials define new architectonic forms, new building technologies, and ways of using them. The focus is also the up-build with 3D printing technologies. Prefabricated 3D building elements and 3D layering on building sites is a fast building technology, which breaks through internationally. With 3D printing applied in civil engineering, the building molds are obtained.

Keywords: *buildability, passive design, less energy consumption principles, 3D layering on building sites*

1. INTRODUCTION

Scotland recently mandated the use of passive house design standards for all new social housing by 2024, after the country's first-ever passive house social housing development in Stirlingshire. The passive house design standards were not at first acceptable in Nordic climates, moreover, they were adjustable and with raised values. For example, in North-East Finland the heating demand was set up to the 30 kWh/m², for Central Finland 25 kWh/m² and for the Coastal Finnish Area 20 kWh/m², which is more than a standardized heating value per square meter, (15 kWh/m²) for a passive house [1]. The high-quality passive house is mirrored in extraordinary workmanship.

The ideal craftsmanship of a passive household enables 1.5 liters of oil or 1.5 m³ of natural gas to heat a square meter of living space, while for the conventional building, the stock is needed 6 to 10 liters of oil per square meter for heating [2].

Passive households have been tested and proven in over 45 countries across the globe since its inception.

In this manuscript, the main buildings' energy efficiency postulates were addressed and drawn from the streamline. The question being asked is where does the buildings' energy

efficiency end up and how much it is related to the building aesthetics that is currently pursued.

2. ENERGY-EFFICIENT DESIGN OF HOUSEHOLDS

With the 21st century going on, the building envelope has a blazing significance, such as the submarine's hull or even the human's skin. In the past, the thermal transmittance coefficient U of the windows was $3 \text{ W/m}^2\text{K}$. Today, the thermal transmittance value U of the windows is below $0.80 \text{ W/m}^2\text{K}$, and U values for the (exterior walls, roofs, ground, and ceilings) are ranging among 0.08 and $0.18 \text{ W/m}^2\text{K}$ [3]. The mandatory heat recovery system within each passive-energy household, keeps the rooms warmed up during the winter season and chilly during the summer season. The passive-energy households are not particularly heated up throughout autumn and spring.

As for the layout of electrical devices in the passive-energy household, the radiators should not be posed underneath the windows; the refrigerators should not be beside the stoves and the ovens; the kitchens should not be in the proximity of bathrooms and toilets because of mixing vapors; and the sockets should be evenly distributed throughout the household. Within the passive-energy households, intelligent engineering solutions are engraved, such as acoustic vapor membranes, full interior plastering, sandwich panels as claddings, reinforced building paper, and various composite boards.

The dew point in the passive households leaves no trace to the building envelope because passive households tend not to be moisturized on the wall surfaces. The pleasant indoor temperature is maintained throughout the day, even with the superior building elements such as the Trombe wall or with incorporated smart materials such as phase-change materials. Cross ventilation through opened windows during the day or night can passively cool the indoors. There are also internal and external blinds, with whom the interior is darkened sufficiently at the heat gusts during the summer season, while during the winter season, the accomplished interior temperature is maintained.

When the phase-change materials are integrated into the building walls, the walls ought to be rather slender, so that PCM can show its effectiveness. The PCM layer in the building walls combined with the thermal insulation is recommended to be third, because the thermal insulation placed ahead of it, has a buffer effect [4].

In Fig.1. are displayed the inner configurations of walls in passive-energy dwellings. The walls are thick approximately 30 cm with an overall thermal transmittance coefficient U less or equal to $0.15 \text{ W/m}^2\text{K}$. The walls contain wooden box beams, plywood I-beams, polystyrol foams, exterior insulating finishing systems, porous concrete, expanded clay, and polyurethane sandwich elements.

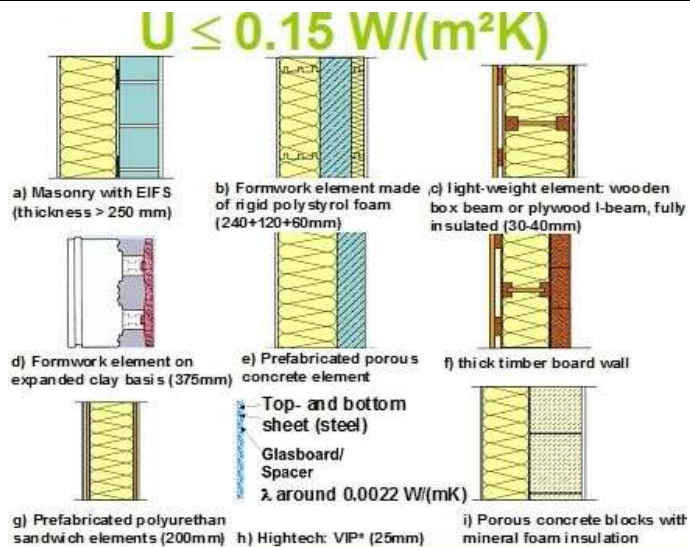


Fig.1. Different wall configurations in passive households [5]

In Fig. 2. is displayed a prefabricated wall, consisting of fiberboards, vapor-permeable membrane, OSB board, and plasterboard panels on the inner and outer surfaces of the wall [6].

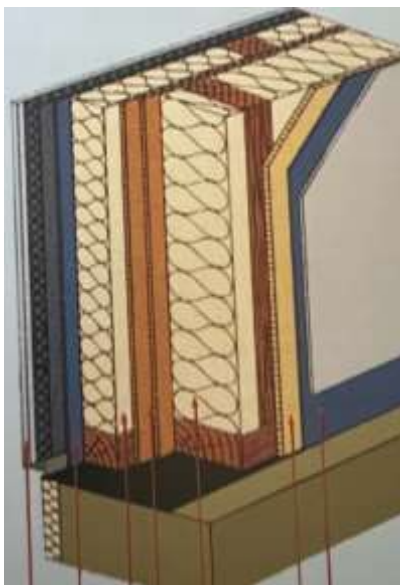


Fig.2. A prefabricated wall configuration [6]

3. AESTHETICS OF THE BUILT

Aesthetic standards frame the functionality of the building. The different styles appear in vernacular architectonic forms: french windows, balconies overgrown in plants, hothouses, Trombe wall specimens, open mansards, movable facades, etc. Precast and cast 3D printing elements, can find their application in the form of partition walls, in museums, restaurants, building sites, artistic buildings, and office buildings.

Skyscrapers or tall buildings tend to leave an impression in a town's silhouette and the tops of such buildings offer distinctive skylines. The tall building blocks follow Sullivan's, base-shaft-top" design pattern. At the beginning of the 20th century, the aesthetics of the building ruled the Gothic revivalism with pinnacles and gargoyles [7].

Vertical greening systems as the green facades are constituted of merged cables, meshes, and planting boxes, set at different altitudes. They revivify the building envelopes and retain redundant water [8].

As for the passive-energy households, they can be conceived as cottages, up-to-date villas, multi-story housings, sheet metal container houses, etc.

Furnished buildings from medieval times, decorated with plaster works on facades, are still preserved as special pearls in different corners of the world. The cultural patrimony is still cherished especially through a building stock.

The Milanese " Bosco Verticale", in Fig.3., are two prototype spires, respectively 80 and 112 meters high, housing a total of 800 tree species. The facades of the building blocks have a porcelain stoneware finish, that reminds of the bark (crust) of the trees. The tree species are just allocated on the balconies, and there are no artificial substrates on the facades or in front of the facades [9]. Around 30 thousand square meters of woodland is situated on 3 thousand square meters of the urban surface. The trees regulate the exterior humidity, produce oxygen, filter the sun rays and make the shades, etc. Plants of different sizes, high trees, perennials, and shrubs create a green curtain and outline the aesthetics of the "Bosco Verticale" building blocks. These building blocks synthesized the natural and man-built building forms. In the urban context of Milan, these spires influence the daily temperature swings, and overheating from the sun, by being, "jungle" vegetated buildings.



Fig.3. The Milanese "Bosco Verticale" building blocks

In the up-to-date building's aesthetics, the tempered and glazed glass plays an important role, Fig. 4. It can be designed as a "hide and seek" concept of light and shade. Glass stitches can be visible at the touching or overlapping glass surfaces.



Fig.4. A movable glass facade in Milan's quartier

A TECLA, an eco-sustainable 3D printed habitat was made in Ravenna, Italy, by the Crane WASP –WASP's brand new 3D printer in the construction industry, Fig.5,6,7. This habitat has an orbicular form of housing and it is made up of local soil and other natural and

recyclable materials. The principle of green and circular economy is contained in the raw earth that was exploited as a building material. These small houses were conceived as double domes [10]. Through 3D large printers can be extruded so far: clay, concrete, some metals, nylon, wood fibers, PVA (polyvinyl alcohol), PETG, ABS filament, PLA filament.



Fig.5



Fig.6



Fig.7

Fig.5,6,7. Ravenna's 3D TECLA houses [10]

4. CONCLUSION

Building technology always has drivers. Since this is the era of air robots, i.e. drones, maybe some futuristic building examples will be levitating. The furtherance of the "passive-house" concept will be performance-based. The longevity of passive building examples is shown through their constancy, time-resistance, and quality, although they are still not too much represented across the globe. Multi-lateral designs can be integrated into

a passive-energy household. Passive-energy constructions are more and more lightweight constructions with cast-in modules and assemblies and a shorter time of construction.

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A REVIEW PAPER ON IOT SOLUTIONS FOR OUTDOOR ENVIRONMENTAL MONITORING

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ABSTRACT:

In accordance with the current requirements for constant monitoring of the state of the living environment, and due to the various advantages and constant progress of Internet of Things (IoT) technology, this paper presents some of the architectures suitable for monitoring of, as well as acting on the living environment. Also, the security issues are observed with one solution being given. An architecture example for monitoring terrains that are hard to reach is also given, including the importance of the sensors' sleep mode, especially in such areas, and ways to manage it, with regard to energy efficiency of the system. The notion of Collaborative IoT was also introduced, as well as the importance of applying crowdsensing and IoT agents in these systems. Overall, this paper provides an overview of possible solutions regarding the IoT systems for outdoor environmental monitoring with the comprehensive insight into this field, including rural and urban areas.

Keywords: *Environmental IoT, secure EIoT architecture, energy efficiency, Collaborative IoT*

1. INTRODUCTION

Environmental problems are an increasingly common topic among the human population, due to rapid urbanization and industrialization of cities. The factors of urban environments are often interconnected and can vary significantly in space and time, [1]. For scientists and engineers, observing, modeling and managing environmental processes has always been a demanding task, [2]. Some standard environmental monitoring methods could not keep up with such dynamic needs of urban monitoring and environmental management, [1,3]. Under them, first of all, approaches with data loggers are observed, whose systems have either very little or, more often, no network connection, and the data collected by them are downloaded personally, mostly with a laptop. In today's dynamic conditions, that is simply not enough, [4].

The Internet of Things (IoT) presents a concept that describes a way in which the Internet spreads into people's daily lives by the means of wireless network of objects/things. IoT

is expected to be able to improve the entire process of environmental monitoring, modeling and management, [2]. IoT represents the integration of many recently developed ICT technologies, such as embedded sensors, wireless networks, advanced communication protocols and cloud computing, [1,5]. Particularly, Wireless Sensor Networks (WSNs) represent basic technology for IoT and are the result of advances in the development of wireless communications, [1,6]. The concept of IoT has enabled WSNs to connect to the Internet, using Transmission Control Protocol/Internet Protocol (TCP/IP), [7].

The IoT concept refers to the situations and conditions under which end devices communicate, how they are used or how they are accessed, i.e., how the network manages traffic and how data is processed, [8]. As IoT enables interaction with everyday physical objects, it is a very useful tool in creation environmental monitoring systems, thus enabling a healthier and safer life, [9]. As a result of the aforementioned, the term Environmental Internet of Things (EIoT) was presented, which enables environmental data to be sensed/collected, transmitted and processed in real time, [1].

2. EIOT ARCHITECTURES

It is most often considered that, when talking about a general architecture of an environment monitoring system, such an IoT system consists of three layers in the architecture – a sensor layer for collecting data about the environment, a network layer for transmitting the collected data, and an application layer for processing and analyzing that data, [10]. Thus, the authors in the paper [3] present an architecture of 3 layers – data collection and process layer, network layer and application layer. The first layer contains a multitude of sensors and actuators, which are interconnected and thus form the backbone of EIoT. It is used to collect data about the environment in real time (using sensors) as well as acting on it (using actuators). The second layer realizes the functions of transmitting information about the environment and interconnecting systems. The last, third layer, provides the functions of organizing, storing and processing incoming data. Also, this layer makes decisions about acting on the environment, that is, it gives instructions to the actuators, [3]. Unlike applications in the environment monitoring domain, with just one-way information processing, applications categorized in the environment control domain use a two-way channel of information. Therefore, a new level of communication is added and instructions can be sent back to the field to modify the state of the environment – it is the case of Wireless Sensor and Actuator Networks (WSANs). Actuators, for example, can turn on valves or pumps, can optimize the use of water, fertilizers, etc., [11].

With the development of EIoT, there are more and more new architecture proposals for environmental monitoring. Thus, authors in the paper [2] propose the new EIoT architecture, which contains 4 layers (as shown in Figure 1): perception layer, network layer, middleware layer and application layer. The perception layer consists of devices

and sensors that are used to collect data about the factors of the physical world, for the purpose of monitoring and managing the environment. This includes multi-sensors (a combination of several types of sensors), as well as remote sensing platforms. The network layer performs the basic functions of data transmission, i.e., the interconnection of central systems and remote platforms. Due to the large amount of different sensor devices, this layer needs heterogeneous network access technologies, [3]. In this approach, two subtypes of the network layer are discussed – access networks and transport networks. Access networks are mostly short-range wireless networks (Wi-Fi (IEEE 802.11), ZigBee, Bluetooth), [5,2], and are used to connect sensors during environmental monitoring; transport networks consist of wired or wireless networks of greater range (Ethernet, 2G/3G/4G), [1,2]. The middleware layer is actually a set of data management sub-layers, software/tools and platforms, which are placed between the network layer and the application layer. The application layer has the role of storing, organizing and processing data, [2].

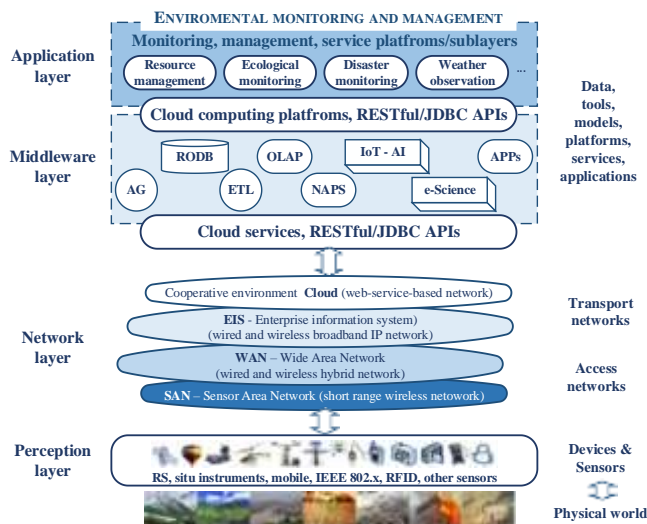


Fig. 1. EIoT architecture with the four layers. *Source:* Redrawn by authors based on [2].

In the paper [1], the authors present a new architecture of 7 layers – sensor layer, transport layer, acquisition layer, storage layer, data layer, application layer and presentation layer. In the sensor layer, with the help of sensors, factors of the living environment are sensed (e.g., air quality, water quality) and the sensors convert these factors into quantitative numerical values or qualitative index numbers (e.g., Air Quality Index, AQI). The transport layer simply transfers the data from the sensor layer to the layer for data collection, the acquisition layer. The data acquisition layer accepts and standardizes data

from the sensor layer in various formats. All received raw environmental data is stored on the fourth layer, the storage layer. The data layer filters and normalizes the raw data. Some data that deviate from the others (outliers) will be either marked or removed from the data set. The data processed in this way can now be used by the application layer. This layer has the function of data analysis, which will identify various patterns about the urban environment and thus environmental models can be developed. The last layer of the architecture, the presentation layer, enables the visualization of data and the distribution of information to the end user.

2.1. Security

One of the main issues is ensuring security in these architectures. A more detailed review of security provision is proposed by the authors in the paper [9]. The proposed architecture consists of 4 layers (as shown in Figure 2): sensing layer, gateway layer, service layer and application layer. The proposed system controls the flow of data by appropriate authentication, authorization and encryption.



Fig. 2. EIoT architecture with a high level of security. *Source:* Redrawn by authors based on [9].

In this proposed EIoT architecture, sensors are authenticated before any data collection is sent to higher layers. Sensor authentication is performed by the gateway at the gateway layer; the ID (IDentification) of the device/sensor is passed to the gateway in an encrypted form, using a hash function. After this step, the next thing is to forward the encrypted data. For data encryption at the sensor level, AES (Advanced Encryption Standard) is used, both at the sensing layer and at the gateway layer. A symmetric AES encryption algorithm is used, i.e., the same secret key used to encrypt data on the first layer will be used on the second layer to decrypt them. When the data is decrypted on the second layer, it is processed, and then re-encrypted and sent to the IoT cloud server (with the help of the Internet), where it decrypts them. Also, with a similar procedure between the second and third layer, data can be protected. The IoT cloud further identifies and authenticates the gateway, with the data being received and stored only after that step. The IoT cloud is also

responsible for authorizing the sensors, to ensure that it is handling the correct data. The IoT cloud also authenticates the user of this system. The application layer provides an interface to the system, while users can monitor and control the system through the user interface. In this case, the users are protected by authentication.

2.2. Terrains that are hard to reach and importance of sensors' sleep mode

Conditions on terrains that are hard to reach, where public terrestrial networks do not provide sufficient coverage, make it difficult to send collected data from sensors. Due to the goal of collecting data as cheaply as possible in such areas, the authors in the paper [12] propose a solution based on the use of an IoT relay system, which enables collecting the data from terrains like that, at high speed. The basic idea is the use of drones (unmanned aerial vehicles) that will collect data from sensors. The controlled mobility of drones can improve the collection of data from remote areas, which can then be sent to a central unit. This approach improves the period of data collection and at the same time reduces the cost of data collection.

There are three main components in this system architecture, as shown in Figure 3, that is: an intelligent terminal/sensor on the ground, a wireless transmission link and a built-in relay on the drone. Drones are implemented as mobile relays for remote data collection from sensors deployed on terrain that is hard to reach, without public network coverage. For data transmission from sensors to drones, 5 GHz wireless communication technology is utilized, which enables high data transmission speed. Sensors for monitoring deployed on such terrains have limited energy resources for long-term environmental monitoring.

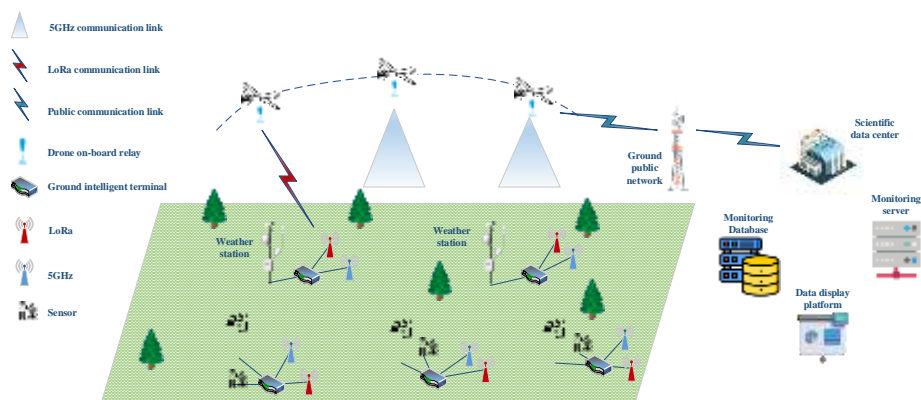


Fig. 3. Architecture of the system for monitoring terrains that are hard to reach based on the IoT relay system. *Source:* Redrawn by authors based on [12].

In order to ensure a longer lifetime of sensors in the field, discontinuous operation of this component in the system can save energy, using a sleep mode, with waking up when it is necessary, due to sending data. LoRa (Long Range, 433 MHz carrier) low-power, long-distance wireless communication technology is utilized to wake up the high-power 5 GHz module on the sensor, or put it into sleep mode to reduce power consumption – this extends the life of the deployed sensors. When the drone enters a region where the built-in LoRa on the drone module can communicate with the sensor module on the ground, the module wakes up. The drone's built-in relay then establishes a high-speed data communication link with the designated sensor. Next, the drone sends a request signal for data collection to the sensor and then collects the stored data from the sensor to a memory card. When the drone obtains this data, the high-power 5 GHz module on the sensor is put into sleep mode, and the drone flies to the next sensors, to collect the remaining data about the state of the environment, and then either returns to some kind of its base, where central data processing unit is placed, or simply fly to an area covered by the public network (then the drone's built-in relay reserves the 4G interface), to forward the stored data to the central data processing unit.

Research carried out by the authors of the paper [12] showed that data is delivered faster on the drone-sensor link than on the sensor-sensor link. Also, it was shown that the sensor-sensor link has a higher percentage of packet loss than the drone-sensor link. Additionally, the research results showed that, for the same distance, the RSSI (Received Signal Strength Indication) value on the drone-sensor link is higher than on the sensor-sensor link. This is why the approach is that the drone collects the data from each sensor individually, rather than using, for example, the method where the sink node collects the data from all the sensors and then forwards them to the drone.

As mentioned, one of the main challenges in such systems is the power limitation, i.e., the battery of the sensor itself. Power consumption management is a very important factor in monitoring such terrains, especially long-term monitoring, [13]. In addition to the authors' solution in the paper [12], there are some other solution proposals for this issue. The authors in the paper [9] propose that the time duration and frequency of data collection by different sensors should be adjusted, by analyzing the data of the area where the specific sensor is located, which allows the sensor to automatically adjust its sleep mode. The authors in the papers [14] and [15] propose a fixed time for all three modes – sensing, sending data and sleeping.

2.3. Collaborative IoT, crowdsensing and IoT agents

Collaborative IoT (C-IoT) is a concept in which several different parties cooperate in order to collect and exchange data. There is also crowdsensing (a method of collecting data about the state of the environment through mobile sensor devices), which finds wide application in C-IoT, especially with regard to monitoring the state of the environment (Figure 4).

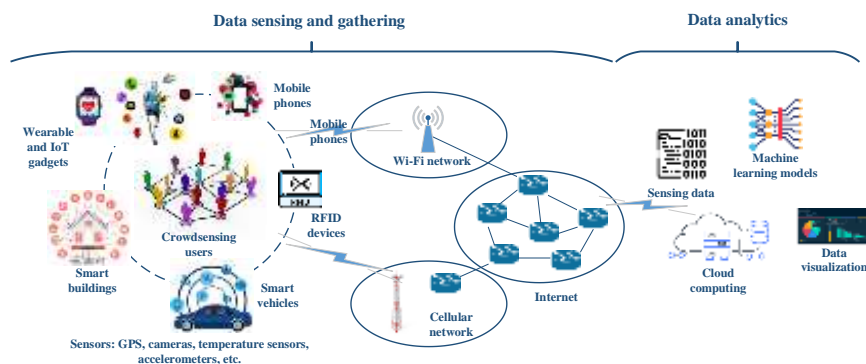


Fig. 4. Crowdsensing

The authors of the paper [16] propose an architecture that can handle a large amount of heterogeneous data and can present it to the end user in a unified manner.

In a heterogeneous and collaborative environment, users should have greater freedom of action as individuals, thereby achieving better final outcomes together. The research of these authors falls under the category of Community-Based Monitoring (CBM) – CBM together with EIoT leads to the concept of C-IoT. The main idea of this kind of joint action is based on the ability of the end user not to be just a mere user of finished services, but to be a necessary part of the system in collecting data of the state of the environment around him – crowdsensing enables exactly this. The advantage of this approach is based on avoiding the deployment of widespread sensor networks for monitoring the state of the environment, but system users will be able to actively participate in data collection and be able to report on their environment. In this way, either the users themselves or someone else will be able to use such finished reports on the living environment, with a huge spatial and temporal coverage. Moreover, users already have some of the sensors within their smartphones and thus can contribute to data collection, without using any additional sensors – a principle known as Mobile CrowdSensing (MCS). The main advantages are regarding the price and the provision of real-time data, and one of the disadvantages can be the reliability of that data (data often arrives unlabeled), as well as their constant availability.

The main idea of the proposed architecture is presented through: (1) the installation of multi-sensors as measuring stations in the households (outdoor) of a large number of citizens of the region where the research was conducted and (2) the use of their own mobile devices. Approach (1) is based on reporting the data either through cellular connection or through some other long-range technology (e.g., LoRa), resulting in an increased cost for the device distributor; data reporting could also be done via shared Wi-Fi by the user (depends on the user's mood). In approach (2), a specific application will simply be

launched on the smartphone and the collected data will be sent to the remote platform. The idea is to have a central unit with computational and decision-making capabilities, so that service providers/users have the simplest possible function. So, we are talking about client-server architecture, without the possibility of a communication link between clients.

As mentioned, users, apart from being service providers, i.e., providing insight into the data they have measured about their environment, would also like some greater benefits from the system itself, apart from mere insight into the data. For example, in the smart home concept, the user could implement actuators that would open the window in the room automatically whenever the temperature reaches a certain threshold value, for the purpose of airing the room, or if the user is allergic to pollen, when measurements show that the concentration of pollen has increased outside, the actuators can automatically close the window and turn on the air conditioner, to regulate the interior temperature.

The previous subject continues through research in the paper [17], where the authors describe a big data sensing type system, which consists of three main layers – mobile agent, middleware and application layer. Therefore, there are mobile measuring stations and server-side data processing software. Three basic features are implemented on the server side: registration of mobile measuring stations (IoT agents), collection of data from them and presentation of data in various forms. Inside the agents there is a GPS (Global Positioning System) for determining the position. Numerous mobile measuring stations, placed on the public transport vehicles (buses, taxi) or private (volunteers' vehicles), collect data of the state of the environment during movement, thus representing IoT agents. The data is written to the SD memory card, in order to be delivered to the server later. Mobile agents send the collected data to a centralized server in situations where they are in the areas of public Wi-Fi networks (after successfully connecting to them), and not through the public terrestrial network, in order to reduce the operating costs of the system.

3. CONCLUSION

The synthesis of environmental monitoring and IoT technology is undoubtedly a leading approach to the environmental protection. This paper describes some of the most representative architectures of these systems. It is generally stated that such systems are based on 3 layers – the layer of smart sensors that collect data about their environment, the layer for transmitting collected data to the central unit and the layer on the side of the central unit (server), with possibilities for data storage, analysis and processing, and to display data to the end user. As some of the most commonly used technologies for sensor networking, some of the 802.15.4 technologies are used, thus defining a low consumption and cheaper system. Collected data is sent to higher layers, towards the central unit, either by wire (often Ethernet) or wireless (public terrestrial networks, such as 3G/4G). The central unit, the cloud server, manages to process the large amount of data that comes to it, in real time. Of course, in addition to the basic 3-layer model, there are also researches with more layers, such as 4 or even 7. The main difference of the 4-layer architecture

compared to the basic 3-layer architecture is that part of the functionality of the application layer has been translated to an additional, lower layer, between the network layer and the application layer. If we are talking about a 7-layer architecture, the functionality of the application layer is spread over 5 separate layers, allowing a deeper insight into what exactly is done by the functionality on the third layer in the basic model of the architecture of these systems. So, if the detailed functionalities of these architectures are known, especially in the application layer, the complete story can be reduced to the 3 basic layers.

One of the main issues in these architectures is the issue of data and user security – IoT security protects both the users' privacy and the useful data about their environment. Because of that, IoT security has important role in these systems, regarding reliable monitoring, as well as reliable instructions sending to the actuators implemented on the area. An overview of a secure IoT architecture, which has 4 layers, is given. Security in this architecture is ensured with the help of authentication of end sensors, using the hash function, as well as their authorization, and encryption of the collected data, using the symmetric AES encryption algorithm.

In this paper, one of the possible variants of the system for monitoring terrains that are hard to reach (rural areas) is also presented – cheaper approach using a drone and a built-in relay with sensors on the ground. The main idea is that the drone flies from sensor to sensor and collects the sensed data, and then delivers them to the central unit for processing. On such terrains, it is necessary to ensure the possibility of long-term monitoring of the environment. Hence, one of the main challenges in these systems is the power limitation, i.e., the battery life of the sensor. There are various proposals – to set a fixed time when the data is collected, when they are sent and when the sleep mode is on; to automatically adjust the duration of these phases based on the analysis of the data of the area where they are located, or to wake up the sensors when the drone is above them, in given approach.

In order to monitor the state of the environment as precisely as possible and obtain the most reliable results, the concept of Collaborative IoT was introduced. It represents a concept in which many different parties cooperate in order to collect and exchange data as much as possible. The main idea of this kind of joint action is based on the end user's ability to not only be a mere user of finished services, but to be a necessary part of the system in collecting data of the state of the environment around him (crowdsensing). Additionally, in order to further expand the picture of the state of the living environment, especially in urban areas, the concept of IoT agents, which represent mobile measuring stations, was introduced. They can be placed on public and private transport vehicles, collect and store data during movement, and when they come into the region of public Wi-Fi networks, they send the collected data to a centralized server for data processing.

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SUSTAINABILITY IN THE PROSESS OF EDUCATIONIN CIVIL ENGINEERING

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ABSTRACT:

Sustainability is not the goal reserved only for technical solutions, systems and generally development. Sustainability is necessary to be obtained in the education process in civil engineering too. The results created within educational institutions have a long term impact on society development. Civil engineering is important branch of economic development. A knowledge base derived from the experience of built facilities creates significant competitive advantage on the market. From the other side the benefits for the whole society, created by knowledge, are available during the complete life cycle of constructed object. If knowledge is concerned as one of sources of value in civil engineering then its continuous improvement and development in civil engineering projects is imperative of vital importance. The main goal of this manuscript is to present the aspects of skills and knowledge acquisition and their improvement of civil and related professions. The goal was also to develop methodology for efficient problem solving in civil engineering and science and also to find the effective approach in sustainable utilization of available resources, as the first condition for advances in science and technology.

Keywords: sustainability, education, civil engineering, advances, science.

1. INTRODUCTION

Education is a complex and long-term process in which the participants (professor/instructor who is transferring knowledge, and students who are acquiring knowledge) are expected to transfer a certain type and scope of knowledge in a certain period of time, which will enable the students to be independent in solving a particular set of problems. The complexity of the process is conditioned by numerous factors that follow the knowledge transfer and it depends on the extent and complexity of the

knowledge itself, necessary for solving of a defined set of problems independently. The school system is irreplaceable in the process of knowledge transfer, although there are different approaches in defining it. There is a quote in the literature which convincingly proves that the main role of education is to transform people from young and dependent members of small families into independent participants of many large organisations and social institutions. Schools teach the „principles of conduct“ which include proper conduct of organisation members – distinguishing between roles and official roles, respect for bureaucratic authority, adherence to standard procedures and responsibility for work performance. Another author, Foucault [1] portrays schooling as a system that evaluates people and classifies them into homogeneous categories.

The basic characteristics of the school system are systematicity and continuity in the process of knowledge transfer from instructors to students. Systematicity is reflected in the breakdown of certain phenomena (natural phenomena, laws) into their constituent elements and their explaining, as well as in the relation with other phenomena, while continuity is reflected in the existence of literature that accompanies each phenomenon and in the possibility of approaching it. This approach indicates a certain level of inflexibility of the school system in transferring knowledge. Namely, school programs for knowledge transfer are created in advance, which means that they are based on the existing knowledge or on some subset of the existing knowledge.

Starting from the assumption that knowledge in a certain field keeps on developing, it can be concluded that the students engaged in the process of knowledge transfer are always falling behind the latest knowledge. This problem could be mitigated or eliminated (taking into account the limited time in which the knowledge is transferred and the capacity of the human brain to acquire knowledge in a certain time interval) by increasing the level of generality of knowledge.

However, this method also has certain limitations due to the fact that after the completion of the knowledge transfer process [2], students are able to solve a certain set of problems which are mostly of a practical nature. For this reason, it is necessary to define properly the scope of theoretical and practical content of the knowledge that is transferred. When it comes to civil engineering, geological, geotechnical and related professions, harmonisation of the content of knowledge is a delicate task because building structures are of great importance for all aspects of social and civilization development.

In addition to the school system of education, defined and governed by regulations, the Dreyfus model [3], described in the literature, observes the development of experts through the acquired experience and identifies five stages (novice, competence, proficiency, expertise, mastery) through which skills and knowledge are gathered and the ability to solve problems is increased. In addition to this concept, the terms „learning curve“ [4] and „experience curve“ [2] are also mentioned in the literature and are associated with organisational learning and strategic management.

Besides the content of the transferred knowledge, it is necessary to consider the context in which the transferred and adopted knowledge will be applied. The context refers to the elements of the system (environment) in which the knowledge will be applied and it can be divided into:

- social,
- spatial and
- time horizons.

The social horizon is defined by the circumstances in which certain knowledge is applied, such as the regulations and economic conditions.

The spatial horizon defines the location in which the concerned knowledge is applied and/or the location in which a specific set of issues is resolved.

The time horizon of knowledge can be defined by the time interval in which certain knowledge will not become obsolete and in which its application will be marketable and socially acceptable.

In order to fully understand the complexity of the civil engineering, geological, geotechnical and related professions, it is necessary to point out that from the standpoint of investors, building structures are observed as products and in this regard it is necessary for civil engineering experts to possess the required knowledge and skills that enable effectiveness and efficiency in accordance with the literature and management practice [5]. „Effectiveness“ means „doing right things“, that is, achieving the objectives, while the term „efficiency“ means „doing things right“, that is, that the resources are not dissipated.

2. MATERIALS AND METHODS

2.1. Knowledge and professional practice in civil engineering and related fields

Based on the mentioned dimensions of the civil engineering, geological, geotechnical and related professions, it is obvious that the process of knowledge transfer in these fields represents a complex system of activities which should yield experts capable of meeting the requirements in the field of their profession, with the knowledge which will enable acceptable market solutions.

Civil engineering is an engineering discipline which deals with the design, construction and maintenance of structures such as buildings, roads, bridges, canals, dams and other structures important for the preservation and improvement of human living and working

conditions [6]. Essentially, it is a humane branch of engineering as well as a branch that largely determines the achievements of the mankind. Due to the specificity of construction of certain types of facilities and their complexity, civil engineering is divided into specializations according to the characteristics of certain groups of facilities.

Geology and geotechnical engineering are defined as applied sciences [7] aimed at enabling the use of the Earth's natural resources for civil engineering projects. It is obvious that the subject of geology and geotechnical engineering as scientific disciplines, is information of exceptional importance for the design, construction and maintenance of building structures. In this regard and bearing in mind that there is a huge amount of knowledge accumulating in this field through academic articles, educational institutions, conventions and discussions, it can be concluded that it is a complex field.

All together, the scientific discipline of civil engineering and the related sub-disciplines are connected by the need to use common information and knowledge for creating a marketable product, that is, a facility that will satisfy all customer requirements, in addition to stability, cost-effectiveness and functionality. This primary objective of civil engineering and the related professions – to construct a facility which will create new value for the investor – indicates that, in addition to the knowledge acquired during the educational process, additional experience and knowledge gained through practice are also necessary. The need for additional knowledge stems from the need to reduce the risks of project failure to the smallest possible extent or to an acceptable level, and in particular the risks resulting from insufficient knowledge.

The request for additional knowledge stems from the logical assumption that experts with more experience in projects will have more knowledge about possible solutions, notice some analogies with the projects they have participated in previously, or avoid the problems that occurred in the earlier projects. All these elements of knowledge result in the expectation that better solutions will be found using the same invested resources, or that solutions that require smaller invested resources at the same risk level will be found.

Because of characteristics of the educational system, in which only historical knowledge is transferred, it is unlikely that the experts who have just completed their education will be able to solve complex situations successfully. It could also be expected that the experts with less experience, during their work with more experienced experts, undergo the process of knowledge transfer necessary to solve a non-specific problem [8]. In this regard, professional practice is a necessary requirement for the development of civil engineering, geological and geotechnical experts, as well as a logical continuation of their upskilling.

According to the literature [9], knowledge transfer should follow the „key characteristics“:

- Why and how to start;

- Who participates (the party who provides the knowledge and the party who seeks it);
- In which way cooperation between the partners is implemented;
- Duration;
- Training;
- Monitoring and
- Main challenges.

A brief overview of the complexity of civil engineering, geology and geotechnical engineering in an environment in which problems in these fields are solved, the importance of building structures for human lives and civilization development, as well as the complexity of the knowledge transfer process [10] indicate the necessity and the imperative of upskilling all experts engaged in these fields.

2.2. Concepts in education and knowledge acquisition during professional development

As already noted in the introductory part, the education system ensures systematicity and continuity of knowledge, but its reliance on historical knowledge greatly reduces the level of flexibility of experts' knowledge. Certain rare and non-specific situations or problems cannot represent the concept on which the education system is based. Also, not all variations of certain general knowledge can be elaborated within the education system due to the limited duration of the educational process. In addition to these limitations, the education system is not able to provide all the multidisciplinary knowledge within a programme, necessary for the successful execution of a building structure.

Direct conclusion is that the experts engaged in civil engineering, geology, geotechnical engineering and the related fields must continue their upskilling if they wish to be trained to find sustainable solutions to complex problems. This upskilling can take place through the process of knowledge transfer within specialist courses of the educational system, as well as through independent work and intellectual processing of one's own experience. It is also possible to transfer knowledge at expert meetings and discussions. Knowledge transfer at expert meetings meets the key characteristics in terms of literature [11]. Certain limitations of knowledge transfer through expert meetings are reflected in their relatively short duration and in the unpredictability of the content of a presentation.

3. RESULTS AND DISCUSSION

3.1. Concepts of learning curve, experience curve and Dreyfus model

The concepts of the learning curve, the experience curve and the Dreyfus model are based on the development of experts as a function of experience and on the fact that with an increase in the number of solved problems, the ability of an organisation or experts to produce goods or to solve problems with less resource consumption increases proportionally. In doing so, the concepts of the learning curve and the experience curve are associated with organisations, while the Dreyfus model considers the development path of an individual.

Bearing in mind that the objective of education is „to create independent participants in the operation of large organisations out of dependent members of small families“ and that this definition concurs with the fact that civil engineering experts can make their full contribution by taking part in large organisations (only construction companies with an appropriate expert structure and with an appropriate organisational structure are able to execute complex projects), the immediate conclusion follows that the concepts of the experience curve and the Dreyfus model are compatible concepts for the development of experts in civil engineering, geology, geotechnical engineering and the related fields. The experience curve represents generalisation of the learning curve and describes the empirically verified fact that tasks are performed faster and more efficiently when repeated [12]. This phenomenon is a consequence of the following factors:

- learning (through repetition, knowledge about the performance of certain tasks is established and knowledge about the process increases),
- specialisation and modification of working tasks (procedures that prove to be more efficient are standardised, thus increasing the productivity),
- improvements of products and processes (repeating the process and learning about the products' shortcomings enables their improvement),
- rationalisation methods and systems by introducing new technologies or technical solutions,
- economies of scale (cumulative production reduces costs),
- organisational improvements (the organisation adapts to new solutions and becomes more efficient).

The Dreyfus model [13] is based on the assumption that anyone who wants to acquire a new skill immediately faces two possibilities:

- either to try it yourself through trial and error („like a baby“)
- or to seek support from an instructor or manual.

The authors consider the second approach more efficient. It is indispensable for high risk and danger activities such as piloting an airplane. As investments in civil engineering and the related disciplines can be considered high risk if the projects are not supported by a

high level of knowledge, it can be concluded that experts who are just acquiring new knowledge cannot be entrusted with complex projects.

Following the logic of experience and the dependence of knowledge on the experience, authors 3 divide the development path of experts into five stages:

- Novice: in this phase the task environment is divided into characteristics, free of context, that can be recognised by the student without help of experience. The student is then given the rules on the basis of which the activity based on these characteristics is determined. For the purpose of upskilling, the novice should observe, either through self-observation or through feedback from the instructor, in order to adjust his behavior;
- Competence: Competence occurs after acquiring significant experience, that is, after facing real situations observed by the expert or emphasised by the instructor as recursive meaningful patterns. These situational components within which a competent student understands the environment are no longer context-free properties. These recurring patterns are called aspects. In this phase, the principles that imply meaningful elements based on the experience, i.e. the instructions, can be formulated;
- Proficiency: Increase of practical experience put the expert in a wide range of typical complete situations. Each complete situation in its first appearance has a meaning relevant for the achievement of a long-term objective. At this stage, the importance of aspects may vary depending on the objectives. In this phase, experience enables recognition of similar situations from a similar perspective. Also, the memorised principles in this phase of development evolve into maxims which determine the corresponding action;
- Expertise: The repertoire of experience at this stage of development is so vast that the expert intuitively undertakes the appropriate activity. This intuitiveness is possible because each type of situation is now associatively linked to a specific response, and
- Mastery: This stage is reached at the time when the expert exceeds his usual high level of performance in finding correct solutions or activities.

The mentioned concepts for improving expertise indicate that experience is necessary both at the individual as well as at the organisational level. This necessity is a direct consequence of the complexity and importance of civil engineering, geology, geotechnical engineering and the related professions in order to diminish and/or reduce to a socially acceptable level the risks inherent in the execution of building structures.

3.2. Knowledge and quality management in the function of development

The present moment of development of civil engineering, geology, geotechnical engineering and other engineering fields requires a high level of knowledge, quality and creativity. Optimal management of knowledge and quality, symbiosis of creative industry and quality of life, result in a successful identity policy of higher education. As every development is based on creativity and application of new technologies, the knowledge and quality imperative gains importance. Education, expertise, skills and talents stand out, because they represent a potential for creating wealth and jobs through generation and exploitation of intellectual property. Industrial development implies extensive prior research on the analysis of impact of creative (intellectual) capital on the possibility of solving social and economic problems and economic prosperity [14].

4. CONCLUSION

The complexity and importance of building structures require that in all phases of their life cycle (from design to operation) an appropriate level of knowledge is provided in order to respond successfully to all the demands of interested parties (investors, customers, users). Since knowledge transfer is a complex process, consumed with certain shortcomings, the experts engaged in civil engineering and the related professions constantly need to upskill and improve their knowledge.

This means that in addition to formal educational programmes, other learning concepts must also be applied. As members of project teams or employees of construction companies, experts are obliged to adapt to the conditions of organisational learning, whereby the concepts of the learning curve or the experience curve may be used. As individuals, civil engineering experts can use the Dreyfus model for personal development and measuring their own level of development, or develop their own personal development model that maximises their performance, depending on their specific knowledge and experience.

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EDUKACIJA, ONLINE EDUKACIJA – E-LEARNING
EDUCATION, ONLINE EDUCATION – E-LEARNING

POTREBE PREISPITIVANJA I MIJENJANJA SISTEMA VASPITANJA, OBRAZOVANJA I ŠKOLSKOG SISTEMA

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SAŽETAK:

Brzi razvoj nauke, umjetnosti, kulture, tehnike, tehnologije, društvenih promjena u svijetu i kod nas, nameću vaspitanje “novog čovjeka” za život i rad u novom vremenu. To ponajprije podrazumijeva modernizaciju škole. Misli se na njenu organizaciju, pedagoške i didaktičko-metodičke osnove rada. Te kriterijume ne može zadovoljiti klasična škola sa krutom organizacijom, zasnovanom na razredno-predmetno-časovnom sistemu i izdiferenciranim položajima nastavnika i učenika. Nova škola i nastava mora pripremiti buduće stručnjake koji će se baviti sve novijim i novijim naukama i njihovim disciplinama, koji će koristiti i stalno unapređivati dostignuća tehnike i tehnološke i svih drugih oblasti ljudskog života. Za razvoj i stalno unapređivanje nauke, tehnike i tehnologije, umjetnosti, kulture i života u demokratskom društvu sa tržišnom orijentacijom u privređivanju, potrebno je novo (šire i bogatije) obrazovanje, novo (moderno) vaspitanje i nova (sadržajna) kultura. Savremena škola mora odgovarati savremenom društveno-istorijskom trenutku i zato mora korenito mijenjati svoj sistem, sistem obrazovanja i sistem vaspitanja. U ovom radu mi smo, primjera radi, obradili izmijenjeni položaj glavnih faktora nastavnog procesa – učenika i nastavnika.

Ključne riječi: Škola, vaspitanje, obrazovanje, nauka, kultura

Savremeni društveno-istorijski trenutak, kada su u pitanju sistem vaspitanja, sistem obrazovanja i školski sistem, obeležen je nastojanjima svih modernih društava u svijetu da se ti sistemi unapređuju, inoviraju, usklađuju, modifikuju, reformišu, pa i temeljno mijenjaju i prilagođavaju potrebama čovjeka ovog vremena. To su nastojanja kojima se želi “...izdići ljude iz siromaštva, postići veću jednakost, razviti multikulturalno društvo koje dobro funkcioniše i svakako, stvoriti naprednu privredu i sve veći broj dobrih poslova” Stewart V. (2012)<https://asiasociety.org/education/top-10-ways-reform-schools>. Centralno pitanje je: Kako obrazovanje to može postići? Brojni autori u svijetu i kod nas ukazuju na zastarelost tih sistema. Je li to zaista tako, pokušaćemo objasniti na nekim pokazateljima ciljanog ishoda procesa vaspitanja i obrazovanja u tradicionalnoj školi

(misleći na mirnodobske decenije 20. vijeka) u poređnju sa nekim zahtjevima savremenog društva (misleći na protekle decenije 21. vijeka).

Klasična škola, bilo ona izvorna Komenskijevskog tipa, bilo ona mijenjana i modifikovana učenjima Pestalocija, Herbarta, Distervega, Džona Djuja ili svih drugih evropskih, ruskih, američkih i naših pedagoga, kao i raznim reformskim pokušajima, zadovoljavala je obrazovne potrebe 19. i prve polovine 20. vijeka, pa i znatno duže. Obrazovan, vaspitan i kulturni čovjek 20. vijeka bio je jasno prepoznatljiv u društvu. Njega su krasile neke vrline, svojstva, obilježja, ponašanja u javnom životu, pa i spoljašnji izgled. Sto godina kasnije, odnosno u našem vremenu, zahtjevi u pogledu obrazovanja, vaspitanja i kulture su bitno drugačiji. Njih diktira mnogo faktora među kojima su brz razvoj nauke, tehnike i tehnologije, društveni odnosi u čijoj suštini je demokratija, sa naznačenim nastojanjima da se ispune ljudska prava, tržišna orijentacija u privređivanju, otvorenost za saradnju sa zapadom, istokom, severom i jugom (lokalno i globalno), usmjerenost prema evropskim integracijama, posvećenost miru, naučnom, umjetničkom i kulturnom razvoju, postizanju prestižnih rezultata u sportu i podizanja nivoa obrazovanja, vaspitanja i kulture nacije. Isto tako, jedno od glavnih pitanja jeste ko će i kako izvršiti sve te promjene. Hoće li one biti, kao mnogo puta ranije, diktirane sa nivoa vlade, prema institucijama (školama) ili obrnuto? Za razliku od ustaljene prakse sada je, kao nikada ranije, neophodno da promjene idu od škole, od učenika, od nastavnika, od pedagoške službe u školama, od školskog menadžmenta „...time bi se u novim kurikulumima bolje usaglasila teorija i praksa, ostvarilo aktivno učešće nastavnika u procesu reforme što bi dovelo do njihove podrške reformi i promjenama, kao i njihova spremnost da se promene izvedu (Prema: O.K. Florić, O.K., 2011 : 140). Taj zadatak je vrlo složen i delikatan. To ne uviđaju samo stručnjaci iz naše sredine, već tako gledaju i čuvena svjetska imena iz ove oblasti. „Koncipiranje budućeg rada u obrazovanju, vraćanje fokusa na obrazovanje i aktuelno razumijevanje njegove individualne i kulturne vrijednosti, neće biti lak zadatak“ (Gidley, Batemen, and Smith, 2004, str. 2). Zašto je to tako? Zato što više nije pitanje sastaviti nastavni program, a onda na osnovu njega i nastavni plan, izvršiti izbor i nazive nastavnih predmeta i izvršiti pravilan raspored realizacije nastavnih tema i nastavnih jedinica. „Sutrašnja škola stoga ne može da se bavi samo činjenicama, nego i načinom manipulisanja tim činjenicama. Učenici moraju naučiti kako odbaciti stare ideje, kako i kada ih treba ukloniti. Ukratko, oni moraju naučiti kako se uči“ Toffler, A. (1970:413).

Cilj vaspitanja u prošlom vijeku bio je opisan kratkom sintagmom: “Svestrano razvijena ličnost”. Budući da je odrednica “svestranost” sama po sebi nedovoljno jasna, to je i cilj u cjelini ostao nedovoljno jasan. Mnoga “koplja” u pedagogiji su se “lomila” oko toga ko je svastran, kako dostići taj ideal, kakvo je zdravstveno (blago) stanje te jedinke, kakva je njegova intelektualna sfera, koje ga moralne vrline krase, kakav je njegov odnos prema

radu i kakav je njegov praktični učinak u radu, koje ga estetske vrijednosti “krase”, čime u obrazovnom smislu raspolaže?

Iako je “model” (ideal kome se težilo) obrazovanog, vaspitanog i kulturnog čovjeka prošlog vijeka dobro poznat, navešćemo njegove glave karakteristike.

a) obrazovana ličnost u prošlom vijeku

Obrazovan čovjek sve do razbijanja i razaranja naše zajedničke države Jugoslavije bio je prepoznatljiv prema završenom stepenu školovanja, prema univerzitetu na kojem je studirao i prema spoljašnjem izgledu i ponašanju. Broj nosilaca visokih diploma i priznanja bio je gotovo identičan broju visoko obrazovanih ljudi. Iz ove konstatacije treba izdvojiti one ljude koji su u društvu uživali visoki ugled, jer su na osnovu stečenog bogatog iskustva imali veoma razvijenu socijalnu inteligenciju. Oni nisu bili obrazovani u pravom značenju te riječi, čak su mnogi bili i alfabetski nepismeni. Obrazovan čovjek, toga doba, posebno je bio prepoznatljiv po mjestima kretanja u društvu: kretao se u bibliotekama, muzejima, institutima, akademijama, igrao bilijar, šah... U svojoj struci je bio priznat i neprikosnoven. Imao je svoj hobi - svirao je klavir, eventualno gitaru, ređe violinu, ili harmoniku. Znao je plesne igre i manire ponašanja u tzv. “visokom društvu”. Pratio je trendove mode u Evropi i svijetu i u skladu s tim birao odjeću i obuću. Govorio je standardnim književnim jezikom; Čitao je raznoliku literaturu, posebno beletristiku, čitao je štampu i druge pisane izvore i jasno razumeo šta čita; Bio je poznavalac naše i svjetske književnosti; Pisao je posebno njegovanim rukopisom, pravopisno korektno i stilski visoko izgrađeno; Njegov govor je bio jasan, bez “poštapalica” i bez teškoća da u svakom trenutku “pronađe” pravu riječ; Znao je da govori, čita i piše na stranim jezicima, a prestižni su bili francuski i njemački, iako se cijenio ruski i engleski; Znao je da citira mudre izreke na latinskom i našem jeziku i da deklamuje stihove naših i svjetskih pjesnika. Poznao je misli antičkih grčkih filozofa, ali i Montenja, Monteskijea, Loka, Hjuma, Herbarta, Getea, Dantea...; Na svakom mjestu mogao je otvoiti polemiku o djelima ruskih književnika: **Gončarova, Dostojevskog, Tolstoja, Ljermontova, Gogolja, Turgenjeva, Gorkog, Černiševskog ... Znao je djela brojnih** čuvenih pisaca Evrope (Šekspira, Zolu, Balzaka...); Poznao je historiju; Sklon je bio filozofiji i logici; Bio je jasno prepoznatljivi intelektualac. Obrazovan čovjek!

Obrazovan čovjek našeg doba se ne može prepoznati po diplomama koje nosi, niti po nekim spoljašnjim pokazateljima. Danas je broj nosilaca visokih diploma nesrazmjerno veći od broja visoko obrazovanih ljudi. Ono što je posebno pogubno u ovom vremenu jeste nastojanje većine da se što brže, što lakše i što jeftinije dođe do diplome, dok je cilj biti obrazovan, biti kulturn i biti vaspitan, bitno zapostavljen, a određenom broju i

nebitan! Naučna, tehnička i tehnološka dostignuća, moderni društveni odnosi, automatizacija proizvodnje i brz protok informacija, samo su neki elementi koji diktiraju novi, savremeni, model obrazovane, kulturne i vaspitane ličnosti. Pokušat ćemo da u nekoliko natuknica, u vidu teza, ukažemo na zahtjeve savremenog društveno-historijskog trenutka u pogledu uslova koje treba da ispuni obrazovana ličnost, vaspitana i kulturna:

b) obrazovana ličnost u savremenom društvu

- Znanje obrazovanog čovjeka ovog vremena se ne zasniva samo i isključivo na činjenicama o objektivnoj stvarnosti i na generalizacijama, već na stalnoj prisutnosti svijesti i korišćenju iskustava stečenih u već doživljenom. “Znanje/a u savremenom društvu uključuju kritičko mišljenje, inovacije, sposobnost rješavanja složenih problema, sposobnost snalaženja i reagovanja u nepredviđenim situacijama, korišćenje informacija, analizu, sintezu, samostalni i timski rad, razvijanje različitih vještina i kompetencija, koja treba da se stiču kroz obrazovni proces. Ovdje su važni mogućnost i sposobnost „transfera“ i primjene stečenih znanja u društvenoj stvarnosti” (S. Lončar - Vicković i Z. Dolecek-Aiduk (2009:24). Znanja (sveukupnost činjenica, informacija i vještina stečenih obrazovanjem i iskustvom) treba razvijati od samog uključivanja pojedinca u obrazovni proces (modelovanje, oblikovanje) i dalje kroz sve faze ovog procesa, ali, svakako, pažnju treba usmjeriti na visoko i cjeloživotno obrazovanje, kao i cjeloživotno, permanentno, formalno, neformalno i informalno obrazovanje. (Prema: Politološka istraživanja, (2013:90).

- Obrazovanost u savremenom društvu podrazumijeva izgrađenost čula, odnosno razvijenost senzornih sposobnosti za uočavanje objektivne stvarnosti (putem: vida, sluha, ukusa, mirisa, taktilnih osećanja, osećanje za bol, za pritisak, za kretanje, za mirovanje...do kinestetskih osjećaja);

- Obrazovana ličnost sve što upozna čulnim putem – perceptivno, podvrgava misaonoj preradi (kritici);

-U svakom trenutku svjesno nastoji da shvati i razumije veze i odnose misaonim operacijama (komparacijom), odnosno uspoređivanjem (sa sličnim, sa drugim, sa drugačijim), mijenjanjem (je li moralo ovako, je li moglo drugačije, bolje, ili lošije), analizom (rastavljanjem cjeline na sastavne elemente), sintezom (inverzni postupak) i konačno sistematizacijom (dovođenjem u sklad u red ...);

- Obrazovana ličnost predstave i predodžbe o objektivnoj stvarnosti stiče sistematski, planski i cjeloživotno (permanentno). To nije samo gledanje, to nije samo slušanje, to nije samo čitanje, već i misaona aktivnost i praktična djelatnost. To je istraživačka radoznalost i empirijsko istraživanje.

- Obrazovana ličnost postavlja cilj i svjesno i planski (namjerno) nastoji da se postavljeni cilj ostvari. Svjesno donosi namjeru, odnosno odluku za djelovanje;

- Obrazovana ličnost je svjesna sebe u objektivnoj stvarnosti;

- Svjesna je svoga “ja”. Svjesna svog identiteta (ličnog – personalnog, socijalnog – društvenog, generičkog -opštjeludskog, vjerskog odnosno teističkog ili ateističkog);

-Vlada svojim razumom, svojim umom, svojom kognitivnom sferom, svojim intelektom;

-Vlada svojom voljom;

-Sama sebi nalazi motive i razvija motivaciju;

- Posедује široko opšte obrazovanje;
- Pored standardnog (književnog) maternjeg jezika, potpuno vlada engleskim jeziom i služi se još jednim ili više stranih jezika;
- Solidno se koristi kompjuterom i “pametnim” telefonom;
- Vlada raznim internetskim platformama i društvenim mrežama;
- Umije da prepozna i odabere kvalitetne sadržaje na internet platformama;
- Zna da zaštititi sebe i svoje uređaje od neželjenih sadržaja i virusa;
- Svjesno pristupa prevladavanju prepreka (unutrašnjih, kao i spoljašnjih);
- Krasi je sklad fizičke, intelektualne, moralne, radno-djelatne i umjetničke strane ličnosti;
- Krase je konkretna znanja, konkretne vještine i konkretne navike;
- Osposobljena je za konkretan rad;
- U toj svojoj specijalnosti njena znanja, vještine i navike su intenzivne i duboke;
- To znači da poseduje (sve)opšta znanja, ali i konkretna, intenzivna znanja u određenoj oblasti;
- Drugim riječima obrazovanu ličnost krasi bogato opšte obrazovanje, ali i strukovne specijalnosti koje upućuju na konkretnu aktivnost, na rad i preduzetništvo;
- Ta ličnost je osposobljena za samovaspitavanje i za samoobrazovanje;
- Spremna je da preuzme odgovorne funkcije za dalje unapređivanje i razvoj društva;
- Pripremljena je da preuzme odgovornost za svoje fizičko i zdravstveno (blago)stanje, za aktivno korištenje intelektualnih potencijala, za vladanje u objektivnoj stvarnosti u skladu sa moralnim normama, za rad i aktivnosti koje joj omogućavaju egzistenciju i za njegovanje estetskih vrednosti i kvaliteta;
- To je samostalna ličnost u pogledu izbora, vrednovanja, evaluacije svojih pristupa objektivnoj stvarnosti i odnosa svih drugih subjekata u toj stvarnosti;
- Osposobljena za pregovore, osposobljena da posreduje, lako artikuliše svoje misli, za sve što govori i kako postupa ima jasne dokaze, osposobljena je da proizvodi, pri čemu ne mislimo samo na privrednu proizvodnju, već i na proizvodnju u oblasti nauke, kulture i umjetnosti, tehnike;
- Osposobljena da eksperimentiše, planira, promišlja, dizajnira, gradi, proučava, igra, uređuje odnose, predviđa i stvara...;
- To je samoorganizovana, samodisciplinovana, samoradna, samoaktivna ličnost, spremna na samokritičnost, samopraćenje, samovrednovanje, samoevaluaciju i samoocjenjivanje.

Obrazovanu ličnost našeg doba nije moguće prepoznati na osnovu spoljašnjih znakova: izgled, stav, odjeća, obuća. Ona je skromna i samozadovoljna i nema potrebe da sebe prezentuje tim znacima.

c) vaspitana ličnost u prošlom vijeku

Kada je u pitanju vaspitanje “model” iz ***prošlog vijeka*** (cilj vaspitanja je bio definisan kratkom, opšteprihvaćenom frazom: “svestrano razvijena ličnost”. Tu “svestranost” možemo shvatiti ovako:

- razvijanje i njegovanje internacionalizma, patriotizma, bratstva, jedinstva, jednakosti, sloge i prosperiteta...;
- visoko softicirano porodično vaspitanje;

-njegovanje “manira lijepog” ponašanja;
-izgrađivanje pozitivnog odnosa prema pripadnicima suprotnog pola;
- izgrađivanje pozitivnog odnosa prema mlađima, prema pripadnicima svoje generacije i prema starijima;
-razvijanje i trajno njegovanje higijenskih navika (životne sredine, stambene sredine, higijeni sopstvenog tijela, odjeće i obuće...);
- vaspitanje za zaštitu i unapređivanje sopstvenog zdravlja;
- Razvijanje i njegovanje moralnih vrijednosti (kako kada je u pitanju lični-personalni moral, tako i kada je u pitanju socijalni-društveni moral i opštjeljudski- generički moral);
- razvijanje vrlina: fizičkih i zdravstvenih, umnih, moralnih, estetskih i radno-tehničkih...
U **savremenom društveno- historijskom trenutku**, kao i u vremenu koje dolazi, vaspitanje nije moguće ciljno usmjeriti rečenicom: “Svestrano razvijena ličnost”. Cilj mora biti iskazan u vidu više jasnih premisa, kojima se treba težiti:

- uredno vođenje računa o svom zdravlju;
- redovno podvrgavanje ljekarskim pregledima;
- izbor organske hrane, različitih suplementa i medikamenta;
- uredno praćenje krvnog pritiska, količine kiseonika u krvi;
- posećivanje teretana i podvrgavanje vežbanju uz nadzor stručnog lica;
- rekreacija na čistom vazduhu;
- izbjegavanje duvana, alkohola, droga i svih vrsta opijata;
- privrženost porodici i korektan odnos prema pripadnicima suprotnih polova, mlađima, vršnjacima i starijima;
- sistematsko i plansko razvijanje i unapređivanje intelektualnih sposobnosti (pažnje, pamćenja, govora, motiva, motivacije, zadovoljstva postignutim uspjesima);
- izbjegavanje stresnih situacija;
- iznalaženje povoda za radost, veselje i prijatno raspoloženje;
- iznalaženje zadovoljstva u radu, tačnosti u radu, odgovornosti, preciznosti, urednosti...;
- nastojanje da se nijednim gestom ne doprinese šteta bilo kome;
- razvijanje druželjubivosti, poštenja, korektnog odnosa u socijalnoj strukturi;
- razvijanje svijesti o nacionalnoj i vjerskoj pripadnosti;
- razvijanje patriotskih osjećanja i ljubav prema domovini i svom narodu (iskazivanje na konkretnim djelima, a ne na verbalnim veličanjima);
- podvrgavanje sopstvenog ponašanja zakonskoj regulativi i moralnim normama svoga društva;
- istinsko poštovanje osjećanja i opredjeljenja drugih ljudi tako da nijedna vrsta razlika među ljudima ne sputava za poštovanje, saradnički odnos, druženje, uvažavanje...;

- u prirodi, u porodici, u ljudskom društvu, na sebi nastojanje da se uoči ljepota;
- razvijanje svijesti o doživljaju ljepote i davanje aktivnog doprinosa za njeno održavanje i unapređivanje;
- iskazivanje uočene i doživljene ljepote: verbalno, pisanom rečju, vokalno, instrumentalno, četkicom i bojama, grafički, oblikovanjem...

U pedagoškoj literaturi postoji ne pisano, ali opšte prihvaćeno mišljenje o postojanju tri bitna sistema:

-sistem vaspitanja (odgoja), kao najširi i najsveobuhvatniji pojam koji prati čovjeka od rođenja do kraja života;

- sistem obrazovanja ili obrazovni sistem, kao uži sistem od vaspitanja, odnosno kao podsistem sistema vaspitanja i

- školski sistem, odnosno sistem institucionalnog vaspitanja i obrazovanja.

S obzirom da je pitanje kulture ličnosti proizvod sva tri predhodna sistema, smatramo da je neophodno, ravnopravno, govoriti o sistemu kulture, odnosno o fenomenu biti kulturni u skladu sa zahtjevima društveno-istorijskog trenutka u kojem se živi.

d) *kulturna ličnost u prošlom vijeku*

Kulturna ličnost u prošlom vijeku bila je prepoznatljiva, između ostalog, i po sljedećim karakteristikama:

- poznavala je, cjenila i poštovala narodnu kulturu, tradiciju, folklor, običaje...
- bila je poznavalac tradicionalne stambene kulture i kuhinje;
- poznavalac “visoke” evropske kulture;
- u javnom životu je nosila odjeću kakva se nosila u evropskim centrima kulture;
- cjenila je modernu arhitekturu i građevinarska ostvarenja;
- cjenila likovnu umjetnost i ostvarenja u slikarstvu, vajarstvu, grafici;
- svirala je klavir, ređe neki drugi instrument (violinu, violon čelo, harmoniku...);
- bila je poznavalac tzv. “ozbiljne” muzike;
- cjenila je ostvarenja velikih muzičkih stvaralaca;
- znala je plesne igre i posjedovala manire te kulture;
- na svakom koraku, u javnom životu, trudila se da pokaže svoju pripadnost toj kulturi...;
- trudila se da nikada ne pretjera u jelu, piću, radosti, žalosti ili bilo čemu drugom.

e) kulturna ličnost u savremenom društvu

- Novo vrijeme, kao i u svim drugim oblastima, donijelo je bitne novine i u oblasti kulture. sofisticirano vrši izbor filmova;
- prati Kulturnu ličnost savremenog doba, kao i doba bliske budućnosti karakterišu, između ostalih i sljedeće karakteristike:
 - poznaje trendove u savremenoj zabavnoj muzici;
 - modne trendove odijevanja;
 - posjećuje fitnes klubove, teretane, SPA centre;
 - član je udruženja čitalaca, ljubitelja ozbiljne muzike;
 - redovno posjećuje kulturne događaje (promocije knjiga, izložbe likovnih ostvarenja, muzejske postavke, galerije...);
 - posjećuje koncerte, posjećuje smotre amaterizma mladih, posjećuje smotre horova, posjećuje pozorišne predstave,
 - ima hobi ili se opredijeljeno bavi nekom naučnom, kulturnom ili umjetničkom disciplinom;
 - u životnoj sredini je prepoznatljiva po umjerenosti u svemu;
 - ljubazan je u odnosima sa drugim ljudima, bez obzira na pol, starost ili bilo koju različitost;
 - prati sportske događaje i bira sportske discipline, klubove i pojedince kojima će se posebno “prikloniti”;
 - prati dnevnu štampu;
 - poznavalac je svetske i domaće književnosti...

Broj onih koji su prihvatani da su obrazovani, vaspitani i kulturni, u prošlom veku, bio je približno jednak broju onih koji su završili visoke stepene obrazovanja u institucijama sistema.

Broj onih koji su prihvataćeni da su obrazovani, vaspitani i kulturni, u ovom veku, je nesrazmerno niži od broja onih koji su završili visoke stepene obrazovanja u institucijama sistema. Drugim riječima, živimo u vremenu u kojem diplome, čak najvećih nivoa, nisu pokazatelji ni obrazovanja ni vaspitanja ni kulture.

Razvoj nauke, tehnike, tehnologije i društvenih promjena kao uslov modernizacije sistema vaspitanja i obrazovanja i školskog sistema

Brzi i veoma ekspanzivni razvoj nauke, tehnike i tehnologije, prožimanja kultura i umjetnosti prvih decenija 21. vijeka, traže novo, bitno drugačije obrazovanje od onog koje je zadovoljavalo čovjeka u vijekovima koji su iza nas. “Želimo li osigurati autentični

proces stvaranja koncepcije, tada djecu i mlade valja razvijati u pedagoškim uslovima koji se u svemu razlikuju od onih u tradicionalnoj školi. Treba, takođe, potpuno ukloniti disciplinarne mere podjele kao što je matematika, fizika, tehnologija, koje se temelje isključivo na ideologijama koje prožimaju naše društvo. Za učenike koji se počinju upućivati u nauke sve se svodi na konkretne akcije koje imaju svoje korijene u tehničkim ili biološkim pitanjima vezanim za našu svakodnevnu okolinu i koji istraživanjem, raščlanjivanjem, stvaranjem, invencijom, kontrolom, upoređivanjem i simbolizacijom vode do odnosa, koncepata i strukture što se postupno povezuje u celine prema različitim nivoima apstrakcije koje izgrađuju matematičko i fizičko mišljenje” (Legrand, L., 1993;113-114).

Kada je u pitanju nauka savremenom čovjeku se nameću potrebe ubrzanog proučavanja i unapređivanja naučnih oblasti koje u ranijim vremenima nisu bile tako aktuelne. Pre svih mislimo na biotehnologiju (biohemiju, mikrobiološku industriju, biomedicinu, biofarmakologiju, bioinformatiku, kloniranje, genetski inženjering itd.) i sve oblasti koje ona pokriva. “Biotehnologija se trenutno razvija veoma brzo, posebno u razvijenim zemljama. Ovaj napredak je obeležen otkrićem različitih tehnologija kao što su genetski inženjering, kultura tkiva, rekombinantna DNK, uzgoj matičnih ćelija, kloniranje i druge”(<https://sr.nucleo-trace.com/430-definition-of-biotechnology-and-examples-of-its-use>).

Život čovjeka treće decenije 21. vijeka je više ne zamisliv bez proizvodnje raznih hemikalija, bez biofarmaceutike, bez učešća biotehnologije u zaštiti zdravlja ljudi, bez biotehnoške zaštite voda, zaštite životne sredine, proizvodnje hrane, agrikulture itd. Posebno je nezamisliv bez stalnog traganja za tim da sve te oblasti vode zdravlju i zaštiti žive i nežive prirode¹. To ukazuje na potrebu obogaćivanja školskih programa koji će pripremati stručnjake za dalje razvijanje i unapređivanje ovih naučnih oblasti.

¹Kolika važnost se, u našoj zemlji, pridaje zdravoj ishrani pokazuje zakonska regulativa ove oblasti. Preporučujemo uvid u:

-Pravilnik o dokumentaciji koja se dostavlja ovlašćenoj kontrolnoj organizaciji radi izdavanja potvrde, kao i o uslovima i načinu prodaje organskih proizvoda („Sl. glasnik RS”, br. 88/16).

- Pravilnik o izgledu oznake i nacionalnog znaka organskih proizvoda („Službeni glasnik RS, br. 107/07, 26/09).

- Pravilnik o kontroli i sertifikaciji u organskoj proizvodnji i metodama organske proizvodnje („Sl. glasnik RS” br. 095/2020). Statistički godišnjak (2020). Zakon o organskoj proizvodnji („Sl. glasnik RS“, br. 30/10, 17/2019).

Republički zavod za statistiku.

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-Zakon o organskoj proizvodnji („Sl. glasnik RS“, br. 30/10, 17/2019).

Savremena nauka mora dati odgovor kako obezbijediti održivost energije kao osnovnog pokretača razvoja ljudske zajednice, bez kojeg nema privrednog razvoja i zadovoljavanja čovjekovih životnih potrebe. Pitanje je dana kada će nestati rezerve uglja, nafte i gasa, te se od nauke očekuje pronalaženje rešenja za proizvodnju sredstava za obnovljivu energiju, utoliko prije što je energija i u sadašnjosti, a još više će biti u budućnosti, povezana sa svim vitalnim uslugama, kao što su zdravlje, hrana, transport, trgovina itd.¹“Posmatrano sa aspekta obnovljivosti, sve izvore možemo svrstati u dvije osnovne cjeline: obnovljive i neobnovljive izvore energije. Grupu neobnovljivih izvora energije čine svi oni izvori čiji su obim i količina limitirani utvrđenim potencijalom ili novim mogućim rezervama koje mogu biti otkrivene. To su izvori energije koji nisu obnovljivi u dužem vremenskom periodu nafta, ugalj, zemni (prirodni) gas, bitumenski škriljci, rude nuklearnog goriva... Obnovljive izvore energije čine oni izvori koji se nakon određenog vremenskog perioda ponovo sami javljaju ili se mogu obnoviti. U obnovljive izvore energije spadaju vodeni tokovi, sunčeva energija, biomasa i biljni i životinjski otpaci, energija vetra, geotermalna energija, energija mora...” (Radiš, D., 2018:83-84). Aktuelnost održivog razvoja energije se povećava ne samo iz godine u godinu, nego faktički iz dana u dan. Na školi je novi izazov i odgovornost da pripremi stručnjake koji mogu pomoći u razvoju održive energije. U vremenu u kojem živimo jedna od prioritarnih naučnih disciplina je nanotehnologija. “To je najnaprednija tehnologija današnjice i vodeća tehnološka dimenzija sutrašnjice, kojom je proces stvaranja i dizajniranja novih materijala uveden u svijet atoma u nano dimenziju koja je milijarditi deo metra”(https://www.nanoklinika.rs/nanotehnologija/). Škola mora posvetiti posebnu pažnju obrazovanju stručnjaka za proizvodnju minijaturizovanih, visoko osetljivih i selektivnih hemijskih i bioloških senzora, bez kojih je savremena tehnika i tehnologija nezamisliva.

Savremena nauka teži novim pristupima obezbeđivanja i unapređivanja materijala za razne proizvodne oblasti. To podrazumijeva izbjegavanje prisustva štetnih materijala i bitno povećanje kvaliteta i funkcionalnosti materijala. Danas se procenjuje da raspoložemo s oko 70 000 vrsta tehničkih materijala. U posljednjih 50-tak godina u upotrebu je ušlo više novih materijala nego u svim prethodnim vijekovima!” <https://dokumen.tips/documents/5-izbor-materijala.html>
Klasična škola i klasična nastava nisu mogle pripremiti stručnjake za odabir savremenih materijala za razne privredne djelatnosti. Zato se savremenoj školi i savremenoj nastavi

¹Našu pažnju privukao je prilog Jokanović, R.V., (2012), Nanotehnologije i uvod u nanomedicinu u knjizi: Nanomedicina, najveći izazov 21. veka, DATASTATUS, Beograd).

nameće zadatak da u školi, u sistemu nastavnog procesa pripremi stručnjake koji će prepoznavati materijale korisne za čovjeka.

Informacione i komunikacione tehnologije od savremene nauke očekuju usavršavanje bežičnog interneta i svega što ta tehnologija može da donese. “Bežični Internet (*High Speed Wireless Internet*) je sistem projektovan s ciljem povezivanja klijenata Internet bežičnom radio-vezom na visokim frekvencijama. Generalno postoji nekoliko različitih frekvencija na kojima funkcioniše ova tehnologija” (<https://oriontelekom.rs/prenos-podataka/bezicni-internet/>). Koje su sve mogućnosti u ovoj oblasti, realno se ne može naslutiti s obzirom na brzi razvoj i unapređivanje. Pored doprinosa u oblasti informisanja, zabave, komunikacija i svega ostalog, trendovi ovih tehnologija idu i u pravcu izrade kosmičkog oružja, biološkog oružja, hemijskog oružja, akustičnog oružja i energetskog oružja, na patentima i idejama genija, Nikole Tesle itd. Škola prvih decenija 21. vijeka je nezamisliva bez sve ozbiljnijih i sveobuhvatnijih nastavnih planova i programa informatike i računarstva. Slobodni smo pretpostaviti da će naredne decenije ovog vijeka još više aktualizovati ova pitanja.

Savremenom čovjeku se nudi brzi stil života, sa obeležjem pristupačnosti sveobuhvatnim informacijama (svima bez obzira na životnu dob) koje omogućuje internet, kao i promjenama sistema vrednosti koji dominira današnjicom. U prvom redu misli se na informatiku. “Informatika je nauka o sistematičnoj i efikasnoj obradi informacija, prvenstveno pomoću automatskih mašina, pri čemu se informacije smatraju medijumom ljudskog znanja i komuniciranja, u kontekstu tehnologije, ekonomije i sociologije.” (Balaban, N., Ristić, Ž., Trninić, J., 2005). Informatika je interdisciplinarna oblast kojom se prikupljaju, obrađuju, skladište i distribuiraju podaci iz raznih (svih) sfera čovjekovog života u objektivnoj stvarnosti. Informatika u našem vremenu ima važnu, slobodni smo napisati dominantnu ulogu u nauci, kulturi i umjetnosti. Jednako je dominantna na polju ekonomije, obrazovanja, zdravstva, sporta, razvoja vojne doktrine, sistema uprave... Informatika, sa savremenim tehničkim aparatima, diktira svakodnevnicu svakog čovjeka na planeti. Život je postao ne zamisliv bez mobilnog telefona, bez kompjutera i bez brojnih platformi kao što su Google, Facebook, Instagram, Twiter i druge. Riječ, informatika je dominantna na svim poljima ljudske delatnosti.

Savremena škola i sistem vaspitanja i obrazovanja moraj pratiti trendove pozitivnih efekata nauke i tehnologije. Tradicionalna škola i tradicionalni pristup pasivnom reproduktivnom učenju ne može zadovoljiti potrebe razvoja poljoprivrede od koje se očekuje višestruko uvećanje kapaciteta proizvodnje hrane. Isto tako “stara” odnosno “klasična škola” ne može pripremati generacije za ostvarenje visokog životnog standarda, za praćenje i životno posredovanje dostignuća medicine, posebno iskorenjivanje poznatih i sve novih bolesti, sa nastojanjima za produžetak ljudskog vijeka. Takva škola i nastava

ne mogu zadovoljiti potrebu praćenja razvoja transporta, urbanizacije, standarda života. Drugim riječima, savremena škola svojim sadržajima, pedagoškim mjerama, didaktičkim i metodičkim rješenjima, treba da odgovori pripremi mladih ljudi za neometano shvatanje i bezbolno uključivanje u razvoj industrije, energetike, transporta, urbanizacije, vojnih tehnologija i njihovo stavljanje u funkciju sigurne zaštite prirodnih resursa i sigurnijeg života ljudi. Isto tako, savremena škola i nastava, kroz nastavne planove i programe i njihovu realizaciju, treba da odgovore neophodnostima otklanjanja zagađenja atmosfere tzv. “efektima staklene bašte”, globalnog zagrijavanja i promjene klime na planeti, ugrožavanja obnovljivih prirodnih resursa (pre svih: vode, hrana, šume, i dr.), zagađivanja tla, uništavanje ekosistema itd. Nauka, tehnika i tehnologija, vođene stručnjacima bogatog obrazovanja stae u službu životne sredine, žive i nežive prirode i iznad svega čovjeka.

Savremena ekonomija je dostigla globalne razmjere i proširena je na tržišta van nacionalnih okvira privrede. Osnovu savremene ekonomije čini tzv. “održivi razvoj”. “Održivi razvoj jeste razvoj koji zadovoljava potrebe sadašnjice, a da ne dovodi u pitanje sposobnost budućih generacija da zadovolje vlastite potrebe”: (Ilić B., Mihajlović, D., Karabašević, D. (2016; 413-423). Za razliku od ekonomije prošlih vremena, savremenu ekonomiju karakteriše elektronsko poslovanje zasnovano na primeni informatičke i internet tehnologije. Elektronsko poslovanje omogućava raznovrsne oblike poslovnih transakcija i razmene informacija dobijenih uz pomoć informacionih tehnologija, između preduzeća, komitenata na tržištu, javne administracije... Za svijet takve ekonomije, pogotovu onih njenih dostignuća koje će tek doneti novo vrijeme, potrebno je bitno drugačije, svestranije i sveobuhvatnije obrazovanje od onoga koje je nudila tradicionalna škola. (Više u: Jovanović, R., Milovanović, S., Radović, O. (2002). U savremenoj školi posebna pažnja treba biti posvećena radnom vaspitanju i konačno, preduzetništvu. (Videti: Prof. dr Sait Kačapor, (2012) Preduzetništvo kao cilj i ishod vaspitanja i obrazovanja, Zbornik radova Filozofskog fakulteta u Prištini, sa privremenim mjestom boravka u Kosovskoj Mitrovici, XLII (1), str.69-94.

Jedan od najbitnijih elemenata na kojima se mora temeljiti savremeni razvoj sistema školstva, sistema vaspitanja i sistema obrazovanje jeste stalana briga o zaštiti i unapređivanju nacionalnog identiteta, odnosno briga o očuvanju pripadnosti zajednici. Ova potreba je posebno aktuelizirana u eri savremene globalizacije, koja je zahvatila naše, a i mnoga (sve) društva u svijetu. Taj val nametanja novih vrijednosti prijeti nestajanju tradicionalnih nacionalnih vrednosti. Tako, na primjer ... “Jedan od najvećih strahova evroskeptika i protivnika evropskih integracija Srbije je gubljenje nacionalnog identiteta, “utapanje” u evropsku istoriju i kulturu, ostajanje bez posebnosti” (<https://novimagazin.rs/vesti/212674-nacionalni-identitet-danas-konstrukt-politike-i->

vere). Isti je problem sa mnogim narodima u svijetu u cjelini. Globalizacija se temelji na dva najvažnija elementa: sociološki i politikološki.”Sociološki pristup ukazuje na globalizaciju modernih razvoja procesa do svjetskih razmjera, čiji je cilj stvaranje modernog svjetskog društva sa zajedničkim institucijama, civilizacijskim procesima i kulturnim vrijednostima. Politikološki pristup se usredsređuje na oblike vojne, političke i ekonomske dominacije moćnijih država nad slabijima, kakvi se uspostavljaju u tzv. novom svjetskom poretku.” (Prema: Bogdanović D., Vuković M. 2015; 30-41). U procesu globalizacije, koja je zahvatila svijet, nestaju brojna obeležja nacionalnih pripadnosti, posebno manjih društvenih zajednica, poput tzv. “malih naroda” i nacionalnih manjina, ali i onih nacionalnih zajednica koje nedovoljno vode računa o očuvanju nacionalnih posebnosti: jezika, pisma, nacionalne kulture, tradicije i vrijednosti na kojima je ta zajednica opstajala i opstaje. Škola, odnosno nastava, preciznije nastavni planovi i programi, ali i izvori koje koriste nastavnici i posebno učenici, se moraju bogatiti prilagođenim sadržajima o istoriji, tradiciji i kulturi. Posebno su na udaru jezici malih naroda i pripadnika nacionalnih manjina.

Potrebu modernizacije sistema vaspitanja, obrazovanja i školskog sistema nameću i najnoviji trendovi globalnih udruživanja, ekonomskih i vojnih saveza. Tradicionalna škola se temeljila na tradicionalnim pedagoškim dostignućima zemalja Evrope i dijelom Amerike. Dominacija zemalja središnje i zapadne Evrope, posebno Amerike, umogome nestaju i pitanje je koja će ekonomska i vojna sila imati veću dominaciju, odnosno koja će veća civilizacija u svijetu ponuditi ekonomski i društveno primamljivije razvoje i opštu sigurnost. Kada je u pitanju pedagogija kao nauka o vaspitanju i obrazovanju, sve je aktuelnije proučavanje dostignuća u zemljama bliskog, srednjeg i dalekog istoka, od Republike Turske, Izraela i modernih arapskih društava poput Emirata i Katara, do Indije, Kine, Japana, Severne i Južne Koreje, Indonezije... Školu i sisteme vaspitanja i obrazovanja, odnosno krovnu nauku o vaspitanju – pedagogiju, više ne zadovoljavaju samo proučavanja naučnih dostignuća Njemačke, Francuske, Rusije, Engleske i SAD kao nijedne druge zemlje u Evropi i Americi. Isto tako, savremenu školu više ne zadovoljava ponavljanje kako se škola razvijala u prošlosti, na tlu Evrope, niti šta su ostavila saznanja o doprinosu klasika vaspitanja i obrazovanja. Ta problematika trajno i isključivo ostaje u domenu posebne discipline pedagogije –istorije pedagogije. Moderna pedagoška nauka će se sve više temeljiti na vrijednostima koje poznaje pedagogija Planete u cjelini, što već omogućava brzi protok informacija dostupnih na internetu.

Uloga glavnih faktora nastavnog procesa u savremenoj školi naspram tradicionalne škole

U savremenoj školi nužne su brojne, pa i korenite izmjene. Da pođemo od uloge glavnih subjekata procesa nastave – nastavnika i učenika.

U klasičnoj školi, nastavnik je bio znalac, koji besprijekorno zna interpretirati nastavne sadržaje, izdvojene na sekvence za jedan nastavni čas, odnosno na nastavne jedinice. Na taj način on je “držao” “predavanje”, te je njegovo glavno obilježje bilo da je predavač.¹ U savremenoj školi, odnosno u savremenom nastavnom procesu, nastavnik više nije predavač. On je moderator, onaj koji pokazuje, ukazuje, usmjerava, pobuđuje pažnju, tumači, objašnjava, animira učeničku pažnju i pruža sve širu mogućnost dolaženja do saznanja.

Nastavniku savremene škole nije prioritet da on kaže učenicima činjenice koje treba usvojiti, niti da on pokaže da je shvatio kako se dolazi do generalizacija, niti da saopšti definicije, pravila, zakone, zakonitosti, povratne informacije, algoritme. Njegova uloga je da najprije obučeni učenici vještini uspjeha učenja. Tek kada učenici ovladaju vještinama učenja, nastavnik je siguran da će u nastavi, sa učenicima, postići uspjeh. Tako obučeni učenici će pomoći nastavnicima kako da oni (učenici) upoznaju činjenice i kako da na temelju činjenica dođu do generalizacija, odnosno kako da u procesu misaone aktivnosti usvoje nastavne sadržaje i kako da ih posreduju u praksi, u konkretnim životnim okolnostima.

Savremeni nastavnik posebnu pažnju pridaje fenomenu motivisanja učenika za proces saznanja u nastavi. Savremena nastavna tehnologija, posebno ponuda sadržaja u vidu visokokolorizovanih i pokretnih slika, trodimenzionalnih sadržaja, svjetlosnih i zvučnih signala, pobuđuju motivaciju, privlače pažnju učenika što je sigurna garancija uspjeha. U klasičnoj školi to je bila samo “živa riječ” nastavnika potkrepljena najčešće samo tablom i kredom.

U klasičnoj školi nastavnik je nametao nastavne sadržaje i aktivnost učenika. Neuspjeh u učenju i radu surovo je kažnjavao negativnim ocenama, prijavljivanjem nastavničkom vijeću i upravi škole, što je vodilo čak do isključenja iz škole, a najčešće fizičkim kaznama (šibanjem po dlanovima). U savremenoj školi nastavnik pruža mogućnost izbora sadržaja,

¹U lingvističkom smislu “predavanje” i “predavač” su neodrživi, kada je u pitanju nastava i proces usvajanja znanja o objektivnoj stvarnosti. Naime znanja se ne mogu predati, ona se ne mogu preuzeti, uzeti i mijenjati vlasnika... Znanja se usvajaju čulnim putem – perceptivno (vid, sluh, ukus, miris, taktilna osećanja ... kinestetičkim čula), “prerađuju” u svijesti (misaonom aktivnošću – mišljenjem), radnom aktivnošću i praktičnom aktivnošću.

oblika i metoda usvajanja znanja. Nastavnik može nuditi opcije, ali to ne znači da on onemogućava učenicima izbor. Prekori i kazne, pogotovu samovoljne kazne nastavnika i korišćenje fizičke nadmoćnosti su strogo zabranjene. U ovom prilogu iskazujemo ubeđenje da takvih ponašanja nastavnika u našim školama više nema!

U klasičnoj nastavi preovladavao je frontalni oblik rada sa pretežno jednosmernom komunikacijom. Naime, u procesu tzv. “obrade” nastavnih sadržaja komunikacija je bila usmjerena od nastavnika prema (svim) učenicima, a u procesu tzv. “utvrđivanja” nastavnih sadržaja¹ komunikacija je bila usmjerene od pojedinih učenika prema nastavniku. Tako je nastavnik, najčešće isključivo verbalnim putem, dobijao povratnu informaciju o stepenu usvojenosti nastavnih sadržaja. “Nastava je socijalni proces, proces interakcije. U toj interakciji učestvuju učenici i nastavnici čiji su “... životni putevi u posebnim društvenim prilikama – različite socijalne percepcije, predrasude, načini djelovanja i stavovi (Gudjons i saradnici, 1992:15). Zato nastaju smetnje, opiranja, sukobi i kompromisi. U savremenoj nastavi komunikacija je dvosmjerna i odvija se u živoj interakciji učenika i nastavnika. Praktična primjena znanja, na konkretnim pokazateljima je odgovor na stepen usvojenosti znanja, a ne deklamovanje naučenih lekcija. Umjesto frontalnog oblika rada učenicima se pružaju mogućnosti slobodnog izbora: individualnog oblika rada, rada u parovima, rada u manjim grupama ili rada u većim grupama. U klasičnoj nastavi nastavnik je nametao partnera u radu u parovima ili sastav grupa ako je bilo grupnog oblika rada. U savremenoj nastavi učenik bira sa kime želi da radi u paru ili grupi i time i sam doprinosi atmosferi u radu. Rad u takvim sociološkim oblicima omogućuje projektovanje aktivnosti, istraživački rad, demonstraciju uspjeha, izvještavanje o radu i postignutom uspjehu itd.

U klasičnoj nastavi cilj učenja je bio jasan samo nastavniku. “...Škola današnjice i škola sutrašnjice osim ispunjavanja sazajnih, obrazovnih ciljeva, mora zadovoljiti i humanističke ciljeve. Misli se na nezavisnost, samopouzdanje, preuzimanje odgovornosti za vaspitno-obrazovne ishode, unutrašnju motivaciju, uspostavljanje sopstvenih kriterijuma uspješnosti i kreativnosti (Prema: Glaser, W., (1990) ; Hentig, H., (1997). “Ako društvo želi razvijati demokratiju, sa tržišnom orijentacijom u privređivanju, što

¹Isto tako termini “obrada”, a posebno termin “utvrđivanje”, kada su u pitanju nastavni sadržaji su neodrživi. Termin obrada je prigodan za proizvodnju i građevinarstvo i razne druge oblasti ljudske djelatnosti, a neprikladan je za nastavne sadržaje. Nastavni sadržaji se ne obrađuju, oni se usvajaju perceptivnim i misaonim putem, a njihova primjena se usavršava praktičnom aktivnošću. Isto tako termin “utvrđivanje” je prikladan u građevinarstvu (utvrđuje se gradnja, učvršćuje se beton, gips i razni drugi građivni materijali, a ne nastavni sadržaji. Nastavni sadržaji se kraće ili duže zadržavaju u svijesti, a trajno se mogu zadržati u procesu vežbanja, tj. radne, praktične aktivnosti.

prije svega i iznad svega znači konkurentnost na tržištu, ekonomski rast i razvoj i garanciju sigurne egzistencije stanovništva, onda se mora preispitati cilj vaspitanja i obrazovanja, ne samo u institucijama sistema – školama, već i na svim ostalim nivoima: u porodici, u vrtiću, u medijima, u slobodnom vremenu, u procesu permanentnog (cjeloživotnog, formalnog, neformalnog i informalnog) vaspitanja i obrazovanja” (Kačapor, S., 2012;69). U savremenoj nastavi prioritetna uloga nastavnika sastoji se u tome da on pomogne učenicima da jasno definišu cilji, da shvate da je cilj dostupan i da stalno pomaže učenicima da nalaze najracionalniji put dolaska do cilja. Na taj način savremeni nastavnik omogućava svim učenicima da postavljaju svoje ciljeve i da traža najbolje načine ostvarivanja ciljeva.

Jedna od glavnih karakteristika tradicionalne nastave jeste ta da u njoj preovladava „predavanje“ nastavnih sadržaja. To dovodi nastavnika u položaj subjekta, a učenika stavlja u ulogu objekta koji pasivno prima informacije, pri čemu je uloga nastavnika dominantna. Na takve pozicije glavnih subjekata u procesu nastave ukazivao je veliki broj didaktičara (Bibić, M., 2020;77).

U tradicionalnoj školi nastavnici su jedini znali šta će se sve učiti. U savremenoj školi, u nastavnom procesu, učenici su, zajedno sa nastavnikom, a sve češće samostalno kreatori kurikuluma. Nastavnici u toj oblasti imaju ulogu usmjerivača, sigurnog kreatora kome se u datom trenutku, prema potrebi, mogu za pomoć i podršku obratiti učenici.

Uloga nastavnika savremene škole ogleda se u stvaranju povoljne pedagoške klime za sticanje znanja, vještina i navika, kao i za primjenu stečenih znanja, vještina i navika u praksi. Uz podsticaj nastavnika učenici u nastavnom procesu mogu stvarati razne situacije poput stvarnih životnih: proces proizvodnje, proces prerade, proces distribucije, trgovine i sl, ili društvenih odnosa poput pralamentalnog pokretanja određenih pitanja, rasprava, donošenja zaključaka, odluka i sl. Takav način rada ne ostavlja nijednog učenika u položaju pasivnog “prisutno-neprisutnog” člana, već svi učenici živo uzimaju učešće u radu.

U tradicionalnoj nastavi odnosi su strogo regulisani. Nastavnik je uglavnom stajao ili se kretao ispred učenika, a učenici su sjedeli i “pretvarali se u oko i uho”. U savremenoj nastavi nastavnik stvara sigurno okruženje koje odgovara domaćim (kućnim) uslovima. Učenicima je dozvoljeno da se kreću, da na stolu drže grickalice, bombone, vodu, sok i sl. U klasičnoj nastavi nastavnik je objašnjavao sadržaje u fazi obrade, a postavljao pitanja učenicima u fazi utvrđivanja i vježbanja, posebno u fazi provjeravanja i ocjenjivanja. U savremenoj nastavi nastavnik stalno objašnjava, najčešće postavljanjem pitanja koja pobuđuju na misaonu aktivnost i rad.

U klasičnoj školi nastavnik je vodio evidenciju o uspjehu učenika dajući u dnevniku ocjene, ili razne znake koji su samo njemu bili jasni. U savremenoj nastavi učenici sve

više sami procjenjuju i ocjenjuju svoj rad i stepen postignuća. Spoljašnja, ekstrinzična motivacija, zamijenjena je za unutrašnju intrinzičnu motivaciju. Samopraćenje, umjesto praćenja, samoprocjenjivanje, umjesto procjenjivanja i samoocjenjivanje umjesto ocjenjivanja pobuđuju samomotivaciju i saodgovornost što bitno povećava uspjehe u učenju. O svojim uspjesima učenici mogu voditi kumulativni oblik evidencije. Uspjeh učenika u usvajanju nastavnih sadržaja nastavnik klasične škole nije smatrao svojim pitanjem, niti svojom brigom. Za to su bili zaduženi učenici, a uloga nastavnika bila je da učenike u procesu ocjenjivanja rasporedi na skali od jedan do pet. Postojali su tzv. "strogi" nastavnici čija skala ocjenjivanja je bitno bila pomjerena u lijevu stranu, tako da je bilo mnogo negativnih ocjena, malo dovoljnih, a još manje dobrih, dok su vrlodobre i odlične ocjene bile rijetkost. Na drugoj strani, bilo je nastavnika čija je skala u ocjenjivanju bila bitno pomjerena u desnu stranu, te je najviše bilo odličnih, manje vrlodobrih, još manje dobrih, a loše ocjene su bile krajnja rijetkost. Za razliku od toga, nastavnik savremene škole i nastave ima velika očekivanja od svoji učenika. On to ne krije, već to stalno saopštava učenicima, motivišući ih da to i postignu i, zajedno sa njima, tražeći najsigurnije puteve da se postignu ta očekivanja. Upravo za to nastavnik savremene škole postavlja krajnji cilj i adekvatnim pristupima svakom učeniku, na njemu najprikladniji način, demonstrira šta se od učenika očekuje, uveravajući ga da postoje načini da on to i ispuni. Zato nastavnik savremene škole preuzima odgovornost za učenika (sa)znanja i postignuća, odnosno za napredak svakog učenika. Važan momenat u radu savremenog nastavnika jeste njegova svijest o sposobnosti svakog učenika, odnosno svijest o tome sa kojim znanjima, kada je u pitanju konkretni nastavni sadržaj, su učenici započeli proces saznanja, a sa kojim stepenom saznanja se završava taj proces. Savremeni nastavnik stalno usmjerava učenike na razmišljanje i planiranje svoga uspjeha i na stalnu samoocjenu o stepenu ostvarenja cilja. Tako učenici povećavaju vlastitu odgovornost, a ocjenu o uspjehu shvataju kao nešto krajnje lično, svoje, a ne kao "poklon" od nastavnika, ne kao "nagradu", a pogotovu ne kao "kaznu".

Nastavnik klasične škole je bio autoritarna ličnost. Uzimao je sebi slobodu da kritikuje, izvrgava ruglu, ili fizički kažnjava učenike za nedisciplinu i za iskazana slabija znanja u učenju. Nastavnik savremene škole ne prihvata i ne koisti nijedan pokazatelj takvih ponašanja.

Nastavnik savremene škole u interaktivnoj komunikaciji sa učenicima, kroz modelovanje nastavnog procesa, kroz vođenje, kroz monitoring, kroz rezultate koje postiže sa svojim učenicima na najbolji način, indirektno, ne nametljivo, pokazuje da je vrhunski poznavalac nastavnih sadržaja na kojima radi sa učenicima i da mu to omogućava vrhunske rezultate u praktičnim operacijama koje zahtevaju baš ta znanja, vještine i navike.

Nastavnik klasične nastave važio je za pedagoga koji je vješt da “prenese” znanja.¹ Nastavnik savremene škole očigledno prikazuje, stavljajući pred čula učenika, pobuđuje misaonu aktivnost u cilju dolaženja do zaključaka i motiviše za praktičnu primjenu znanja i vlastiti rad koji je pokazatelj uspjeha. Time se dolazi do trenutka saznanja, do “aha – doživljaja”, odnosno do trenutka vlastitog zadovoljstva postignutim uspjehom.

U klasičnoj nastavi nastavnik je svoja “predavanja” prilagođava zamišljenom “srednjem” učeniku. Taj “srednji” učenik je zapravo nepostojeći, imaginaran. U procesu samostalnog, individualnog rada učenici su različito uspjevali da usvoje nastavne sadržaje. To usvajanje nastavnih sadržaja je najčešće bilo pasivno, reproduktivno. U savremenoj nastavi nastavnik vodi računa o mogućnostima svakog učenika i svakom od njih prilagođava zahtjeve, kreira učenje i puteve dolaska do saznanja. Znanja koja se usvajaju su primjenjiva, produktivna, praktična i funkcionalna. Drugim riječima, nastavnik savremene škole prilagođava tok nastavnog procesa jednako nadarenim, srednjim i učenicima sa posebnim potrebama i poteškoćama u učenju i radu.

Nastavnik klasične nastave najčešće nije obraćao pažnju na ono što savremena škola definiše kao “skriveni kurikulum”. Nastavnik savremen škole nastoji da upozna i uslovei mogućnosti svakog učenika. Njega zanima fizički, društveni i intelektualni razvoj svakoga učenika, ali i materijalni i porodični uslovu u kojima učenik živi. Drugim riječima, nastavnik savremene škole upoznaje potrebe kako talentovanih, tako i hendikepiranih učenika i svih drugih karakteristika. U skladu s tim on prilagođava zahteve u procesu učenja i nastavnog rada.

U klasičnoj nastavi ocjene koje je “davao”² nastavnik su imale selektivan karakter. Vrlo često su bile pokazatelj nastavnikovog odnosa prema učeniku, a isto tako i čin spoljašnje motivacije, kao i čin nagrade i (ili) kazne. U savremenoj nastavi konačna ocjena o učenikovom postignuću je proizvod njegovog odnosa prema radu, njegove samoocjene i ocjene nastavnika. Savremeni nastavnik nije onaj ko samostalno odlučuje o ocjeni i koji na taj način “ugoni strah i trepet”. On ne drži monopol nad procesom praćenja, merenje, vrednovanja, evaluacije i ocjenjivanja, već u svemu tome ravnopravnu učestvuju učenici i kolektivno i grupno i individualno. Ocjena nema selektivni karakter, ali je ona podsticaj za postizanje još boljih rezultata.

¹Sam termin “prenošenje” znanja je ne održiv, kada je u pitanju nastava i proces usvajanja znanja, vještina i navika. Znanja se ne mogu nositi, ne mogu se prenositi, kao što se ne mogu davati i uzimati. Mogu se tumačiti, razlagati na činjenice i generalizacije, usvajati čulnim i misaonim putem i praktičnom aktivnošću.

²Termin “dati” je neadekvatan kada je u pitanju vrednovanje učenčkih znanja i postignuća. Ocjene se ne mogu dati, niti uzeti, one su proizvod sistematskog praćenja, mjerenja, vrednovanja i evaluacije procesa usvajanja znanja, vještina i navika.

Nastavnik klasične nastave je samostalno planirao rad. U savremenoj školi nastavnik ima vodeću ulogu u programiranju i planiranju nastave. Međutim, svoju značajnu ulogu u tom procesu imaju učenici, učnički roditelji, nastavnici srodnih nastavnih predmeta, nastavnici svih predmeta koji imaju bilo kakve dodirne tačke u sadržajima, školski pedagozi i menadžment škole. U procesu programiranja i planiranja rada bitnu ulogu imaju medijatekari, animatori, bibliotekari i svi drugi faktori na čiju podršku i pomoć se računa. U klasičnoj školi jasno su postojali propisi o “kućnom redu”, kako za učenike, tako i za nastavnika. Ta pravila su se zasnivala na krutoj disciplini, na autoritarnom stavu nastavnika i na subordinaciji školskog menadžmenta. U toj hijerarhiji najniži i “najtanja karika” bili su učenici. U savremenoj školi školski menadžment, nastavnici, ostali radnici škole i učenici, čine jedinstveni kolektiv koga povezuju nastavni programi i planovi i zajednički jedinstveni cilj – uspjeh učenika. Svi članovi tog zajedničkog kolektiva vode računa o sopstvenom ponašanju, o higijeni i zdravstvenoj zaštiti, o radu, redu i disciplini. Svako od njih je podvrgnut samokontroli, samodisciplini, samoredu i samoradu. Sva dobra škole su dobra svih i svi nastoje da vode računa o toj imovini i njenoj funkcionalnosti.

U tradicionalnoj školi nastavnik je bio posrednik između nastavnih sadržaja i učenika, organizator vaspitno-obrazovnog rada, a odnosi na relaciji nastavnik-učenik bili su zasnovani na hijerarhijskim načelima. S druge strane, u savremenoj školi u kojoj vlada ili bi trebalo da vlada demokratski stil, uloga nastavnika nije samo obrazovanje, već i vaspitno djelovanje. Savremenog nastavnika karakteriše demokratski stil: ljubazan glas, isticanje prijedloga, zadobijanje saradnje, ohrabrenje, priznanje učenika, pomaganje i dijalog. (Trnavac, Đorđević, 2005). Nastavnik savremene škole je bitan inicijator i nosilac pozitivnog života u školi. Bitna karakteristika savremene škole jeste kolegijalnost i saradnički odnos kako među nastavnicima, tako i među učenicima i svim ostalim članovima kolektiva. “Osnovni oblici rada učenja koje je nastavnik koristio u svom radu jesu predavanja i receptivni oblici učenja” (Branković Illić, 2011). S druge strane, osnovni nastavnikov zadatak u savremenoj nastavi je da što pre osposobi svoje učenike za samostalan i produktivan rad. Učenicima su dostupni svi izvori informacija što govori o tome „da se nastava u izvesnom smislu demistifikuje i oslobađa dogmatizma tradicionalne škole u kojoj su sve informacije od izvora do učenika morale ići isključivo preko nastavnika” (Prodanović, Ničković, 1974: 56, prema: Arsić, 2019:170). Savremena nastava nesme predstavljati primo-predajni odnos. Dužnost nastavnika nije da „daje”, niti učenika da „primaju” znanja, kao što je slučaj u tradicionalnoj nastavi. Nastavnikova uloga u savremenoj nastavi se ogleda u tome da organizuje stvaralačko sticanje znanja. Pravo znanje je uvijek rezultat atmišanih napora, prema tome, nastavnici su ti koji u čenicima ne treba da daju „gotove” pojmove, zaključke, definicije, dokaze i sl., već da im omogući da do njih dolaze samostalno, zaključivanjem, razumevanjem i slično.

Škola sa svim svojim kapacitetima, posebno nastavnicima, stručnim saradnicima i saradnicima u nastavi, treba dati puni doprinos demokratizaciji društva kroz odgoj za demokratiju, za shvatanje i prihvatanje demokratskih tokova, prava i sloboda, obaveza i odgovornosti. Isto tako škola treba da bude najrealniji posrednik između nauke, tehnike, tehnologija, kulture i društvenog života. (Bibić, M., 2020:196).

Danas nastavnik ne treba biti samopredavač i ocjenjivač, već sve više “planer, programer, dijagnostičar, istraživač, organizator, inovator, savjetodavac i vaspitač. Što nastavnik u većoj mjeri vrši te savremene funkcije, njegov stil rada je manje klasičan, autoritaran, a više inventivan i demokratičan” (Ilić, 1999:141).

Na osnovu prethodnog izlaganja, moguće je doći do zaključaka da je uloga nastavnika u obrazovnom procesu u velikoj mjeri određena njegovim položajem u razredu, odnosno odjeljenju i da prije svega uključuje aktivnost u nastavnom radu, uvažavanje prava svih aktivnih subjekata nastave, odnosno učenika i obaveza nastavnika da nastavni rada ili uspjeh učenika unapredi (Vučinić Antonijević, 2020).

Nastavnik savremene škole stalno radi na svom stručnom usavršavanju. Nastavnici, više od brojnih drugih, nužno moraju prihvatiti cjeloživotno, formalno, neformalno i informalno obrazovanje i stručno usavršavanje. Jedino tako mogu pratiti ubrzani trend razvoja nauke, tehnike i tehnologije, prožimanja kultura i društvenih promjena. Nastavnici nužno moraju poznavati osnove informatike, posebno u dijelu praćenja savremenih kulturoloških, naučnih i umjetničkih dostignuća, kao i društvenih promjena u zemlji i svijetu u cjelini. Isto tako, sastavni dio nastavničkog obrazovanja mora biti korištenje kompjutera, izrada prezentacija, surfovanja nastavnih sadržaja na različitim platformama itd.

Rad nastavnika u savremenoj školi ne podrazumijeva samo rad u nastavi i vannastavnim aktivnostima. Pored rada u nastavi, nastavnik blisko sarađuje sa učeničkim roditeljima. U klasičnoj školi ta saradnja se zasnivala na roditeljskim sastancima i na individualnim sastancima na inicijativu nastavnika ili na inicijativu samih roditelja. U savremenoj školi ta saradnja je šira i sveobuhvatnija. Nema nijednog pitanja vezanog za učenika koje ne može biti predmet saradnje nastavnika i učeničkog roditelja. Pored formi koje su postojale i u klasičnoj školi, u savremenoj školi to mogu biti razne akcije, projekti higijenskog, zdravstvenog i humanitarnog karaktera. Isto tako to mogu biti rekreativni projekti i kulturno-umjetnički projekti.

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NEEDS TO REVIEW AND CHANGE THE UPBRINGING, EDUCATION AND SCHOOL SYSTEM

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ABSTRACT:

The rapid development of a science, an art, a culture, a technique, a technology and social changes in the world and our country both, imposes the education of a "new man" for life and work in the new age. This primary implies the modernization of the school. It refers to the school's organization, pedagogical and didactic-methodical foundations of work. The classical school can not satisfy those criteria with rigid organization based on the class-subject system and differentiated positions of the teachers and pupils both. The new school and teaching must educate future experts who work on newer and newer sciences and their disciplines that it will be used and developed always by the achievement of a technique and a technology and all the other fields of human life. For the development and constantly advancement of science, the technique and the technology, an art, a culture and a life in the democratic society with market orientation in the economy, it is necessary the new modern (richer and wider) education and new (more meaningful) culture. The modern school must correspond to the new socio-historical moment and because of that, the modern school must radically change its system and also the system of education and teaching. In this work, for example, we have processed the changed position of the main factors of teaching process for-the teachers and the pupils both.

Keywords: School, upbringing, education, science, culture...

ZNAČAJNI KVANTITATIVNI POKAZATELJI POSTIGNUĆA STUDENATA U ISPITNIM ROKOVIMA

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SAŽETAK:

Nacionalno telo za akreditaciju i obezbeđenje kvaliteta u visokom obrazovanju od visokoškolskih ustanova očekuje da sistematično prate i proveravaju ocene studenata po predmetima i preduzimaju odgovarajuće mere ukoliko dođe do nepravilnosti u distribuciji ocena (suviše visokih ili niskih ocena, degenerativna raspodela ocena) u dužem vremenskom periodu, kao i da prate i proveravaju prolaznost studenata po predmetima, programima, godinama i preduzimaju korektivne mere u slučaju suviše niske prolaznosti ili drugih nepravilnosti u ocenjivanju. U cilju postizanja zahtevanih očekivanja, u radu se obrazlaže značaj izbora i prezentovanja kvantitativnih pokazatelja postignuća studenata u ispitnim rokovima za dobijanje odgovarajuće kvalitativne analize.

Ključne riječi: statistički kvantitativni pokazatelji, probabilistička analiza, grafoanalitička obrada podataka.

1. UVOD

Savremene informacione tehnologije omogućile su skladištenje velike količine podataka, njihovu efikasnu obradu, brz prenos i ilustrativno prezentovanje. Posledično, takvo okruženje obezbedilo je uslove za realizaciju strategije praćenja sistemskih procesa tokom vremena u cilju dolaženja do izvesnih zaključaka i donošenja odluka, uključujući mogućnost eventualnog sprovođenja potrebnih korektivnih mera.

Nacionalno telo za akreditaciju i proveru kvaliteta (NAT) Republike Srbije je republička institucija nadležna za spoljašnu proveru kvaliteta visokoobrazovnih ustanova u smislu da obavlja poslove akreditacije, provere kvaliteta visokoškolskih ustanova i jedinica u njihovom sastavu, vrednovanja studijskih programa i obezbeđivanja kvaliteta u visokom obrazovanju u Srbiji ([1]: str. 4).

Kroz Standard 8 - Kvalitet studenata u okviru *Pravilnika za samovrednovanje* ([2]: str. 6-7) uz dodatna uputstva data u dokumentu *Standardi i uputstva za samovrednovanje* ([3]: str. 11-12), NAT od visokoškolskih ustanova očekuje da sistematično prate i proveravaju prolaznost studenata po predmetima, programima, godinama i preduzimaju korektivne mere u slučaju suviše niske prolaznosti ili drugih nepravilnosti u ocenjivanju. Takođe, kroz isti standard, podrazumeva se da visokoškolska ustanova sistematično prati i

proverava ocene studenata po predmetima i preduzima odgovarajuće mere ukoliko dođe do nepravilnosti u distribuciji ocena (suviše visokih ili niskih ocena, degenerativna raspodela ocena) u dužem periodu.

Standardom 14 – Sistematsko praćenje i periodična provera kvaliteta, koji je obrazložen u dokumentu [2] (str. 9) i dopunski u dokumentu [3] (str. 17), NAT predviđa da visokoškolska ustanova obezbedi uslove i infrastrukturu za redovno, sistematsko prikupljanje i obradu podataka potrebnih za ocenu kvaliteta studenata na osnovu njihove prolaznosti u ispitnim rokovima i ostvarenim kvantitativnim i kvalitativnim ocenama, kao usvojenim merama ishoda učenja. Za razliku od prikupljanja podataka, koje se vrši kontinuirano tokom školske godine, provera postignuća studenata u ispitnim rokovima se sprovodi periodično u smislu utvrđivanja trenutnog stanja za tekuću školsku godinu i eventualnog donošenja korektivnih mera u pogledu procene znanja studenata i njihove prolaznosti u ispitnim rokovima, a u cilju dostizanja željenih standarda kvaliteta. Budući da su nastavnici, saradnici i studenti ključni akteri u sprovođenju nastavnog procesa, visokoškolska ustanova je u obavezi da upozna nastavnike i saradnike putem katedri i stručnih organa, studente preko studentskih organizacija, a Komisiju za akreditaciju i proveru kvaliteta, kao i javnost, preko svoje internet stranice o postignutim rezultatima studenata u ispitnim rokovima tokom školske godine (videti na primer [4] i [5]).

Polazeći od prethodno navedenih zahteva NAT-a, ključni kvantitativni pokazatelji postignuća studenata u ispitnim rokovima su *prolaznost studenata* i *raspodela ocena*. *Prolaznost studenata* se definiše kao odnos *broja studenata koji su položili ispit* i *broja studenata koji su prijavili ispit iz nekog predmeta* u jednom ispitnom roku, odnosno broja položenih ispita i broja prijavljenih ispita u okviru jednog studijskog programa ili jednog ispitnog roka ili jedne, a može i više školskih godina. *Raspodela ocena* se odnosi na raspodelu realizovanih ocena u okviru jednog predmeta, ali može i na raspodelu ocena položenih ispita u okviru jednog studijskog programa, jednog ispitnog roka, jedne ili više školskih godina.

Odatle, sistematsko prikupljanje podataka o postignućima studenata u ispitnim rokovima zahteva takvu organizaciju da u svakom ispitnom roku, u okviru svakog studijskog programa i na svakoj godini studija, za svaki predmet dobijemo podatke o *broju studenata koji su prijavili ispit, odustali od ispita, nisu položili ispit* i *broju studenata koji su položili ispit*, uključujući *raspodelu ocena* sa pripadajućom *prosečnom vrednošću* i *standardnom devijacijom*. Budući da se ukupan broj prijavljenih ispita iz nekog predmeta u posmatranom ispitnom roku može razložiti na broj studenata koji su odustali od ispita, broj studenata koji nisu položili ispit i broj studenata koji su položili ispit iz tog predmeta, prikupljeni i razvrstani podaci predstavljaju frekvencije koje redom odgovaraju kategorijama *odustali od polaganja ispita, nisu položili ispit* i *položili ispit* obeležja *Rezultati ispita*, a sama prolaznost studenata, relativnu frekvenciju kategorije *položili ispit*. U svakom ispitnom roku podaci se registruju nad elementima populacije. Međutim, populacija se kvantitativno, a posebno *kvalitativno* menja iz godine u godinu po ispitnim rokovima, što za sobom povlači promenljivost pokazatelja postignuća studenata u ispitnim rokovima – *prolaznost studenata* i *raspodela ocena*. Shodno tome, navedeni pokazatelji postignuća studenata u ispitnim rokovima predstavljaju slučajne promenljive čije

vrednosti zavise od kvaliteta populacije koja se tokom godina menja i nije unapred poznata. Uzimajući u obzir njihovu stohastičku prirodu, prvi deo ovog rada biće posvećen probabilističkoj (verovatnosnoj) analizi pokazatelja postignuća studenata u ispitnim rokovima. Sa druge strane, kako realizovane vrednosti navedenih slučajnih promenljivih imaju ulogu pokazatelja trenutnog stanja postignuća studenata u ispitnim rokovima, drugi deo rada razmatra grafoanalitičku obradu prikupljenih podataka i način prezentovanja dobijenih rezultata.

2. STATISTIČKI POKAZATELJI POSTIGNUĆA STUDENATA U ISPITNIM ROKOVIMA

Podaci u vezi prolaznosti studenata i raspodele ocena u nekom ispitnom roku bazično se prikupljaju u okviru jednog predmeta na određenoj godini studija izvesnog studijskog programa. Sumiranjem, prvo po predmetima u okviru jedne godine studija, a potom po godinama studija dolazimo do traženih podataka u okviru određenog studijskog programa, a zatim i zbirno za sve studijske programe na nivou posmatranog ispitnog roka. Sa druge strane, sumiranjem po ispitnim rokovima za svaki studijski program, dolazimo do traženih podataka za određen studijski program u posmatranoj školskoj godini, a odatle i zbirno za sve studijske programe na godišnjem nivou. Ponavljajući postupak, navedene podatke možemo dobiti za jedan studijski program ili zbirno za sve studijske programe u toku više školskih godina odnosno određenog vremenskog perioda.

Uzimajući u obzir koncentričnu strukturu dobijanja podataka u vezi prolaznosti studenata i raspodela ocena, prilikom probabilističke analize odgovarajućih slučajnih promenljivih ne preciziramo da li je ukupan broj ispitnih prijava, broj položenih ispita, kao i raspodela ocena sa pripadajućom prosečnom vrednošću i standardnom devijacijom vezan za predmet, studijski program, ispitni rok, jednu ili više školskih godina, već pretpostavljamo da se podaci prikupljaju na izvesnoj populaciji Ω popunjenih ispitnih prijava studenata čiji nam kvalitet unapred nije poznat, ali je poznata veličina populacije.

2.1. Prolaznost studenata

Pošto nas zanima prolaznost studenata na ispitima, to među ukupnim brojem popunjenih ispitnih prijava interesuju nas frekvencija kategorije *položili ispit* od tri moguće kategorije obeležja *Rezultati ispita*. Odatle, neka je za dati ukupan broj popunjenih ispitnih prijava N , A događaj da je na slučajno izabranoj popunjenoj ispitnoj prijavi upisana jedna od pet tzv. *pozitivnih ocena* potrebnih za prolaz na ispit: 6, 7, 8, 9 ili 10. Kako se registrovanjem jedne od ovih pet pozitivnih ocena na popunjenoj ispitnoj prijavi zapravo registruje kategorija *položili ispit*, to među N popunjenih ispitnih prijava, broj povoljnih jednakoverovatnih ishoda za događaj A odgovara frekvenciji kategorije *položili ispit*. Shodno tome, označimo sa

$$S_N = \sum_{j=1}^N I_A^{(j)}, \text{ gde je } I_A^{(j)} = \begin{cases} 1, & \text{ako je na } j - \text{toj ispitnoj prijavi pozitivna ocena;} \\ 0, & \text{inače.} \end{cases} \quad (1)$$

indikator događaja A u ispitivanju j -te ispitne prijave, $j = 1, 2, \dots, N$, a $S_N: \Omega^N \rightarrow \mathbb{R}$ je slučajna promenljiva koja predstavlja broj ispitnih prijava položenih ispita odnosno frekvenciju kategorije *položili ispit* među ukupno N popunjenih ispitnih prijava. Očigledno, S_N uzima vrednosti u skupu $\{0, 1, 2, \dots, N\}$. Budući da je N veličina populacije, *prolaznost studenata* se definiše kao *proporcija populacije* ([6]: str. 322):

$$\frac{S_N}{N} = \frac{1}{N} \sum_{j=1}^N I_A^{(j)}. \quad (2)$$

Zbog svog značaja za naredna tvrđenja, sledeće dve vrlo poznate teoreme (videti [7]: str. 187 i str. 204) navodimo bez dokaza.

Teorema 1. (Kolmogorovljev zakon velikih brojeva)

Neka je (X_n) niz nezavisnih slučajnih veličina takav da važi $\sum_{n=1}^{\infty} \frac{\text{Var } X_n}{n^2} < +\infty$. Tada je

$$P \left\{ \lim_{n \rightarrow +\infty} \frac{1}{n} \sum_{j=1}^n (X_j - EX_j) = 0 \right\} = 1. \quad (3)$$

Teorema 2. (Muavr-Laplasova integralna teorema)

Neka je (X_n) niz nezavisnih slučajnih veličina čija je raspodela data sa $P(X_n = 1) = p$ i $P(X_n = 0) = 1 - p$, $n = 1, 2, \dots$, $0 < p < 1$, i $S_n = \sum_{j=1}^n X_j$. Tada

$$\lim_{n \rightarrow +\infty} P \left\{ \frac{S_n - np}{\sqrt{np(1-p)}} \leq x \right\} = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^x e^{-\frac{t^2}{2}} dt, \quad x \in \mathbb{R}. \quad (4)$$

Tvrđenje 1. Neka je $p = P(A)$ verovatnoća realizacije događaja A , $0 < p < 1$. Tada *prolaznost studenata* (2) ima matematičko očekivanje $E\left(\frac{S_N}{N}\right) = p$ i varijansu $\text{Var}\left(\frac{S_N}{N}\right) = \frac{pq}{N}$, gde je $q = 1 - p$. Za dovoljno veliko N ($Np > 5$ i $Nq > 5$), normalna raspodela $\mathcal{N}(p, \frac{pq}{N})$ aproksimira raspodelu verovatnoća *prolaznosti studenata* (2). Ova aproksimacija je posebno dobra kada je vrednost verovatnoće p oko 0.5.

Dokaz: Budući da niz indikatora događaja A , $I_A^{(j)}$, $j = 1, 2, \dots, N$, su nezavisne jednakoraspodeljene slučajne veličine sa $E(I_A^{(j)}) = P(A) = p$ i $\text{Var}(I_A^{(j)}) = pq$, to slučajna veličina S_N ima binomnu raspodelu sa parametrima N i p , pri čemu je $E(S_N) = Np$ i $\text{Var}(S_N) = Npq$ (npr. videti [7]: str. 216). Odatle, na osnovu osobine matematičkog očekivanja i varijanse, neposredno dobijamo da je $E\left(\frac{S_N}{N}\right) = p$ i $\text{Var}\left(\frac{S_N}{N}\right) = \frac{pq}{N}$. Pored toga, uzimajući u obzir da na osnovu *Muavr-Laplasove integralne teoreme* važi

$$\frac{\frac{S_N}{N} - p}{\sqrt{\frac{pq}{N}}} \sqrt{N} \xrightarrow{D} Z: \mathcal{N}(0,1), \text{ kad } N \rightarrow +\infty,$$

gde D označava konvergenciju u raspodeli, neposredno sledi da standardna normalna raspodela $\mathcal{N}(0,1)$, za dovoljno veliko N ($Np > 5$ i $Nq > 5$), aproksimira raspodelu verovatnoća standardizovane prolaznosti studenata (2). Ova aproksimacija je posebno dobra kada je vrednost verovatnoće p oko 0.5. Odatle, smenom promenljivih, dobijamo da normalna raspodela $\mathcal{N}(p, \frac{pq}{N})$ aproksimira raspodelu verovatnoća prolaznosti studenata (2), i to posebno dobro kada je vrednost verovatnoće p oko 0.5. ■

Tvrđenje 2. *Ako je s_N registrovan broj položenih ispita odnosno realizovana vrednost slučajne promenljive S_N definisane sa (1), tada dobijena prolaznost studenata $\frac{s_N}{N}$ predstavlja verovatnoću $p = P(A)$ realizacije događaja A , $0 < p < 1$.*

Dokaz: Uzimajući u obzir da je $(I_A^{(j)})_{j=1,2,\dots}$ niz nezavisnih slučajnih veličina takav da važi $\sum_{j=1}^{\infty} \frac{\text{Var } I_A^{(j)}}{j^2} = \sum_{j=1}^{\infty} \frac{pq}{j^2} = \frac{\pi^2 pq}{6} < +\infty$ i $E(I_A^{(j)}) = p$, $j = 1, 2, \dots, N$, na osnovu Kolmogorovljevog zakon velikih brojeva (3) važi da relativna frekvencija $\frac{s_N}{N}$, kategorije *položili ispit* aproksimira verovatnoću $p = P(A)$ realizacije događaja A . Štaviše, kako je reč o populaciji veličine N , gde registrovana frekvencija s_N kategorije *položili ispit* odgovara broju povoljnih jednakoverovatnih ishoda za događaj A , to dobijena prolaznost studenata $\frac{s_N}{N}$ određuje verovatnoću $p = P(A)$ realizacije događaja A . ■

2.2. Raspodela ocena položenih ispita

Neka je data realizovana vrednost s_N , $1 \leq s_N \leq N$, slučajne veličine S_N definisane sa (1), odnosno ukupan broj položenih ispita među N popunjenih ispitnih prijava. Na skupu svih ispitnih prijava položenih ispita A definišemo slučajnu promenljivu X koja predstavlja *ocenu položenog ispita*. Kako X može uzeti jednu od pet tzv. pozitivnih ocena za prolaz na ispitu, to događaji $A_i = \{X = 5 + i\}$: “Na slučajno izabranoj ispitnoj prijavi, od ukupno s_N ispitnih prijava položenih ispita, upisana je pozitivna ocena $5+i$ “, $i = 1, 2, 3, 4, 5$, potpuno razlažu prostor ishoda A , odnosno $A = A_1 + A_2 + A_3 + A_4 + A_5$. Odatle, slučajnu promenljivu X možemo definisati sa

$$X = \sum_{i=1}^5 (5+i) I_{A_i}, \quad (5)$$

gde je I_{A_i} indikator događaja $A_i = \{X = 5 + i\}$, $i = 1, 2, 3, 4, 5$. Sa druge strane, za svako $i = 1, 2, 3, 4, 5$, označimo sa $S_i: A^{s_N} \rightarrow \mathbb{R}$ broj popunjenih ispitnih prijava studenata koji su dobili ocenu $5 + i$, odnosno

$$S_i = \sum_{j=1}^{s_N} I_{A_i}^{(j)}, \text{ gde je } I_{A_i}^{(j)} = \begin{cases} 1, & \text{ako je na } j\text{-toj ispitnoj prijavi upisana ocena } 5+i; \\ 0, & \text{inače.} \end{cases} \quad (6)$$

indikator događaja $A_i = \{X = 5 + i\}$ u ispitivanju j -te ispitne prijave, $j = 1, 2, \dots, s_N$. Očigledno za svako $i = 1, 2, 3, 4, 5$, slučajna promenljiva S_i uzima vrednosti u skupu $\{0, 1, 2, \dots, s_N\}$ i predstavlja *frekvenciju ocene* $5 + i$ među ukupno s_N položenih ispita. Uzimajući u obzir da je $A = A_1 + A_2 + A_3 + A_4 + A_5$ neposredno dobijamo da važi

$$P\{S_1 + S_2 + S_3 + S_4 + S_5 = s_N\} = 1. \quad (7)$$

Posledično, ako su $p_i = P(A_i)$ verovatnoće realizacije događaja A_i , $i = 1, 2, 3, 4, 5$, tada važi $p_1 + p_2 + p_3 + p_4 + p_5 = 1$ i za proizvoljne $s_i \in \{0, 1, 2, \dots, s_N\}$, $i = 1, 2, 3, 4, 5$, takve da $s_1 + s_2 + s_3 + s_4 + s_5 = s_N$ ispunjeno je da

$$P\{S_1 = s_1, S_2 = s_2, S_3 = s_3, S_4 = s_4, S_5 = s_5\} = \frac{s_N!}{s_1!s_2!s_3!s_4!s_5!} p_1^{s_1} \cdot p_2^{s_2} \cdot p_3^{s_3} \cdot p_4^{s_4} \cdot p_5^{s_5} \quad (8)$$

odnosno slučajne veličine S_1, S_2, S_3, S_4 i S_5 imaju multinomnu raspodelu verovatnoća.

Tvrđenje 3. *Neka su $p_i = P(A_i)$ verovatnoće realizacija događaja A_i , $i = 1, 2, 3, 4, 5$. Tada, za svako $i, i \in \{1, 2, 3, 4, 5\}$, frekvencija ocene $5 + i$, kao slučajna promenljiva S_i definisana sa (6), ima binomnu raspodelu sa parametrima s_N i p_i , tako da za proizvoljno $s_i \in \{0, 1, 2, \dots, s_N\}$ i $q_i = (1 - p_i)$ važi*

$$P\{S_i = s_i\} = P\left\{S_i = s_i, \sum_{\substack{k=1 \\ k \neq i}}^5 S_k = s_N - s_i\right\} = \frac{s_N!}{s_i!(s_N - s_i)!} p_i^{s_i} \cdot q_i^{s_N - s_i}, \quad (9)$$

pri čemu je $E(S_i) = s_N p_i$ matematičko očekivanje, a $Var(S_i) = s_N p_i q_i$, varijansa slučajne promenljive S_i .

Dokaz: Za svako $i, i \in \{1, 2, 3, 4, 5\}$, dokaz neposredno sledi iz definicije (6) slučajne veličine S_i , uslova (7) i multinomne raspodele (8) kao uopštenja binomne raspodele (9), gde je $q_i = (1 - p_i)$. Budući da S_i ima binomnu raspodelu sa parametrima s_N i p_i , tada njeno matematičko očekivanje i varijansa su redom dati sa $E(S_i) = s_N p_i$ i $Var(S_i) = s_N p_i q_i$. ■

Tvrđenje 4. *Neka su $p_i = P(A_i)$ verovatnoće realizacija događaja A_i , $i = 1, 2, 3, 4, 5$. Tada ocena položenog ispita X , kao slučajna promenljiva definisana sa (5), ima raspodelu verovatnoća datu sa $P\{X = 5 + i\} = p_i$, $i = 1, 2, 3, 4, 5$, čije je matematičko očekivanje*

$$E(X) = \sum_{i=1}^5 (5 + i) p_i. \quad (10)$$

Dokaz: Za svako $i, i \in \{1, 2, 3, 4, 5\}$, $A_i = \{X = 5 + i\}$ i odatle $P\{X = 5 + i\} = P(A_i) = p_i$. Matematičko očekivanje (10) neposredno dobijamo iz definicije (5) slučajne promenljive X i činjenice da je $E(I_{A_i}) = P(A_i) = p_i$. ■

Tvrđenje 5. *Neka su S_i frekvencije ocena $5 + i$, $i = 1, 2, 3, 4, 5$, definisane sa (6) na populaciji od s_N ispitnih prijava položenih ispita. Tada, realizovane vrednosti proporcija populacije S_i/s_N , $i = 1, 2, 3, 4, 5$, određuju raspodelu verovatnoća slučajne promenljive X , gde X predstavlja ocenu položenog ispita definisanu sa (5). Posledično, aritmetička sredina i varijansa realizovanih ocena svih položenih ispita određuju matematičko očekivanje i varijansu slučajne promenljive X na posmatranoj populaciji. Posebno, ako jedna od promenljivih S_i uzima vrednost s_N , $i = 1, 2, 3, 4, 5$, tada slučajna promenljiva X ima degenerativnu raspodelu verovatnoća.*

Dokaz: Za svako i , $i = 1, 2, 3, 4, 5$, realizovana vrednost slučajne veličine S_i , kao frekvencija ocene $5 + i$, odgovara broju povoljnih jednakoveratnih ishoda za događaj $A_i = \{X = 5 + i\}$ na populaciji od ukupno s_N jednakoveratnih ishoda. Odatle, realizovana vrednost proporcije populacije S_i/s_N određuje verovatnoću realizacije događaja A_i , $i = 1, 2, 3, 4, 5$, odnosno raspodelu verovatnoća $P\{X = 5 + i\} = p_i$, $i = 1, 2, 3, 4, 5$, slučajne promenljive X . Posledično, aritmetička sredina i varijansa realizovanih ocena svih položenih ispita određuju matematičko očekivanje i varijansu slučajne veličine X na posmatranoj populaciji.

Uzimajući u obzir jednakost (7), postoji mogućnost da jedna od slučajnih veličina S_i uzme vrednost s_N , a preostale četiri vrednost nula. Kako vrednosti proporcija populacije S_i/s_N , $i = 1, 2, 3, 4, 5$, određuju raspodelu verovatnoća slučajne promenljive X , to u ovom slučaju jedna ocena će imati verovatnoću realizacije 100%, a preostale 0%, odnosno X će imati degenerativnu raspodelu. ■

2.3. Grafoanalitička obrada podataka statističkih pokazatelja postignuća studenata u ispitnim rokovima

Probabilistička analiza pokazatelja postignuća studenata u ispitnim rokovima prvenstveno ima za cilj da ukaže na promenljivost njihovih vrednosti u zavisnosti od kvaliteta populacije studenata na kojoj se registruju. Međutim, u svrhe utvrđivanja trenutnog stanja na konkretnoj populaciji, prolaznost studenata i ocene položenih ispita posmatraju se kao statistički pokazatelji postignuća studenata u ispitnim rokovima koji zahtevaju sistematsko prikupljanje podataka, njihovu obradu, kao i tabelarno i grafičko prezentovanje dobijenih rezultata.

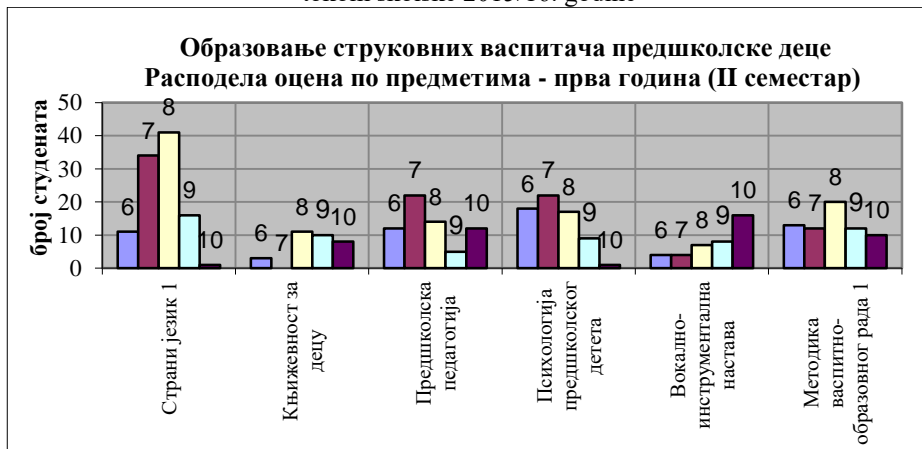
Zahvaljujući savremenim informacionim tehnologijama, grafoanalitička obrada podataka na efikasan i dopadljiv način, pored obrade, i prezentuje dobijene rezultate u formi pogodnoj za kvalitativnu analizu i donošenje zaključaka, kao i za dalju statističku obradu (npr. videti [8] i [9]).

U cilju ilustracije prikaza rezultata grafoanalitičke obrade podataka statističkih pokazatelja postignuća studenata u ispitnim rokovima – prolaznosti studenata i raspodela ocena položenih ispita – kao primer navodimo četiri grafikona (Slika 1, Slika 2, Slika 3 i Slika 4). Pomenuti grafikoni su preuzeti iz dokumenata [4] i [5], gde je izložena detaljna analiza prolaznosti studenata u ispitnim rokovima školske 2015/16. godine na osnovnim i specijalističkim strukovnim studijama, zasnovana na realnim podacima. Izdvojeni

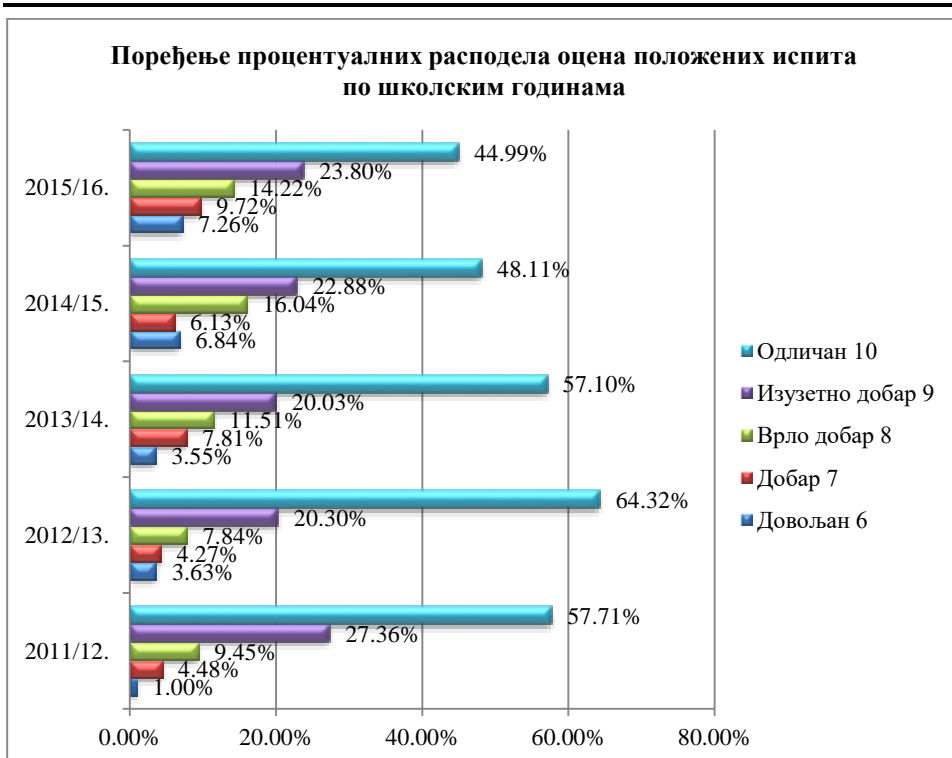
grafikoni ne samo što ukazuju na dobijene vrednosti pomenutih statističkih pokazatelja, već i na mogućnost njihovog poređenja na primer, po godinama studija (Slika 1), po predmetima (Slika 2), po školskim godinama (Slika 3), kao i po ispitnim rokovima i školskim godinama (Slika 4).



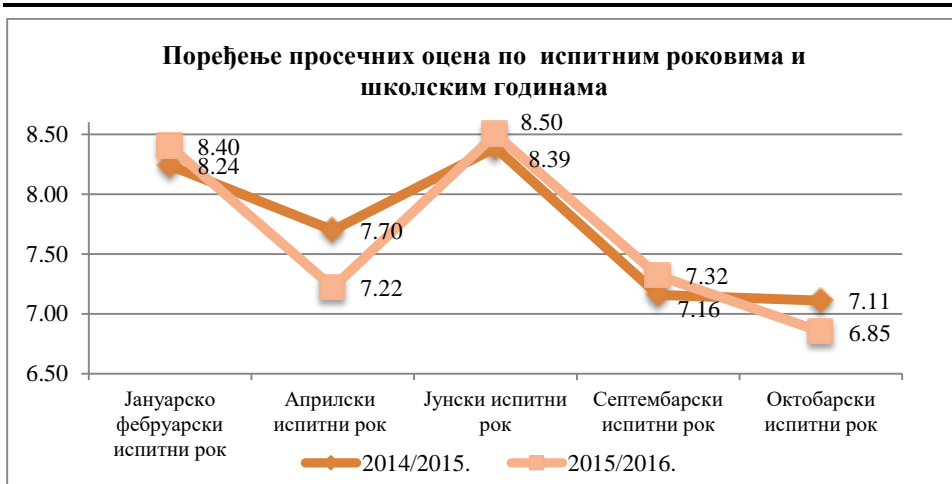
Slika 1. Poređenje prolaznosti студената по godinama osnovnih strukovnih studija tokom školske 2015/16. godine



Slika 2. Raspodela ocena položenih ispita po predmetima na prvoj godini osnovnih strukovnih studija u junskom ispitnom roku školske 2015/16. godine



Слика 3 Поређење процентуалних расподела оцена положених испита по школским годинама на специјалистичким струковним студијама



Slika 4 Poređenje prosečnih ocena po ispitnim rokovima i školskim godinama na osnovnim strukovnim studijama

3. ZAKLJUČAK

U cilju podizanja kvaliteta nastavnog procesa, neophodno je kontinuirano praćenje rezultata ishoda učenja kroz unapred definisane statističke pokazatelje postignuća studenata u ispitnim rokovima. Probabilistička analiza pomenutih pokazatelja ukazuje na određene pravilnosti u njihovom ponašanju na koje treba obratiti pažnju prilikom kvalitativne analize obrađenih podataka prikupljenih na konkretnoj populaciji.

U radu su obrazložene osnovne stohastičke karakteristike prolaznosti studenata i ocena položenih ispita, kao slučajnih veličina čije vrednosti zavise od kvaliteta populacije studenata na kojoj se registruju. Budući da dublja kvalitativna analiza podrazumeva i iscrpniju probabilističku analizu, otvara se mogućnog utvrđivanja i drugih relevantnih stohastičkih pravilnosti, kao i primene statističkih metoda u cilju dobijanja potpunijih zaključaka u vezi ponašanja pomenutih pokazatelja postignuća studenata u ispitnim rokovima. Međutim, dublja kvalitativna analiza prevazilazi postavljene zahteve u vezi kontrole ishoda učenja u visokoškolskim ustanovama. Pored utvrđivanja trenutnog stanja postignuća studenata u ispitnim rokovima na konkretnoj populaciji, akcenat se dodatno stavlja na prikaz dobijenih rezultata. Kako „slika govori više od hiljadu reči“, u ovom kontekstu odgovarajući grafički prikazi su vrlo poželjni, jer na ilustrativan način prezentuju trenutno stanje i ukazuju na eventualne nepravilnosti za koje je potrebno preduzeti odgovarajuće korektivne mere.

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SIGNIFICANT QUANTITATIVE INDICATORS OF STUDENTS' ACHIEVEMENTS IN THE EXAMINATION PERIODS

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ABSTRACT:

The National Body for Accreditation and Quality Assurance in Higher Education expects from higher education institutions to systematically monitor and check students' grades by subject and take appropriate measures if there are irregularities in the distribution of grades (too high or low grades, degenerative distribution of grades) over a long period of time, as well as to monitor and check the pass rate of students by subjects, programs, years and take corrective measures in case of too low pass rates or other irregularities in grading. In order to achieve the required expectations, the paper explains the importance of the selection and presentation of quantitative indicators of students' achievements in the examination periods for obtaining an appropriate qualitative analysis.

Keywords: *statistical quantitative indicators, probabilistic analysis, graphoanalytical data processing.*

EMOTIONAL ENGAGEMENT IN LEARNING ENGLISH AS A FOREIGN LANGUAGE DURING COVID-19 PANDEMIC

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ABSTRACT:

Online learning settings, as a direct consequence of the COVID-19 pandemic, have undoubtedly affected parameters for achieving learning outcomes. English as a foreign language and English as a second language have been much debated in relation to motivation, learning strategies, and anxiety in face-to-face and, lately, in distant and e-learning settings. The author explored the matter further by applying the emotional engagement factor to the equation. The research was conducted among first-, second-, and fifth-year students of a non-English major at the University of Slavonski Brod in Croatia. The outlined results will clarify the correlation of the Strategy Inventory for Language Learning (SILL) Scale, the Second Language Motivational Self System (L2MSS) Scale, and the Emotional Engagement (EE) Scale results obtained from participants who had previous experience of online classes during secondary or tertiary education levels.

Keywords: *online, English, motivation, strategy, emotional engagement, University*

1. INTRODUCTION

When the Covid-19 epidemic entered our daily lives few years ago, online education has become a vital component of all educational levels. These ICT-assisted educational initiatives range from Computer Assisted Language Learning (or CALL), which has been popular among teachers and students for several decades, to more contemporary and sophisticated usage of applications and social networks for educational purposes. Numerous studies targeting the identification of cognitive, affective, social, and other aspects of students using such technology in the learning process were carried out during those years, but much remains unknown about how these factors relate to one another in terms of achieving the desired learning outcomes. Some of the most prominent research papers were published in the field of motivation and language learning strategies, both of which have been the subject of the growing interest since late 21st century.

When speaking of motivation in second and foreign language learning, names of Gardner, Dörnyei, Lambert and Oxford stand out as their theories led to a more profound understanding of how motivation cannot simply be considered in terms of intrinsic and extrinsic drive. Motivation in English as a foreign language (EFL) or English as a second

language (ESL) can also be influenced by the teacher or instructor as the mediator, the group in which a learner is positioned and which relates to learning goals, the curriculum and teaching materials, and, among others, personality traits that encompass cognitive, social, and affective abilities and preferences. In e-learning and distant learning, the knowledge of how to use the appropriate ICT tools to achieve the desired outcomes is undoubtedly one of the most relevant factors, but it should be considered in relation to the learners' motivation. Following Gardner's model of integrativeness (Gardner, 1985), Dörnyei (1994:274) states that second language (L2) learning is a communication coding system that is an integral part of a learner's identity and that, alongside mastering new information and knowledge of the target language and the culture it belongs to, involves various personality traits and social components. Dörnyei (2005) proposed the L2 Motivational Self System (L2MSS), which consists of several variables, including the Ideal L2 Self (IL2S), the Ought-to L2 Self (OL2S), and the L2 Learning Experience as integrativeness, as well as Instrumentality Promotion and Instrumentality Prevention as outcome regulators. The IL2S and the OL2S are conceptualized as the learner's future guides in becoming a proficient speaker of the target language. Instrumentality promotion relates to the IL2S as it controls the learner's striving to reach professional and personal success in L2 learning. Instrumentality prevention is related to the OL2S and motivation associated with the learner's feelings of duty and obligation towards others. Through previous L2 learning experience, learners perceive their quality and control their intended effort, which may, as Dörnyei (2019) later states, be the most powerful component of L2MSS.

Strategies in learning EFL and ESL have also been much debated on during past several decades. One of the most widely used questionnaire in exploring the strategies in language learning (LL) is Oxford's Strategy Inventory for Language Learning (SILL), even though it has come across some criticism (Oxford, 1990, 2017). SILL is divided into two sets of language learning strategies (LLS): direct (cognitive, memory, and compensation) and indirect (metacognitive, social, and affective) strategies. Learners use cognitive strategies to analyse and synthesize the material being learned; memory strategies to aid storing the learned material; compensation strategies to override difficulties in memorising the learned material; metacognitive strategies to plan, monitor and evaluate the learning tasks; and social and affective strategies when interacting with others (Larsen-Freeman and Anderson, 2011). Due to increased usage of computers and ICT in distant and e-learning, students' preference in using the described LLS strategies have changed. Fišer conducted several pilot research on Croatian students of non-English majors who had recently experienced online learning of EFL via Microsoft Teams (MT). She discovered that one third of them did not watch recordings of online EFL lessons but 80% of them made notes by hand during the lesson (Fišer and Živić, 2021: 56). Reviewing the recorded video material for subsequent learning would be one of the metacognitive LLS which facilitates self-regulatory learning through planning, scheduling, and self-evaluating the learning progress (Kuo et al., 2013: 20). In a follow-up study, Fišer

(2022:68) further investigated which features of MT application interface, used to conduct EFL course lessons, students of non-English majors have preference for. The participants in that study reported they deliberately do not use their web cams during online lessons even though they are aware that watching the vocal apparatus of the speaker facilitates the acquisition of the pronunciation and offers the opportunity for detailed feedback. Students also reported they preferred engaging in chat at MT platform which is, in addition to previously mentioned metacognitive and cognitive LLS, a strategy from the social LLS group.

Emotional engagement (EE) in EFL has also been much debated, mostly in terms of foreign language anxiety. There have been several scales used in measuring the affective filters in L2 learning but the instrument used in this research was the one developed by Bernardić and her colleagues (Bernardić et al., 2017). It consists of only five particles and the authors used it in measuring the EE of secondary school students in learning physics. Although the obtained alpha coefficient was at the lower bond of acceptability ($\alpha=.65$) in the research they conducted, the scale's particles encapsulate the main issues in language learning anxiety among non-English majors which would be sufficient in exploring its relation to online learning setting. In her prior work, Fišer (Fišer and Živić, 2021; Fišer, 2022) also partially investigated the EE of students in relation to the experience of online learning and teaching. The findings suggest that using chat options to communicate with the lecturer as well as other classmates while participating in EFL practicum delivered via MT facilitated the decrease in stress and anxiety usually connected with foreign LL (Wright, 2017).

2. METHODOLOGY

2.1. The aim of the research

The aim of the research was to determine the relationship between motivation, LLS use, and EE of EFL students who had online learning experience. The author hypothesised that EFL online learning experience affected the manner in which students learn EFL during tertiary education and which will be noticeable in motivation and the use of LLS.

2.2. Participants

27 first-year, 17 second-year, and 26 fifth-year students of Teacher Education study at the relatively newly established University of Slavonski Brod (UNISB) in Croatia participated in research. All participants are non-English majors. The age of participants ranged from 18–30 years, with most of them being 19 (27.1%), 20 (25.7%), and 23 (17.1%) years old. 68 of the total 70 participants are female students. All 70 participants learned EFL for four years in their secondary school and took an EFL State Graduation Exam (21,7% of them

obtained a grade D, 42% a grade C, 27,5% a grade B, and 8,7% a grade A). During their secondary school years, the majority (54,3%) of them took online or distant EFL classes. FL practicums are mandatory courses in the first and second years of their study at UNISB.

2.3. The instrument

The questionnaire used in this research consisted of four parts. The first part was designed by the author to collect the socio-demographic data with questions about their age, sex, the semester they were currently enrolled in, and their previous experience in learning EFL. The second part of the questionnaire consisted of the L2MSS questionnaire and Intended Effort scale (Taguchi et al., 2009), consisting of 52 items, which were used to measure participants' motivation in learning EFL and which Martinović (2013) used in exploring the motivation to learn EFL among students of non-English majors but before the COVID-19 breakout and the transition to online and distant education. The mentioned scale consisted of six subscales followed by a 6-point Likert rating: IL2S, OL2S, Intended effort (IE), Instrumentality Promotion (IPro), and Instrumentality Prevention (IPre) subscale. The third part of the questionnaire consisted of the SILL scale with 50 items, version 7.0 (Oxford, 1989), divided into six 5-point Likert rating subscales that measure the use of direct and indirect strategies in language learning among EFL and ESL learners: Memory (Mem), Cognitive Direct (CD), Compensation (C), Metacognitive (M), Affective (A), and Social (S) LLS subscale. The EE scale (Bernardić et al., 2017) with 5-point Likert rating items, adapted for learners of EFL, constituted the fourth part of the questionnaire and consisted of five items. The questionnaire was translated to Croatian language.

2.4. Means of gathering and analysing data

The questionnaire, in its paper form, was administered to participants during their regular courses and in a face-to-face setting during November 2022. The students voluntarily participated in the study, and they remained anonymous. The gathered data was analysed with SPSS version 27. The relationship between variables was tested with t-tests, Mann-Whitney, Kruskal-Wallis, and Anova statistical calculations.

3. RESULTS

The mean value (M) of the participants' answers to particles of the L2MSS scale is 3,59 (range 1-6), M of the participants' answers to particles of the SILL scale is 3,14 (range 1-5), and M of their answers to particles of the EE scale is 2,443 (range 1-5) (Table 1). The particles of the EE scale measure the negative EE in learning EFL. Therefore, the lower the M of the scale or the individual particle (except for the first one which was recoded so that it conforms with others), the less negative EE the participant expresses.

Table 1: The average values of participants' responses to L2MSS, SILL and EE particles

		L2MSS scale	SILL scale	EE scale
N	Valid	55	66	70
	Missing	15	4	15
Mean		3,5904	3,1396	2,4429
Std. Deviation		,73427	,54560	,94785

The analysis revealed that the strongest motivational factor in EFL and English for generic purposes (EGP) learning among future class teachers is the one related to the IL2S ($M = 4,255$), and the weakest motivational factor is the one related to the OL2S ($M = 2,578$) (Table 2). The highest value of the arithmetic mean (\bar{x}) of the respondents' answers is recorded for the IPro subscale's particles: *'Learning English is important for me because English language skills are necessary for progression in the future'* (\bar{x} is 5.48 while the standard deviation (SD) is 0.80), followed by *'Learning English can be important for me because I think I will need it for further study'* (\bar{x} is 5.06 while SD is 1.05), and *'Learning English is important to me because with English I can work globally'* (\bar{x} is 5.06 while SD is 1.23). The lowest value of \bar{x} of the respondents' answers is recorded for particles belonging to the OL2S subscale: *'I have to learn English because if I do not, my parents will be disappointed with me'* (\bar{x} is 1.83 while SD is 1.17), followed by *'I learn English because my close friends think it is important'* (\bar{x} is 1.84 while SD is 1.20).

Table 2: Average indicators for observed factors of L2MSS subscales

	N		Mean	Std. Deviation	Minimum	Maximum
	Valid	Missing				
Intended Effort (IE)	67	3	4,0630	,89293	1,78	5,89
Ideal L2 self (IL2S)	67	3	4,2552	1,23181	1,30	6,00
Ought-to L2 self (OL2S)	64	6	2,5781	,96418	1,25	5,25
Instrumentality-promotion (IPro)	68	2	4,0962	,80649	1,69	5,69
Instrumentality-prevention – (IPre)	67	3	3,5261	1,05114	1,25	5,63

The analysis of participants' responses to particles of the SILL scale revealed that students mostly apply Cognitive Direct LLS ($M = 3,490$), and the least represented LLS are the ones belonging to the affective group ($M = 2,647$) (Table 3). The highest \bar{x} value of the respondents' answers is recorded for particles: '*I watch TV shows in English or watch movies spoken in English*', belonging to the CD subscale (\bar{x} is 4.60 while SD is 0.94), and '*I pay attention when someone speaks English*', belonging to the M subscale (\bar{x} is 4.23 while SD is 1.02). The lowest \bar{x} value of the participants' responses is recorded for particles belonging to the A subscale: '*I write my feelings in a language learning diary*' (\bar{x} is 1.16 while SD is 0.40), followed by '*I talk to someone else about how I feel when I learn English*' (\bar{x} is 1.91 while SD is 1.32).

Table 3: Average indicators for observed factors of SILL subscales

	N		Mean	Std. Deviation	Minimum	Maximum
	Valid	Missing				
Memory (Mem)	69	1	3,0467	,63925	1,56	4,33
Cognitive Direct (CDS)	70	0	3,4898	,69192	1,93	4,86
Compensation (C)	69	1	3,1377	,75351	1,50	4,67
Metacognitive (M)	69	1	3,3913	,91637	1,22	5,00
Affective (A)	69	1	2,6473	,56050	1,50	4,00
Social (S)	70	0	3,1714	,95468	1,00	5,00

As for the EE of participants in learning EFL and EGP, the lowest \bar{x} value of their answers is recorded for the particle '*I generally feel well during EFL lessons*' (\bar{x} is 1,87 while SD is 1,05) and the highest for the particle '*I feel frustrated when I cannot answer a question*' (\bar{x} is 2.94 while SD is 1,32). The lower \bar{x} value denotes more positive EE of the participant, and vice versa, the higher \bar{x} value denotes more negative EE.

The online experience in EFL learning was one of the variables the author hypothesised would have an impact on motivation and LLS but the Mann-Whitney U test did not reveal a significant difference in the mean values of the participants' answers to the L2MSS scale and its six subscales, the SILL scale and its five subscales, or the EE scale based on the variable of having experienced online EFL classes during their secondary schooling.

As can be seen from Table 4, the analysis of participants' answers on all three scales revealed the statistically significant:

- strong positive linear correlation of motivational factors in EFL learning and using LLS,
- negative linear correlation of motivational factors and negative emotional engagement in learning EFL,
- and negative linear correlation of negative emotional engagement and using LLS in EFL learning.

9.

Table 4: Spearman (ro) rank correlation of participants' responds on L2MSS, SILL and EE scales

	L2MSS	SILL	EE
L2MSS	1		
SILL	,643**	1	
EE	-,269*	-,294*	1

** Correlation is significant at the 0,01 level (2-tailed)

* Correlation is significant at the 0,05 level (2-tailed)

4. DISCUSSION

The hypothesis that an online EFL learning experience has an effect on motivation, LLS use, and the emotional engagement of non-English majors learning EGP was tested with the variable of having such an experience during their secondary schooling. The Mann-Whitney U test did not reveal a significant difference between participants who had that experience and those who did not. Although the hypothesis is not proven by a statistical analysis of the gathered data, the results may be compared to the findings of similar research conducted prior to the COVID-19 breakout and the shift to online learning and teaching settings.

Martinović and Sorić (2018) used the L2MSS questionnaire to test the possible difference between female and male non-English major students at the University of Zadar (UNIZD). Findings of their research show higher mean values of respondents' answers to particles of the IL2S, OL2S, IPro, and IPre subscales than the mean values of the same subscales reported in this research paper. Interestingly, participants from Zadar ranked intended effort particles lower than participants from Slavonski Brod. Intended effort is related to previous experiences in learning, meaning that students determine how much effort they should exert in EFL learning based on their success in previous formal EFL learning (their EFL grades from secondary schools). 42.6% of participants in this study finished secondary school with an average EFL grade of B and 32.4% of them with an average grade of C. Compared to participants from UNIZD (ibid: 43), one can notice that there is

almost no difference between 3.75 average UNISB and 3.7 average UNIZD students' final English high school grade, meaning all motivation factors from L2MSS (except intended effort) seem to have a less impact on students now than they did five years ago when online learning settings were not mandatory.

Findings of this research show that motivational factors appear to have less of an impact on the learning process in COVID-19 times than they did before the pandemic and online learning, and intended effort to learn EFL has increased. Despite using the same questionnaire with students from both UNIZD and UNISB, participants did not differ in terms of final EFL high school grades, which have been shown to correlate with results on all L2MSS scales (ibid). If we look at which particles from the L2MSS questionnaire received the highest ranking, we see that they are related to using the English language for future employment and working globally, which might suggest that there has been a change in understanding the importance of English as a lingua franca related to the socio-economic situation in Croatia.

LLS were also examined among Croatian students prior to the pandemic and the shift to online education. Findings from research conducted by Božinović and Perić (2012) suggest that higher competence in EFL positively correlates with social, affective, and cognitive LLS. The results of the data gathered by this research revealed the highest mean value of cognitive and metacognitive LLS, while participants reported using the affective LLS the least, which is, therefore, not in concordance with the results of the LLS use in the pre-pandemic learning setting. Mihaljević Djigunović (2001), furthermore, concluded in her research that affective and social LLS did not correlate significantly with the motivation to learn EFL. If we look at Table 4, we can see evidence of a strong positive correlation between motivation and LLS, which would suggest a more detailed analysis is needed to untangle the correlation of LLS subscales and motivation in the context of online learning experience.

EE, as the final puzzle, reveals that students generally do not feel much negative emotion during EFL studies (Table 1). Also, EE correlates negatively with both motivation and LLS use. Due to the EE scale measuring negative emotions during an EFL course, such results mean the more motivation students at UNIBS have for EFL learning, the more LLS they use, and the more emotionally content they feel during EFL courses.

5. CONCLUSION

Learners' LLS and motivation in EFL have been extensively researched prior to the mandatory online, distant, or e-learning caused by the COVID-19 pandemic. Such research was also conducted among students in Croatia, but not with an aim to distinguish

relationships between motivation, LLS use, and EE within the context of an online learning experience. The findings of research conducted among non-English major students at the University of Slavonski Brod depicted in this paper indicate a positive correlation between motivation and LLS, but they are not entirely consistent with the findings of research conducted prior to the implementation of mandatory e-learning. Motivation related to comparing oneself with an ideal L2 speaker, striving to fulfil obligations and duties as an L2 learner, and using instruments in doing so have a lesser impact on today's post-COVID EFL learner. Surprisingly, the intended effort, a motivational factor based on previous learning experiences, has increased in the past five years, and suggests a positive understanding of the English language as a means of insuring better future employment. In comparison with previously documented LLS use in EFL among Croatian students, cognitive and metacognitive strategies have gained value while affective and social LLS have lost their significance, even though EE positively correlates with both the motivation to learn EFL and the use of LLS in general.

The experience of online EFL classes during secondary schooling has not been proven in this research to have a significant impact on motivation, LLS use, or the EE, but comparisons with research done before the pandemic undoubtedly indicate the changes in the approach today's students have to EFL learning. Since the participants in this research studied EGP, the same questionnaire should be distributed to students of English for specific purposes, whose motivation, EE and LLS use may be more related to personal goals and future professional prosperity. The relatively small number of participants could possibly be the shortcoming of this research, which should, therefore, be distributed to a larger number of students and include a more detailed analysis, that is, the correlation of results on all subscales of the L2MSS and SILL questionnaires with EE and the previous online learning experience.

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DEVELOPMENT OF DESIRED COMPETENCIES OF MILITARY LEADERS

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ABSTRACT: *The paper analyzes the development of desirable competencies of officers through the process of higher education. The dilemma is actualized whether innate predispositions or qualities acquired through continuous learning have a dominant influence on leadership. It is pointed out that the knowledge that offers theories systematized in a period and content approaches do not give a satisfactory answer to unraveling the complex phenomenon of leadership, as well as that modern security problems, research in the field of military sciences and clearly expressed requirements of professional work in the army represent a reference framework within the limits of which it is a possible unambiguous definition of the military profession. Theoretically, the concept of combat action is considered, which has all the characteristics of Volatility, Uncertainty, Complexity, and Ambiguity (VUCA). A special review is given to commanding as a key activity of elders in the conditions of combat operations. It is emphasized that people brought into a certain relationship with assets form, together with these assets, a kind of socio-technical combat system and that the effectiveness and efficiency of the execution of tasks directly depend on the leaders at different levels of the military hierarchy, which implies broad powers, responsibility, professional competence and a high degree of autonomy. It is also indicated that the conditions in which combat operations can be carried out in the 21st century require continuous requirements for the progression of the level of competence of officers, taking into account that officers in command duties represent the "elite" of the military profession. In this regard, education in a military organization can be seen as a process of developing general military and professional knowledge, intellectual abilities, character traits, emotional properties, and psychophysical endurance of future leaders.*

Keywords: *leadership, command, combat actions, education*

1. INTRODUCTION

Changes in the global environment significantly affect the changes in the operational environment in which combat activities take place in modern wars. Military leaders must understand not only current doctrine and how to deal with emerging security challenges. The future operating environment is defined as changing, uncertain, complex, and ambiguous (VUCA). These changes are directly reflected in the structure of education and required knowledge and skills of officers who need a truly "adaptive way of thinking",

because even in modern conditions, as shown by the wars fought in this century, the dominant influence on the functioning of the military organization is still exerted by people. The development of educated and capable military leaders is the best protection against a harsh and uncertain future in an eventual armed conflict. The most powerful tool any officer should possess is not his weapon but his knowledge, ability, and his mind. It is necessary to improve the process of military education in the field of developing cognitive abilities, to better understand the environment, phenomena, and processes, as well as the available information important for the decision-making process. Accepting new technologies, approaching them without prejudice, as well, and balancing between traditional and new methods, which have not been studied in the educational process so far, are of exceptional importance. That is why Military Education must ensure the transfer of critical knowledge and skills that will enable future leaders to adapt and make adequate decisions in dynamic and complex conditions of combat operations. Combat operations represent a purposeful human activity for the realization of which certain forces and means are necessary that are used in that process. They represent an integral part of the displayed hostilities and the organized use of the forces and assets of the units of the opposing parties, and their effective use of assets also implies adequate organization. As stated by Dušan Višnjić, " People brought into a certain relationship with means form (with those means) a kind of socio-technical combat systems and organized forces that bear the hallmarks of the historical epoch of technical and technological development..." (Višnjić, 1988:81). Time is both an advantage and an enemy because the skills of future warriors imply information literacy, reacting following the available data and cognitive reasoning without prejudice, as well as the balancing act between suspicion of algorithms and reliance on machines. Preparation for possible future events is crucial because the stagnation of the educational process can potentially be expected due to the insufficient number of candidates for enrollment in military educational institutions, the reduction of teaching staff as well as insufficient investment in education. The imperative to recognize the challenge's scale does not mean that there is time available to face it. The smartest will use the lack of time to their advantage, while most will find it difficult to do so.

2. COMBAT ACTIONS

An armed conflict characterized by the legal application of armed force implies a process of mutual destruction of the conflicting parties and a military-technological social phenomenon in which political, economic, military, diplomatic, or other goals of the conflicting parties, could not be achieved by other means, are achieved through mutual destruction. Traditional armed conflicts, which throughout history were mostly symmetrical, have acquired a new dimension in recent decades, which affects the development and new approaches in the engagement of military forces that carry out combat operations and play a dominant role in modern armed conflicts. Each combat operation has its special characteristics, but all of them also have common characteristics, which in modern conditions include: high tension, dynamism and the nature of combat operations on the ground and in the air space, the application of simultaneous powerful

fire and electronic actions; the use of different methods of carrying out combat tasks; rapid transition from one type of military action to another; complex operational-tactical environment and others. The high tension and dynamism of hostilities are the result of the opposing parties' desire and ability to conduct active operations using artillery-missile, air force, and other forces, as well as the purposeful activity of the enemy to suppress the will of the people to engage in combat operations. The characteristics of combat operations are also a consequence of rapid changes in the qualitative and quantitative relationship and balance of forces and assets, the creation of huge areas of destruction and destruction, the sudden use of new means and methods of combat, and other factors. Forms of combat actions, types, and methods of their management are determined depending on the purpose and structure of the units, and assigned combat tasks, as well as on the place and nature of the enemy's actions, its composition, and combat layout, as well as the characteristics of the objects planned for destruction. At a lower level of manifestation, according to the criterion of the importance that is achieved, they are classified into battle, individual actions, and counter-actions. At higher levels, we speak of operations at the joint level. The use and high mobility of units, their high firepower, and their striking power can lead to a change in the situation in a short time. Airplanes, helicopters, and recently various types of drones significantly increase firepower and enable the use of new methods of fighting using the third dimension-airspace. In modern conditions, in addition to modern weapons, some of the important factors that determine the speed of change in the situation are the ability of individuals and units and successful command.

3. PRINCIPLES OF COMMAND AND CONTROL

According to its form, each command in a dynamic system represents a special type of activity of the commanding body, which consists in determining the goal and mode of action of the object of command, as well as acting on it, necessary to achieve the planned goal. Thanks to such action, the qualitative stability of the system is maintained in conditions of continuous changes in the internal and external environment, its disorganization is prevented and the desired effect is achieved. In other words, the process of command appears as a process of arranging the system and harmonizing it with the objective laws operating in the given environment. According to its content, as shown in Figure 1, each command is an information process that usually contains such activities and measures of the command body as obtaining the necessary initial information about the object of command and the environment surrounding it (state information), making a decision (processing and transforming state information) and setting tasks command object (command information) Lucas (1994: 17).

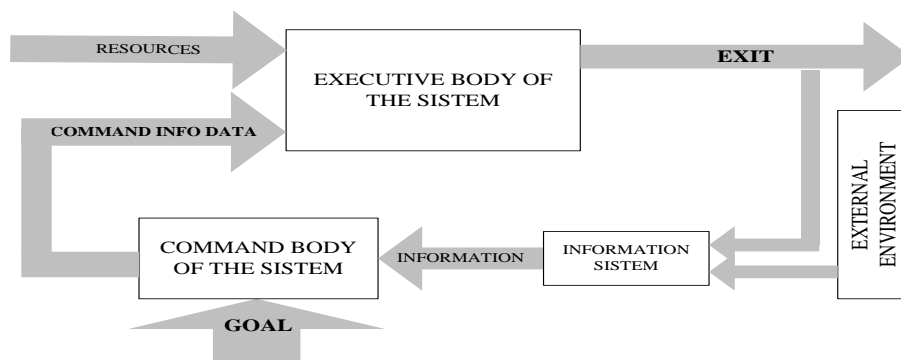


Fig. 1. Command as an information process

The highest and ultimate goal of that process is to optimize the functioning of the entire system and obtain the best possible useful results with the least effort and expenditure of material resources. During the realization of these operations, a closed circle is formed, in which there is a management body (commanding body), executive bodies-individuals (units that are commanded), and an information system, decision-making (processing and transformation of state information), and setting tasks to the object of command (command information).

Each unit command system is under the active influence of the external environment and functions under conditions of constant danger from means of destruction, which creates additional difficulties in its activity. This requires high expertise and the ability to function in a complex situation from the commanding officers. The exposure of the system to the influence of various factors of the operational environment brings elements of disorganization and randomness into their work, forces them to work with incomplete information leads to an uneven burden on people, and complicates the scope and duration of work in commanding units. In modern conditions, the commanding unit is a complex process and the complexity of combat operations requires the design of their implementation. The set of activities that senior officers on command duties and command bodies performed in the process of command are called process functions of command. In contemporary literature, the following are mentioned as the basic functions of command (Figure 2): planning, organizing, ordering, coordination, and control (Radovanović 2021:140-150).

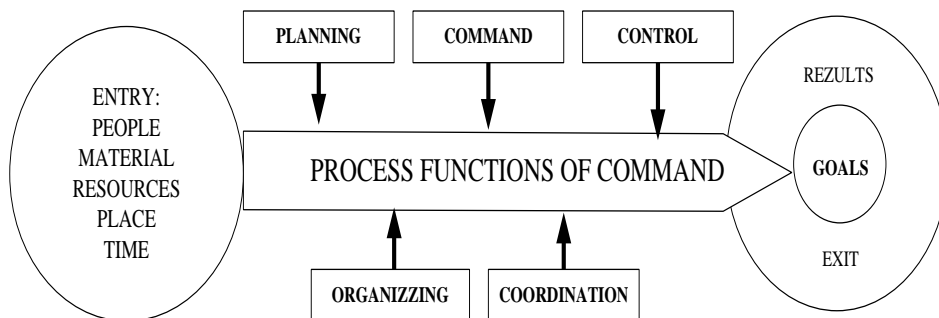


Fig. 2. Process functions of command

Commanding is an expression of necessity arising from the complexity, nature, and character of joint work in a military organization, so it is quite understandable that commanding is an often-researched phenomenon. In such conditions, the success of any military organization depends on the experience and good judgment of its leaders. The importance of that area of research is explained by the fact that the effectiveness and efficiency of task execution directly depend on the commander. In this regard, all the knowledge and abilities on which the success of command depends in the complex conditions of combat operations, as shown in Figure 3, can be classified into several groups: intellectual traits, character traits, emotional qualities, psychophysical endurance general, and professional knowledge.

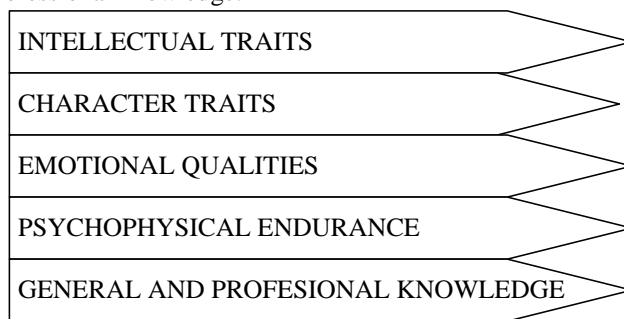


Fig. 3. Knowledge and abilities

- Elders' intellectual abilities are reflected in the critical and quick perception of important information, creative thinking, correct reasoning, a predictive ability that enables making realistic decisions about the use of forces and an adequate choice of form and form of action;
- Character traits are manifested through independence in work, persistence, determination, responsibility, fairness, independence from authority and templates, ability to persuade, ability to think and behave correctly and adapt one's opinions to others;

- Emotional properties, enabling self-control in complex situations, courage, and rational behavior under great psychophysical stress;
- Psychophysical endurance, which contributes to emotional stability and moral strength;
- Possession of general military and professional officer knowledge implies a high level of education and knowledge in the field of military and other sciences.

Based on the above, it can be said that the basic assumption for the functioning of military organizational systems, their direction to carry out planned tasks is the knowledge, experience, and ability of senior officers in command duties to make the best use of available resources (Radovanović and Karović 2015:195-221).

4. PRINCIPLES OF LEADERSHIP IN MILITARY ORGANIZATION

The functioning of a military organization requires planning and guidance. The immediate organizers of military work are commanders, chiefs of staff, heads of organizational units, commanders, and other senior officers. Creating a realistic basis for functioning in all areas of the military organization's work implies knowing the real situation in them and harmonizing its organizational, personnel, and material factors with the possibilities of their realization (Radovanović and Karović, 2014:245-258).

The numerous tasks that command bodies perform require specific approaches to problem-solving. As a result of the desire to apply modern work methods in modern conditions, there is a tendency to prescribe that work in the form of legal provisions and principles. However, practice shows that this is not enough in specific conditions. That is why there is a need to check all knowledge in practice, deepen and improve and that the improvement of the work in the sphere of military leadership is done consciously, rationally, planned, and to achieve the set goals in the work (Radovanović, 1989).

Presumed elders are persons that followers follow in the realization of their visions, and their power is based on the concept of influencing other people. That influence is proportional to the strength of the personality profile of the officer in command duties. In practice, levels are observed within command duties, as shown in Figure 4: position, license, production, personality development, and personality.

- Position - the leader possesses the power that derives from the formal position. This position gives power only if it becomes a quality basis for authority and influence over subordinates. It is less favorable if that influence is absent, especially if it compensates for missing personal qualities.
- Permission - marks those organizational models in which followers follow the leader because they want to. The leadership of this level is of higher quality compared to positional leadership because people do what they are not required to do to fulfill the goals and expectations of the collective.
- Production - subordinates follow the superior because of the success he achieves and the benefits his influence brings to the organization. This kind of leadership increases the effectiveness in the execution of tasks, and the subordinates are highly motivated to perform tasks and achieve increased results.

- People development - constantly increases the potential of associates. The leader of this level is very successful and his most important task is to enable others to do the job in the best possible way, which affects that subordinates constantly raise their competencies to perform tasks within their jurisdiction with expressed loyalty and loyalty to the commander.

PERSONALITY	People follow a leader because of who he is and what he represents. Highly Experienced Leaders
PEOPLE DEVELOPMENT	People follow a leader because of everything he has done for them. An exceptional level of leadership
PRODUCTION	People follow a leader because of everything he has done for the organization. A very favorable level where problems are easily solved.
PERMISSION	People follow the leader because they want to. People follow because of the leader's authority. A dangerous level for the manager if he stays at it.
POSITION	People follow the leader because they have to. A leader's influence does not extend beyond formal authority

Fig. 4. The influence of the level of leadership on command

- Personality - the pinnacle of leadership on which the commander no longer needs special effort to influence subordinates because just following such a leader represents a certain kind of prestige and satisfaction. From the aspect of the implementation of tasks in military units, it is important to point out that leadership is not copying and imitating “exemplary examples” and “great people”. Each person who finds himself in command duty is unique and must therefore find his way of engaging the personal qualities that will enable him to build an authentic command style.

5. PROJECTION OF DESIRABLE QUALITIES OF MILITARY LEADERS

From the beginning of society until today, successful people have attracted attention, and the very criteria for success in certain periods of society's development were different. These rulers were once considered successful, military leaders once, and leading thinkers once. Their common characteristic was that they all brought change to the society in which they lived. Due to the influence, authority, and power they possessed, due to the ability to gather a large number of people, such personalities were perceived as leaders. Regardless of their common denominators, it is important to note that there is a difference regarding the definition of the term leader, which refers to historical, political figures or military leaders.

A question about leadership that science will not have a definite answer to for a long time is: Are leaders born with unique predispositions to be leaders or are they individuals who acquired their qualities through continuous learning and development? Modern theories more often have the attitude that leaders are created and that everyone can find in themselves the qualities that will lead them to the top through thorough work. However, on the contrary, among them, there are significant and recognized authorities who believe in myths: that successful leaders are born with a special gift, that they are people with a naturally gifted creative spirit and talent, and that the skill of leadership cannot be learned. There is no doubt that the success of the command is largely influenced by the personality of the commander or commander, his style of work, his dominant traits, conditions in the organization, and the nature of the job. *At the same time, it is necessary to take into account the fact that even leaders do not always react in the same way, but easily adapt and adjust their style to the needs of followers and the demands they face in a specific situation* (Radovanović 2021:140-150).

Looking at the desirable qualities of a successful military leader, one can see traits that are genetically predisposed and acquired through experience, learning, and practice. (Višnjic, 1988:19). Acknowledging the need for officers in today's conditions to constantly improve and by acquiring knowledge and skills to adapt to a dynamic environment, military organizations strive to develop an implemented approach to the education of future officers that meet the stated requirements of the military profession. Through education and lifelong learning, as well as gaining life experience, officers acquire safety, precision, and speed of reaction to complex situations. In the following text, some of the established qualities that should be developed in officers through the schooling process are listed:

- Knowledge of work, knowledge of the entire branch, professional area, and familiarity with characteristic technical issues and performance procedures does not completely solve the problems that individuals encounter, but they can improve the success of the leadership process.
- Intelligence and general intellectual ability are prerequisites for success in any job, including in the command system. The average intellectual score of a good leader should be at an enviable level and above the average level. The essence is in enabling effective communication and understanding of people of similar intellectual capacities. The ability to perceive is directly related to intelligence.
- Communicativeness is reflected in the readiness and ability to establish diverse contacts with different people inside and outside the organization. The job of an officer is full of communication, and it should be remembered that not all communications are pleasant because many bring conflicts and stress, especially in the sphere of implementing changes.
- Self-confidence reflects absolute confidence in one's abilities. Leaders are daily in situations where they have to make many more or less significant decisions and are faced with the risk of making a mistake. Many people are paralyzed by such situations, which a successful commander must not allow himself, because it is difficult to expect people to follow someone who does not have enough faith in himself.

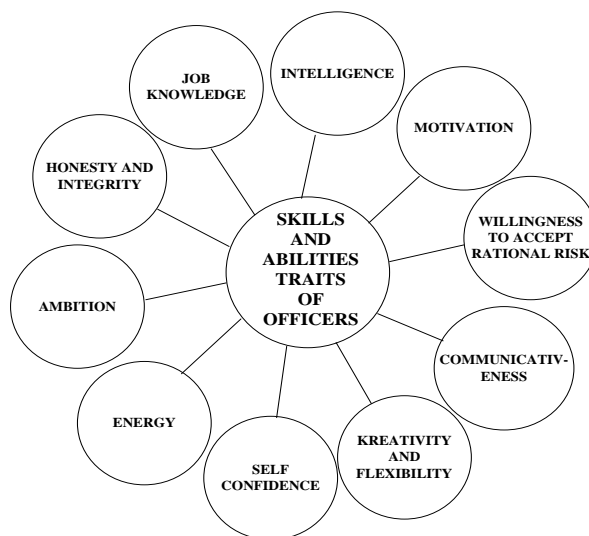


Fig. 5. *Desirable personality traits of commanders and commanders*

- Energetics is a trait manifested by the fact that only people eager to prove themselves, hardy, and full of initiative can successfully lead people. Being a commanding officer or commander is a demanding, ruthless job with great pressures and serious responsibility, and therefore it should be reserved for only the most persistent and courageous.
- Ambition is another prerequisite for a successful leader. This trait comes from motivation because some people just don't want to accept the role of leader and show initiative. Contrary to them, successful officers have the desire to prove themselves, to "take matters into their own hands" and make decisions when necessary.
- Honesty and integrity also include qualities such as trust, reliability, etc.
- Motivation, is the desire to dominate to achieve goals, that is, the individual's desire to influence others and essentially lead them. Motivation can take two forms: the pursuit of power as the only goal and power as a means to achieve common goals.
- Creativity and flexibility, the ability to adapt to the needs of followers and the demands of the situation. Flexibility means that the officer can see the measures that need to be taken in specific situations and direct his activity.
- *Willingness to accept rational risk, react to changes, and constantly strive to improve something while facing the possibility of error.*

Conditions and circumstances are changing, so that, in addition to new knowledge, also requires new skills. Thus, skills have their course and development, but also diversity. From the aspect of the military profession, we also talk about the commander's or staff officer's skills. Each of them comes more or less close to unraveling the complex phenomenon of command.

6. CONCLUSION

Experiences from practice and systematized certain research results indicate that the success of commanding in combat operations depends to a large extent on the commander or commanders themselves, that is, on the qualities of his personality that are considered desirable. It depends on them whether they will be accepted as a leader who should be followed in all situations, even when, as is the case in combat, the results of the work are extremely uncertain and sometimes very risky. It can be said that the personality traits of a good commander, are developed through education and professional training, are professional competence, meaning, the ability to develop good interpersonal relationships, character traits, and morality.

Professional competence is represented by the ability to organize work, determination, ability to command, general and professional education, authoritativeness, and professional attitude towards work.

Social climate - expresses the manager's attitude towards the personality of subordinates and the collective as a whole, and is based on the willingness to help others, develop and nurture proper interpersonal relations, communicativeness, understanding of needs and problems, as well as a friendly relationship with subordinates, knowledge and respect for the personality of individuals and collectives overall, flexibility and motivation to perform command duties and the like.

Character traits-principled ness, objectivity, fairness, self-control in behavior, persistence, consistency, and reliability are crucial for the formation of personal authority, without which an officer cannot aspire to significant success at work. It largely depends on them whether the subordinates will accept their superior as a leader or whether space will be created in the collective (military unit) for the formation of informal groups without a clear orientation and goals in it, which is not only not allowed but can seriously harm the execution of combat missions. tasks.

Morality - moral qualities of modesty and neatness. They include the commitment of military officers to harmonize their activity with the goals, values, aspirations, and norms of collective action.

The military profession, which represents an organized professional system of a special organizational structure constituted basic elements within its work system, such as jobs, duties, and professions. For each listed work element, the basic requirements of that element are defined. Thus, achievements in the field of military sciences, and the differentiated and clearly expressed requirements of professional work in the army represent a reference framework within the limits of which it is possible to unambiguously define the military profession, as well as certain competencies of individuals in that profession. The possession of certain qualities is a necessary, but not a sufficient condition for successful command because the qualities of a leader's personality are highly valued by subordinates are not static and unchanging. Their preference is conditioned by several factors, and the strength of the stability of traits comes from adequate education and the professional and human authority of the elder. Competencies are understood as individual abilities and properties, knowledge, and skills representing the basic model of

interpretation of this complex activity in the officer development system. *Such an approach stems from an understanding of the nature of human skills, which are partly innate personality traits and predispositions, and partly the result of socialization, experience, learning, and knowledge.*

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USING TECHNOLOGY AND ONLINE RESOURCES IN THE CLASSROOM

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ABSTRACT:

Because of the COVID-19 pandemic, teachers all around the globe have been faced with numerous challenges with regards to the adaptation of their teaching methods. This paper showcases online tools that can be used in both the virtual and the physical classroom, providing the interactive component that is crucial for a successful class. These cost-effective and engaging online resources include interactive presentation platforms (Mentimeter, Prezi), online quizzes (Kahoot, Socrative), and digital canvases (Padlet), all of them being tools that are convenient for the concept of flipped classroom. The paper will present the benefits and drawbacks of using online resources in teaching through practical examples and the students' feedback.

Keywords: *online teaching resources, interactive presentation platforms, online quizzes, digital canvases, flipped classroom.*

1. INTRODUCTION

As early as in 2003, Kim and Bonk recognized the growing demand for online learning through a survey that examined the numerous challenges both the academic institutions and online students had been facing. Seemingly the greatest challenges were the ever-emerging new e-learning technologies that created “a perfect e-storm” surrounding e-learning (Kim and Bonk 2006: 22). Based on the results of their survey, Kim and Bonk attempted to forecast where the field was headed, concluding that “we are entering a unique and exciting era in online teaching and learning. And perhaps the perfect e-storm is becoming less cloudy and ominous” (29). Fast forward to the emerging COVID-19 pandemic in the early 2020 and the storm seems to be picking up yet again. Whereas in 2003 blended learning and distance learning had been a matter of choice, the use of online tools during the pandemic quickly became a matter of urgency no one was prepared for. The onset of the pandemic seemed to have been the moment Marshal McLuhan's prophecy was fulfilled, namely that “we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned” (McLuhan 1994: 3). The global embrace of the COVID-19 pandemic resulted in the new world of the global village, which “had achieved a social and institutional extension of all

human faculties” (104). Yet, despite having been aware of the existence and the impact of online communication in educational environments for decades prior to the pandemic, “almost no one working in education had a feeling of being ready to work in new circumstances” (Tanasijević and Janković 2021: 168). The period of adaptation and “digital acculturation” (180) was admittedly harder for the educators, but Tanasijević and Janković’s research shows that without “educational technology on their side, [*the new*] generations of students would not have been able to truly develop academically in the times of sudden change” and that the “atmosphere of mutual trust and the shared learning-teaching roles during the months of collaborative online work have vastly contributed to everyone’s personal and professional growth” (180). In a similar vein, Boskic and Hausknecht argue that the COVID-19 pandemic has reshaped the educational landscape for the better and made it apparent that “universities need to be prepared for uncertain events that disrupt traditional approaches and structures” (Boskic and Hausknecht 2021: 47). The lessons learned have proved to be invaluable in recognizing that this is “a time when there is an opportunity to embrace innovation and digital literacy promotion for all members of the education environment” (48).

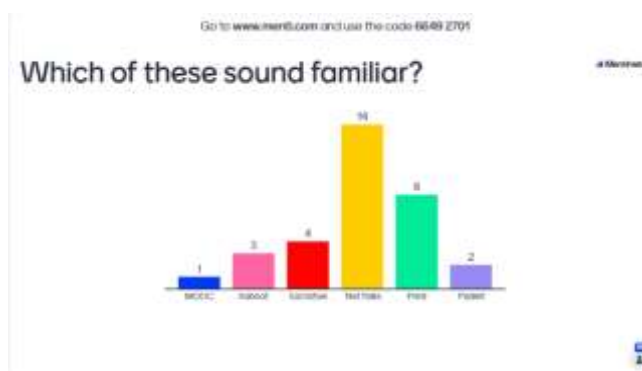
Now that the pandemic is nearing its end and is fairly under control, we are slowly returning to the way things were, i.e. to the traditional classroom, but as a result of our newly acquired digital literacy, many online tools have remained in use and allowed for the blended approach to modern teaching. This paper showcases online tools that can be used in both the virtual and the physical classroom, providing the interactive component that is crucial for a successful class. These cost-effective and engaging online resources include interactive presentation platforms (Mentimeter, Prezi), online quizzes (Kahoot, Socrative), and digital canvases (Padlet). The paper will present the benefits and drawbacks of using these online resources in teaching through practical examples and the students’ feedback.

2. INTERACTIVE PRESENTATION PLATFORMS: MENTIMETER AND PREZI

Mentimeter (or “Menti” for short) is an interactive presentation software that allows interaction with students using real-time voting. The software does not require downloads or installations and is used completely online. To start making your presentation, you need to open a free account, which allows you to make as many presentations as you want but is limited to three slides per presentation. An upgrade is available for more slides, but since this is not a presentation and slides program like PowerPoint or Prezi, three slides are usually enough for its intended use. Namely, Mentimeter is a brilliant online tool that can be used to conduct a quick survey or poll during class and thus engage students, initiate discussion on a chosen topic, “give voice” to introvert students who otherwise would never voice their opinion, etc. The platform is extremely easy to use and the educator can make a presentation in just a couple of minutes. Once you click “New presentation” and give it a title, you are prompted to insert your slides based on the type of question you want to ask. The choice of question types is varied: multiple choice, word cloud, open ended, scales, ranking, this or that, truth or lie, guess

the number, etc. The multiple-choice slide provides you with boxes to insert your options/possible answers, with the possibility of inserting an image for each option. Hence, the multiple-choice question can be based either on word answer or image answer, which is particularly useful for certain academic fields, such as medicine for example, where students could be asked to distinguish between healthy and sick tissue in a photo. With the scales slide, students are asked to grade/rate something from low to high, for example from 1 to 5 (or any given assigned numbers), or even rate with statements (from “not so good” to “excellent”, “irrelevant” to “extremely relevant”, “strongly disagree” to “strongly agree”, etc.). The ranking slide is a variation on the theme, with student ranking items from the first to the last place. Finally, with the word cloud slide you can ask a question that requires a one-word/one phrase answer that students type in the box and all their answers instantly appear on the projector screen in real time, with the most common answer appearing bigger than the rest so that the ensuing discussion can be based on that. Once you choose your question type and create the slides, you should click “Present” and the software immediately generates a code for the presentation. Students are asked to go to www.menti.com, submit the code from the screen, and answer the questions. The real-time voting and generating the answers on the projector screen makes this tool extremely engaging and attractive for students. An added value for students is their being able to use their cell phones in class in a productive way rather than be reproached when using one. Furthermore, the collected answers are anonymous, which rids students of the burden of “being wrong”, and can be saved for future analysis, comparisons, or educational research.

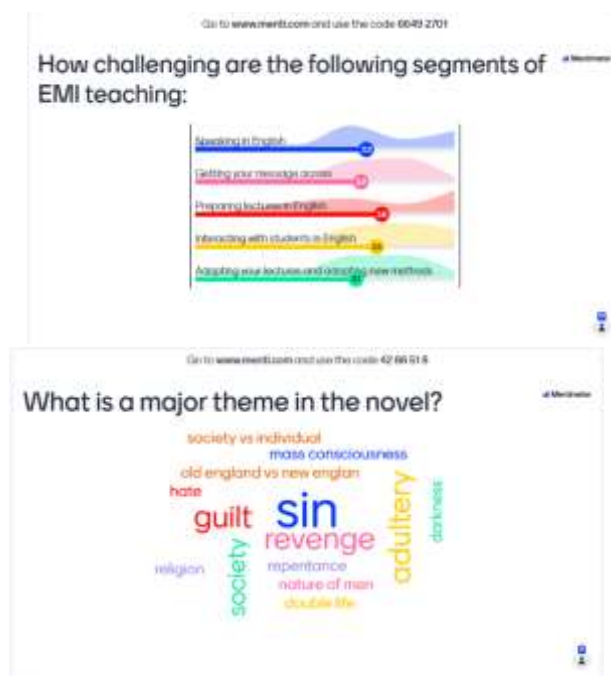
Figure 1: Multiple-Choice Question on Mentimeter



However, since the answers are anonymous, Mentimeter cannot be used for assessing individual students, so it is best used as a tool that provokes discussion in a non-judgmental and safe educational environment. Students need to have a Wi-Fi-connected device to participate, but if some of them do not, educators can allow group answers. Finally, the attraction and the novelty of Mentimeter for students can easily wear off if the tool is used too frequently, so one piece of advice would be to use it sparingly and to your advantage,

for example when the rhythm of your classroom has slowed down and you want to renew their interest in the topic. Apart from the features that we mentioned, there are numerous other features of Mentimeter to be explored, and critical attention to the matter has not been lacking. Pichardo et al. view Mentimeter as a “useful digital software in higher education for promoting participation” and ensuring “inclusive and equitable quality education that promotes learning opportunities for all” (Pichardo et al. 2021: 16-17). Similarly, Davies et al. claim that “Mentimeter has the clear potential to increase student satisfaction, engagement, voice and learning within higher education as well as the potential to produce a more dynamic and stimulating teaching role for the lecturer” (Davies et al. 2020).

Figures 2 and 3: Scales Question and Word Cloud Question in Mentimeter



Another useful presentation platform is Prezi, which has been frequently compared to PowerPoint in terms of their effects on “the students’ cognitive load, the level of recall of the learning and conceptual learning” (Akgün et. al. 2016: 1). According to one study, although PowerPoint is the software most used to prepare lectures and presentations, allowing “the use of multimedia in the teaching-learning process” and enriching “the lecturing method with images, thus affecting pedagogy” (Ibid), Prezi,

developed in 2009, “may be a better alternative for more conceptual learning and to reduce the cognitive load” (8). Although both presentation design tools “have similar effects on learning in the domain of remembering” (Ibid), Prezi’s unique feature of zooming in and zooming out provides additional dimension to the learning canvas, which is useful for comparing and contrasting different elements on the screen. There are numerous (and often very complicated) ways to make a Prezi presentation, but the basic one begins with a home screen on which the students can see the overall layout of the given lecture, with various topics organized as a “planet topic” (one main slide with the name of the topic that can be further divided into more subtopics), or “stack topic” (one main slide with the name of the topic followed by traditional slides for the exploration of that topic). One great advantage with this layout is that the educators can zoom into whichever topic they choose, and that will take them further into exploring that topic. Conversely, PowerPoint allows only for the chronological order of the slides once you start the slideshow, thus limiting the freedom to choose the (sub)topic based on the current interest of the students. With Prezi software you can create presentations (Prezi Present), videos (Prezi Video), and designs (Prezi Design) online either by starting from scratch, which does require some skills and practice, or by using one of the many templates within each category. For example, if you decide to use a template for the presentation, you can choose a category first (General, Sales & Business Development, Marketing, Education & Non-profit, HR&Training, Classic), and then scroll through the templates to pick one to your liking. The templates can then be adjusted, (sub)topics added or removed, text changed, etc.



Figure 4:
The Antique World
Map Template in Prezi

All three categories of Prezi (presentation, video, design) allow you to convert or import the existing PowerPoint presentation into Prezi. With Prezi Video, lectures can be

recorded prior to the traditional class and used for “flipped classroom”¹, i.e. the students watch the recorded part of the lecture *before* coming to the actual class, which then can begin with the discussion about what they have heard. During the pandemic, this feature was especially useful: at the Faculty of Philology and Arts in Kragujevac, Serbia, all the lectures for the courses Victorian Literature, Early American Literature, and Shakespeare were pre-recorded and then posted to Google Classroom for the students to watch and study. Since the links remained in the GC, they were able to go back and re-watch the lecture as needed, which they found extremely helpful. One limitation for the free Prezi account is that the video can be maximum fifteen minutes long, but the lecture can be divided into subtopics with each being presented in a fifteen-minute video. The students found this also particularly beneficial because they were able to choose a particular topic they wanted to listen about again. Finally, Prezi Design is arguably the richest in possibilities, allowing you to create infographics, designs for video, slides, reports, dashboards, charts, maps, posters, social media posts, email headers, YouTube thumbnails, and virtual backgrounds. Each category has its own adjustable templates that can even be filtered by color. Although mastering Prezi requires some effort, it is completely worth it given the possibilities that it offers. On the Prezi home page, you can find the Help Center and many how-to video to get you started, as well as the option to apply for online training and unlock premium features for a decent price of \$7/month (billed annually).

Although the non-linear presentation with the zooming navigation is Prezi’s best feature, it is at the same time its most notorious: new Prezi users should be warned against using too many zooms as that can be overwhelming for students. Additionally, they should be aware that Prezi is not exempt from the “deadly sins” of PowerPoint presentations² since both softwares use slides in a similar way. However, when compared to PowerPoint, Prezi is a less boring, more dynamic, cloud-based presentation tool that enables students to view the presentations online simultaneously from a different location and engage in teamwork. Nora Strasser argues that “Prezi should not be used in all cases since some topics are better suited for presentations structured in a slide format”—although creating a traditional slide presentation *is* possible with Prezi’s stack topics—, but she also adds that Prezi is a tool “that can be used to keep the classroom an exciting and interactive place” and as such should be used in higher education (Strasser 2014: 97). Finally, the researchers who studied the impact of Prezi on the second-year undergraduate students in Humanities and Social Science concluded that “Whilst Prezi has its own individual merits

¹ For my brief instructions on how to use Prezi Video, and my explanation of the concept of “flipped classroom”, see: <https://prezi.com/v/uclex8a6jdqk/emi-flipped-classroom/?preview=1>.

² The “deadly sins” of PowerPoint presentations: too many slide transitions and sound effects; text-heavy slides; reading from the slides; faith in technology / not having a Plan B; lack of visibility; low-quality images; mixing many different fonts; not using contrasting colors for text and background; speaking to the slides instead of to the audience.

and goes some way to solve the linear problems associated with PowerPoint it is not a solution in its own right. It can however make a massively positive contribution to our approach to blended learning which has been shown to have many benefits (Conboy et al. 2012: 41). At the very least, its novelty will provide enjoyment to both the educators who decide to use it and to the students who have not been exposed to it before.

3. ONLINE QUIZZES: KAHOOT! AND SOCRATIVE

According to the revised version of Bloom's Taxonomy, there are six levels of cognitive learning: remembering, understanding, applying, analyzing, evaluating, and creating. Each level contributes to developing learning outcomes and for each of these, starting with remembering, i.e. the ability to retrieve information heard in class, quizzes are invaluable since they help store the information in long-term memory. People learn best through games or play, which is "a crucial element in one's cognitive development from birth through adulthood" (Lin et al. 2018: 569), and quizzes are one way to bring play into the classroom and "gamify" higher education: "Gamification promotes motivation and facilitates effective learning through the employment of game elements, mechanics and game based thinking ... thus making it indispensable for the teaching and learning of content that students term as 'dry' and 'boring'" (567). While quizzes are in themselves play-oriented, not all of them are game-based. For example, Kahoot! is a learning platform that relies on the competition between students, making them more motivated and engaged, whereas Socrative, with its simpler and clean-cut layout is a formative assessment tool that does not necessarily involve competing between students, but can be used individually as a self-assessment tool. Both Kahoot! and Socrative provide students' answers in real time, but with Socrative it is possible to launch a quiz and let the students do it in their own time. Both platforms can be hosted in person or virtually, on any device with an Internet connection. There are, however, some differences between the two, primarily regarding the intended use of the quizzes.

Founded in 2012, Kahoot! is a free platform where the educators can create their own quizzes or use the existing public quizzes. The latter can be chosen on the "Explore content" tab, where you can choose the subject, content, grade, and language to find and sort the quizzes. To make your own quiz, you need to sign up for a free basic account (though payable accounts are offered for those who need premium options), whereas the students do not need one, which is a great benefit, since they only have to enter the game PIN before joining an active quiz. Creating a new kahoot is very straightforward and simple: for the free account, you can choose between a multiple-choice question and true or false question; you can find and insert media that is relevant for the given question; finally, you can add up to four answers for the MC questions, with each answer assigned a different symbol and color—red triangle, blue diamond, yellow circle, and green square.

Figure 5: The multiple-choice question type in Kahoot!



Figure 6: The true or false question in Kahoot!



For this platform, the free basic account does not offer too many possibilities, so it is much more beneficial to upgrade the account if you plan on using it more frequently. For instance, with the upgrade, you can access various question types (type answer, slider, puzzle, quiz+audio), or collect opinions (poll, drop pin, word cloud, open-ended, brainstorm). Once you finish creating the kahoot and click start, you can choose between the classic mode, where the students compete individually, and the team mode, where the players compete as a team. After that, the software generates a game PIN and instructs the students to go to www.kahoot.it and enter the PIN and their nickname so the game can begin. Once all the players have joined the game, the game host—the educator, starts the

game. The questions and the possible answers are then displayed on the projector screen one at a time, and students are required to press the symbol on their device's screen that corresponds to the right answer.



Figure 7: The answer symbols displayed on the player's device in Kahoot!

Each question is allotted a time limit, and after each question the podium is presented with the names of those who not only answered correctly but were also the fastest. Being a competitive quiz, it requires both knowledge and speed. At the end of the quiz, the podium shows the third, second, and first place: a nice idea would be to reward these students by giving them extra points, or a small symbolic gift (a pen, a book, a badge, etc.). Although kahoots should not be overused, students mostly enjoy doing them. One possible drawback is the distracting music that accompanies both the questions and the podium, so it would be better turned down. Various studies have shown that students find kahoots beneficial since they improve “classroom dynamics, engagement, motivation and learning beyond what would be expected from traditional teaching methods” (Licorish et al. 2017: 763). The main benefit of the e-learning platform Kahoot! is the fun it provides, thus creating “an attractive environment which provides active participation and supports learning” (Bicen and Kocakoyun 2018: 89).

Gamified activities are also provided by Socrative, another real-time based formative assessment tool, founded in 2010. With currently nearly 3 million users and available in 14 languages, Socrative offers different types of activities. The game-based and team-based one is called “Space Race”, where students can “play by themselves on their own computer or mobile device, play together by sharing a single computer or mobile device, play together on the same team, but answering on separate computers or mobile devices” (Socrative 2023). Students can choose their own teams via student-choice, or they can be randomly assigned to teams via auto-assign. The free basic account allows for as many as 20 teams to participate in the race. Additionally, a countdown timer for up to 45 minutes is available, as well as the options to shuffle questions, shuffle answers, show question feedback, and show final score. The progress bar of each team is seen on the screen in real time, which makes this option very competitive and engaging.

Figure 8: The progress bar during a Space Race in Socrative



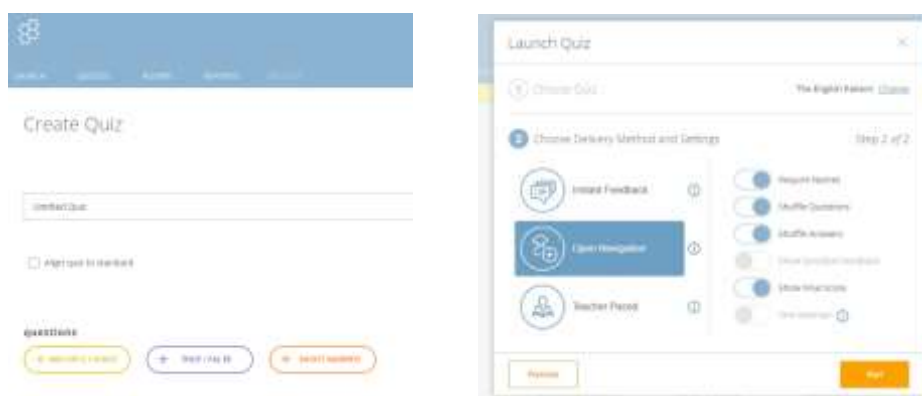
Another Socrative activity is the “Exit Ticket”, which enables you to get the end-of-class feedback. It comprises of three questions: 1. How well did you understand today’s material?¹ 2. What did you learn in today’s class? 3. Please answer the teacher’s question². One more option is to ask a quick question during the class for immediate feedback from the teacher. Finally, arguably the most useful option is to create and launch your own quizzes, which can be done either during the class, or after the class. With the free basic account, you are assigned one “room” of your own, meaning you can deliver one quiz for maximum 50 students at a time, whereas with Socrative PRO you can deliver multiple activities at the same time in up to 20 rooms. As of recently, the free account is limited to 5 quizzes, while the PRO version allows for unlimited number of quizzes. Creating a quiz in Socrative is very user-friendly: you can choose the type of question—multiple choice, true/false, or short answer— and simply fill in the possible answers. Once the quiz is created, the teacher launches it, and students are asked to go to “Socrative Student Login”, enter the name of the room, add their name and begin the quiz. There are different delivery methods and settings for the quizzes. With “Instant Feedback”, students cannot change their answers and they must answer questions in a particular order set by the teacher, who then provides feedback after each question is answered. With the “Teacher Paced” delivery method, the teacher chooses the order of the questions, which can be skipped or revisited as needed. Finally, with the “Open Navigation” delivery method, students answer questions in any order, and they can change their answers before finishing the quiz. Other possible settings include requiring names, shuffling questions and answers, showing question feedback, and showing the final score. For all these delivery methods, both the

¹ This is by default a multiple-choice question, with the following offered answers: A. Totally got it; B. Pretty well; C. Not very well; D. Not at all. In the final report, the answer A is marked as “correct”, so that the class can further discuss if there are many “incorrect” answers, which would mean that the teacher needs to further explain a topic or adjust his/her teaching methods.

² The question can be asked verbally in the classroom, or be written on the board, for example.

teacher and the students can monitor their progress on the projector screen in real time. However, if you want to let the students finish the quiz *after* the class, which is the option I have continued to use even after the pandemic, then you should choose the “Open Navigation” delivery method. Namely, the teacher assigns the time for the beginning and end of the activity (for example, they have a three-hour window after the class to finish the quiz), and once the time runs out, the teacher ends the activity, downloads the report, and shares it with the students.

Figures 9 and 10: Create and Launch Quiz in Socrative



All the activities in Socrative have the option of downloading the report in Excel format, which is particularly useful to students since they can refer to it again while preparing the exam and revisit the questions and the correct answers. In the report, the correct answers appear in green, and the wrong answers appear in red, so it is easy to follow and spot if students had more difficulty with some questions. These open navigation quizzes are not competitive per se, since their primary role is for the individual students to check the knowledge that they acquired during class. On the other hand, the teacher-paced and instant feedback quizzes, as well as the “Space Race”, are competitive and more “gamified” in the sense that students follow their progress in real-time and are aware of their points and position on the leaderboard. As Cerqueiro and Harrison explain, “Socrative and other clickers provide gamification elements such as points or leaderboards, but deliberately including them in the activity design is a basic requirement in order for an activity to qualify as gamified” (2019: 16). Their “comparison between sessions with game-based and non-game-based support” (2) shows that “both with and without gamification elements, clickers increase students’ engagement, [*but*] there is a significant increase in the extent to which the use of Socrative is perceived to be enjoyable and appropriate when sessions include points and leaderboards” (16). Yet, even the non-

gamified quiz in Socrative is highly appreciated by the students, who respond to it extremely well because it is easy/simple to use, it helps them memorize the course material, it is interesting, and the questions and answers are concrete and straightforward¹. Based on our survey at the Faculty of Philology and Arts in Kragujevac, Serbia, students find that doing a quiz after the lecture boosts their confidence, helps them to better memorize the lecture material, makes them do a short revision that they would not usually do, and helps them focus on specific aspects of the lesson that they may not have noticed during the class.

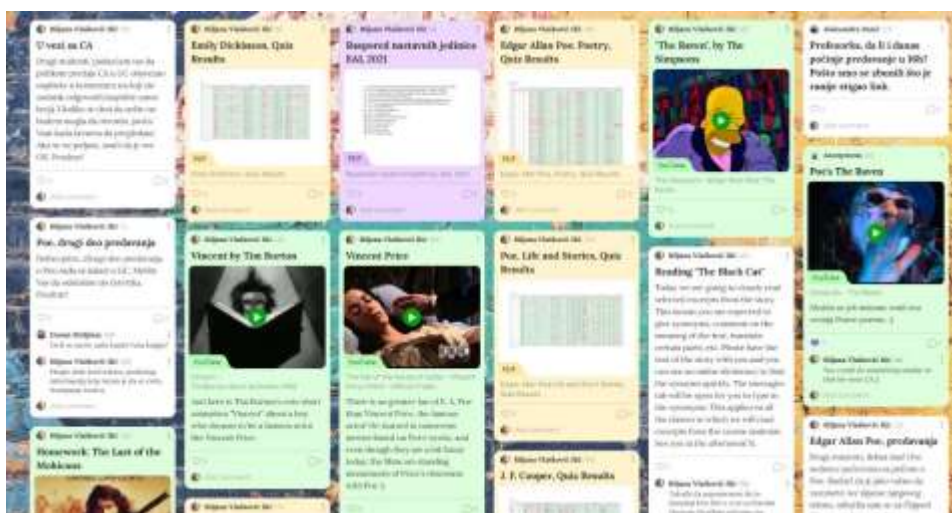
Clickers or “Personal Response Systems (PRS) that provide instant feedback and can be used in the classroom to assess students’ opinions” (Cerqueiro and Harrison 2019: 1), are by all means a highly useful addition to standard ways of teaching. As Pamela Wash claims, “the data are clear; the data cannot be ignored. Students are demanding seamless integration of the varied technologies and mobile devices they own and command. ... These digital natives are demanding that institutions of learning catch up with the 21st century and engage them using the technologies that are a daily staple of their lives. Long gone are the days of standard lecture and PowerPoint presentations from higher education faculty” (Wash 2014: 99). With that in mind, Kahoot! and Socrative have proven to be platforms worth exploring if we want to keep up with the new digitally educated generations of students.

4. DIGITAL CANVAS: PADLET

For students used to being on social networks most of their time, a digital canvas like Padlet is essential. Like the most popular social networks, Padlet allows teachers and students to post stories, react, and comment, thus bringing the chosen circle of academic people together in an innovative and joyful way. The option to anonymously post or comment is another way of boosting the confidence of the more introvert students. Described as “Somewhere between a doc and a full-fledged website builder, Padlet empowers everyone to make the content they want, whether it’s a quick bulletin board, a blog, or a portfolio” (Padlet 2023) and can be used in numerous ways. It is supported in 40 languages and has a free version that allows you to make three fully customizable padlets. Making a padlet is a simple and creative process. First, you choose a format: the simple ones include canvas, timeline, grid, stream, wall, and map, whereas the advanced ones include timeline with sections, grid with sections, stream with sections, wall with sections, and map with sections. Each format has a preview when you hover over it and can be changed later according to needs.

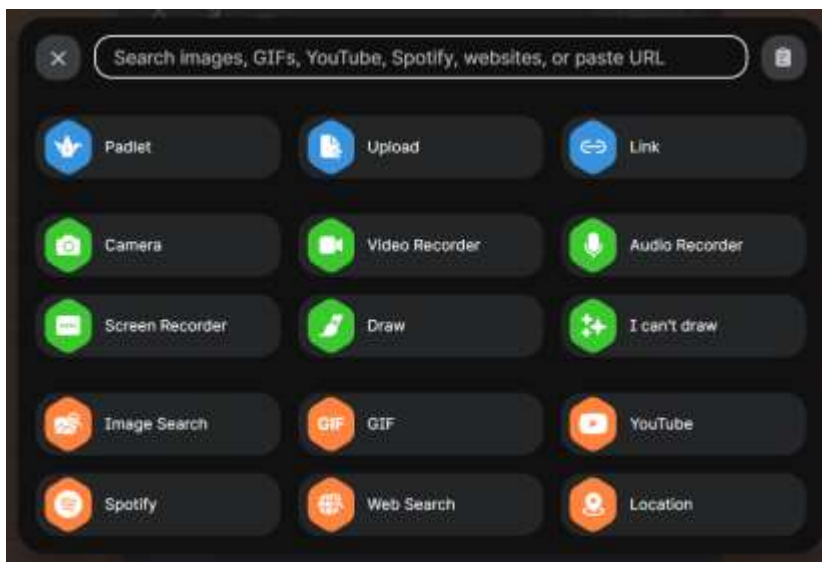
Figure 11: Padlet Wall for Early American Literature (FILUM 2022)

¹ Based on the survey answers by the third-year students of English at the Faculty of Philology and Arts, Kragujevac, Serbia.



Next, under “Settings” you give your padlet a title and description, choose an icon, background, color scheme, font, the position of new posts (first or last); you decide whether to allow viewers to comment, choose how they can react to posts (grade, star, upvote, or like), whether a moderator should approve posts, and even whether you want to filter profanity (replace bad words with emojis). When you are ready to post, you can either “double-click anywhere, drag files in, paste from clipboard”, or click the plus sign in the bottom right, which opens a small window to create your post. You can give your post a subject, then choose among the many types of attachments—upload a file, take a photo, attach a link, search for an image, etc. Each post can be given a color—white, red, yellow, green, blue, or purple—, which is especially important if you want to color-code your padlet so that student immediately know what you have posted based on the color. For example, the color code that I have been using on my courses is the following: WHITE—general notifications; PURPLE—course info; BLUE—course material, books, articles, plays; ORANGE—quiz results; GREEN—interesting facts, trivia, movies, paintings, etc. Based on the survey, students find that communication with the professor and other students via Padlet is much easier when compared to e-mailing and Google Classroom. They claim that Padlet brings them positive energy, makes the material more interesting, and allows them to easily access all the relevant material, instructions, and guidelines for the course. However, there are certain issues that the students have noticed, such as the fact that they are often not notified if someone has posted on Padlet, so that they don’t get to see the new posts or new comments until they open Padlet on their own initiative. Some students even find Padlet a bit chaotic and badly organized, with posts being hard to find, but this is due to the chosen layout, which can be changed at any time and be better organized by the teacher.

Figure 12: Attachment types in Padlet



Padlets can be shared in different ways: you can invite members, copy link to clipboard, get QR code, embed in your blog or your website, email them, or share on Facebook, Twitter, or Google Classroom. They can also be saved as image, PDF, CSV, Excel spreadsheet, or printed, for instance when the course is done and you want to save your padlet for future reference. Studies of Padlet generally conclude that it is easy to use “in a complex teaching environment”, which “makes it a highly useful tool for student and teacher engagement” (Shuker and Burton 2021: 124); it has been described as “a non-threatening space for the collection and curation of collaborative classroom work” where “all the students have the ability to contribute and learn from one another” (Fuchs 2014: 9).

5. CONCLUSION

All the online tools that are presented in this paper were initially used during and because of the COVID-19 pandemic. However, if there is one thing that this global catastrophe has taught us, it is that “readiness is all”, and that educators need to be prepared for necessary changes during global crises. Since all these online teaching resources have continued to be used by teachers and loved by students, it must be concluded that occasional change is not a bad thing. Examining online and remote learning in higher education institutes during the COVID-19 pandemic, Dr. Wahab Ali has come to realize

that “adopting online learning environment isn’t just a technical issue. It is a pedagogical and instructional challenge” (Ali 2020: 22). Hence, the educators who used Information Communication Technology (ICT) tools during the pandemic have recognized that these tools have become “a potent force in transforming the educational landscape the world over” (Ibid). Today, after the pandemic, the educational landscape is irretrievably changed, arguably for the better, at least from the viewpoint of students. The digital revolution that had begun long before the pandemic has had its peak and the benefits of it (as well as the drawbacks) are here to stay, so it is on the educators to try and embrace the “new normal” and blend the traditional teaching methods with the plethora of available online teaching tools.

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THE EDTECH - FRAMING THE FUTURE OF EDUCATION

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ABSTRACT:

In the realm of education, digital revolution is increasingly generating game-changing advantage because broadband Internet connectivity has derived more economical, accessible and distance-learning solutions. The accelerated integration of technology in education on a worldwide scale, generally referred to as "EdTech," has resulted in substantial modifications to traditional education and new skillset development practices. This encompasses a wide range of applications and assets, including the management of learning systems, virtual classrooms, assistive devices, online learning platforms, augmented reality, gamification, podcasts, 3D printing, machine learning, and mobile applications. These advancements have contributed to the expansion of the edtech industry; investors spent \$20.8 billion worldwide in the edtech industry in 2021, which is roughly over 40 times what they invested in 2010. EdTech may assist conventional classroom-based education or allow distant and interactive learning. In order for innovation strategies to accomplish their aspiration of empowering student performance and creative thinking, they must be required to demonstrate a holistic knowledge of the technologies used during teaching practices, the nature of concepts, and crucial issues involving legal implications, real-world opportunity analysis, and ethical aspects of educational equity. The paper emphasizes EdTech's enormous potential to strengthen educational processes by facilitating easy access to interactive, entertaining, and streamlined approaches that encourage new teaching perspectives, a creative mindset, redesigned curriculum, revised performance metrics, and educational experiences.

Keywords: EdTech, digital revolution, education, AI, digital skills.

1. INTRODUCTION

The influx of technology into education has revolutionized teaching and learning processes, generating the area of educational technology (EdTech), which strives for more engaging, inclusive, and individualized learning environments. Through providing novel platforms for instructional delivery, producing content, and collaboration, the digital revolution has highlighted the requirement for digital literacy and digital citizenship. Digital literacy refers to the capacity to effectively navigate, examine, and produce digital content, whereas digital citizenship incorporates responsible and ethical utilization of digital resources and online participation. It has become an essential skill set for

individuals to actively participate in society, education, and the workforce in the current digital age and includes technological competence, critical thinking, information and media literacy, and the ethical use of digital resources, among others. In addition, digital literacy includes the ability to assess the trustworthiness and reliability of web-based data, recognize prejudices and misleading information, and protect personal privacy and digital security. Essential educational strategies include incorporating digital literacy into the curriculum and providing opportunities for practical experience and critical interaction with digital tools. It is essential to view digital literacy as a never-ending method of learning, as technology fluctuates swiftly and individuals have to change and update their skills effectively. (1) The function of EdTech in supporting these skills among students is crucial. It offers students opportunities to acquire information literacy, media literacy, and digital communication skills. In addition, EdTech platforms and tools can be leveraged to instruct students about online safety, privacy, and responsible digital behavior.

The Association for Educational Communications and Technology (AECT) defines educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources". (1) The transformative potential of EdTech toward improving traditional pedagogical approaches, promoting personalized learning, and providing students with essential 21st-century skills is increasingly demonstrating the demand for additional studies and expenditures in EdTech to promote the future of education. In addition to practical educational experience, educational technology is founded on theoretical knowledge from a range of disciplines, including communication, education, social science, psychology, neural networks, and the science of computing. (2)

Fundamentally, the discipline revolves around the optimal application of technological advances to educational practices and entails a continuous reevaluation of all aspects of the teaching-learning process. As an academic field, it enables people to understand educational assets, the methods for evaluating and designing ideas towards those challenges through research, theoretical terms, conception, manufacturing, assessments, and consumption, and the procedures associated with business and personnel management.

2. EDTECH AND SUBSTANTIAL MODIFICATIONS TO TRADITIONAL EDUCATION

Diverse innovative learning environments have been sparked by paradigm alterations. Epistemological shifts have engendered a variety of innovative learning environments and established principled-based approaches to designing learner-centered environments, emphasizing learning with understanding and the importance of social and cultural contexts in learning. These student-centered approaches reflecting epistemological

variants have emerged including project- and problem-based learning, cognitive apprenticeships, computer-supported collaborative learning, learning-by-design, games and simulations and open learning environments. (3) Technology enables lecturers to develop into co-learners alongside the students they teach by facilitating the development of fresh perspectives for a more in-depth examination of curriculum. There are virtually infinite possibilities for educators for choosing and implement technological resources in manners that align with their students' interests and advance their educational objectives. The following enriched education exemplifies John Dewey's concept of fostering "more mature learners." (4) Nevertheless, the narrative of disruptive educational technology (edtech) surfaces on occasion. For instance, in the beginning of the 2000s, there was a hubbub around the notion of flipped education, which was anticipated to bring about an enormous change in traditional classrooms. In 2012, the emphasis shifted to Massive Open Online Courses (MOOCs), which were thought to revolutionize the transmission of education. It seems that there is at present a prevalent surge of anticipation pertaining to the conceivable effect of artificial intelligence (AI), big data, and learning analytics on education delivery. (5)

These instances of high expectations serve as examples of a pattern that sees edtech as a catalyst for significant changes in education. Nonetheless, it is essential to approach these narratives with a critical eye and to consider the practical implications and obstacles associated with implementing these technologies in educational settings. While edtech innovations have unquestionably brought about advancements and improvements in various aspects of education, the enormous statements of disruption frequently struggle to remain true. The field of education is intricate and multifarious, involving a variety of stakeholders, intricate social dynamics, and numerous factors that influence the learning process. Consequently, while it is natural to be enthusiastic about the opportunities afforded by edtech, it is crucial to moderate expectations and approach these technologies with a critical mindset.

2.1. Blended Learning

Blending online and face-to-face instruction has become more prevalent, providing flexible learning opportunities that accommodate to the requirements and preferences of individual students. This pedagogical paradigm incorporates digital technologies into the curriculum, allowing students to engage in both in-person and online activities. It offers adaptability, personalized learning experiences, and instantaneous feedback via online assessments.

Blended learning, described by Picciano is characterized by the strategic incorporation of digital technologies into the curriculum, where students engage in both in-person interactions and online activities. The online component frequently includes multimedia resources, interactive modules, discussion forums, and virtual simulations, affording students opportunities for independent study, collaboration, and reflection. (6) Blended

learning additionally supports different instructional methods and habits, allowing students to obtain course materials any moment and from any location. Blended learning has the potential to significantly improve education by integrating the characteristics of traditional and online learning methods.

2.2. The flipped classroom

The flipped classroom is an innovative pedagogical paradigm that has garnered significant interest in recent years. Participants get involved with learning resources, such as video lectures or assessments, in addition to class prior to taking live sessions in which they may utilize and broaden their comprehending through activities, debates, and teamwork. Using technology to deliver content outside the classroom, this strategy seeks to maximize classroom time for proactive learning and higher-order thinking abilities.

There are arguments that technique of flipped classrooms can be challenging to implement as well as drawbacks particular groups due to dissimilar availability of technological resources (7,8). Proponents of the flipped classroom approach claim that it offers numerous benefits, including increased classroom efficiency and participation by students.

It is essential to recognize that the flipped classroom cannot be a method that is universal indicating that its effectiveness is determined by variables such as subject matter, pupil readiness, and expertise of educators. Although the flipped classroom has demonstrated promise, it is essential to perpetually evaluate their effect and investigate its potential advantages and disadvantages in a variety of educational settings

2.3. Personalized Learning

Utilizing technology, data analysis, and student-centered instructional strategies, personalized learning creates a more individualized and adaptable learning environment. Educational software and programs have become more "adaptive," focusing on technology and algorithms for assessing not solely what an individual comprehends but additionally his or her learning experience and psychological condition. EdTech encourages flexible educational activities by adapting content and pacing to the needs of individual learners, thus promoting tailored educational environments that target each student's academic abilities and shortcomings, interests and reasons, individual preferences, and optimum pace of studying. According to studies, personalized learning may enhance student outcomes and motivation by providing individualized pathways, nurturing ownership of learning, and utilizing technology for data analysis and resilient education. (9)

2.4. Computational thinking

Computational thinking is a psychological approach that employs computer science principles and methodologies for problem-solving, critical thinking, and algorithmic logic. It aims to aid in the decomposition of complex problems into less overwhelming elements, enabling systematic examination and the development of effective solutions based on computational concepts and techniques. It should be noted that computational thinking encompasses a wider spectrum of fundamental abilities that can be employed across a variety of domains and contexts in addition to programming expertise.

The importance of computational thinking isn't restricted to computer scientists and programmers; it is an invaluable skill set that is applicable to many disciplines. Integrating computational thinking into educational programs stimulates creativity, capacity for problem-solving, and logical reasoning within learners. It cultivates an appreciation for abstraction, decomposition, and algorithmic reasoning, equipping students with the ability to solve complex problems confronted in disciplines including business, science, engineering, and the humanities.

3. CONCLUSION

This paper has highlighted the prevailing function of EdTech to obtain substantial modifications within conventional education and nurture new practices for the development of skills. EdTech incorporation has the capacity to respond to diverse learning requirements, enhance student achievement, and reinforce the acquisition of essential 21st-century skills. EdTech has the potential to transform education by leveraging innovative technologies and pedagogical approaches, making it easier to customize, informative, and efficient.

These mediums present students with authentic, real-life situations in which they must implement their knowledge, make informed decisions, and develop problem-solving techniques. By engaging in these activities, students develop critical thinking skills that allow them to effectively navigate and make sense of complex digital environments. Nevertheless, obstacles such as access disparities, issues related to privacy, and requirements for professional development for educators must be recognized and addressed.

In conclusion, the interplay of traditional and online components offers adaptability, personalized learning experiences, and increased learner engagement, which can significantly enhance learning outcomes and meet the specific requirements of multiple learners. Effective implementation involves thoughtful instructional design, continuing educator support, and an emphasis on the seamless integration of technology and pedagogy within the learning environment. Policymakers, educators, and researchers should therefore collaborate to guarantee equitable access to EdTech assets, promote evidence-based practices, and support ongoing research and innovation. Embracing these

changes and addressing the associated challenges will pave the way for an inclusive education system that is prepared for the future.

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MULTIMEDIA TOOLSET DEPLOYMENT IN THE ENGLISH-COURSE PRESENTATION OF DIGITAL AGRICULTURE

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ABSTRACT

In a general aspect of teaching English as a foreign language (TEFL), English as a foreign language (EFL) is considered stimulating to the English language learners (ELLs) because the TEFL practice in that particular case refers to English language teaching in a country whose official language is other than English. To contribute to a desirable students' English proficiency level in the scope of a comprehensive education—that is, the one that progressively relies on the digitalization process and technological advancements in multiple sectors—various learning methods are applied, frequently favoring the so-called blended learning as a technology-mediated, or web-enhanced, personalized learning policy. A partially self-directed study-at-home via e-learning platforms (e.g., the Moodle-based course management systems such as Merlin) was especially promoted at the time of the COVID-19 pandemic, having remained fully operational in case of the English in Digital Agriculture course too. English in Digital Agriculture e-textbook thus represents a formal-content learning material, with an emphasis placed on the students' basic interpersonal communicative skills (BICS) in the English language and their cognitive academic language proficiency (CALP). The e-textbook's multimedia contents semantically and syntactically comply with the C1 and C2 levels of the Common European Framework of Reference for Languages (CEF), but the exposure to the native speakers' oral and textual styles and a peer tutoring advocacy and tolerance might effectively and ethically assist in the neutralization of educational inequality, or students' achievement gaps, facilitating the students' English-based professional and technical communication in Digital Agriculture.

Keywords: *agronomist education, Digital Agriculture, English language acquisition, innovation, technological advances*

1. INTRODUCTION

Since the practice of teaching English as a foreign language (TEFL) regularly refers to English language teaching in a country whose official language is other than English (Birgy, 2022), English as a foreign language (EFL) is considered stimulating to the English

language learners (ELLs) in such a general aspect (“8 Abbreviations,” 2021; García et al., 2008, p. 6; *Grammar Fundamentals*). Thus, various learning methods are applied, frequently favoring the so-called blended learning as a technology-mediated, or web-enhanced, personalized learning policy (Tucker et al., 2017). This, in our opinion, might contribute to a desirable students’ English proficiency level in the scope of an in-depth education—that is, the one that progressively relies on the digitalization process and technological advancements in multiple sectors. At the time of the COVID-19 pandemic, however, a partially self-directed study-at-home via e-learning platforms—for example, the Moodle-based course management systems such as *Merlin*—was especially promoted, having remained fully operational in case of the English in Digital Agriculture course too (“Merlin,” 2023; Rothwell & Sensenig, 1999).

2. ENGLISH IN DIGITAL AGRICULTURE: THE EXAMPLE OF AN E-TEXTBOOK

With an emphasis placed on the students’ basic interpersonal communicative skills (BICS) in the English language and their cognitive academic language proficiency (CALP), *English in Digital Agriculture* e-textbook represents a formal-content learning material. While so doing, it in fact follows the context-bound, face-to-face BICS premises outlined by Jim Cummins (1979, pp. 198, 199, 201, 202), updating these hypotheses to reflect Cummins’ BICS/CALP distinction (Paulston & Tucker, Eds., 2003, pp. 324–325), as well as the necessities of a novel “academic language” or of a “conversational language,” noted by Jana Echevarría and Anne W. Graves (2015, pp. 3, 9, 12, 130). To avoid what Carolyn Vincent observed as the considerably deceptive students’ language attainments in an ethnically diverse classroom setting, which is similar to the one encountered in our Graduate Study Program in Digital Agriculture, we have meticulous attention to the e-book structuralization, as the students are apparently more fluent and proficient in their conversations and terminology usage related to the quotidian topics, whereas the application of the English-based Digital Agriculture vocabulary still occasionally represents one of the major problems (1996, p. 195).

2.1. Semantico-syntactic compliance

Semantically and syntactically, the e-textbook’s multimedia contents consequently comply with the C1 and C2 levels of the Common European Framework of Reference for Languages (CEF); yet, the students’ exposure to the native speakers’ oral and textual styles and a peer tutoring advocacy and tolerance might effectively and ethically assist in the neutralization of educational inequality, or students’ achievement gaps, facilitating the students’ English-based professional and technical communication in Digital Agriculture

(“CEFR Levels,” 2023). Second-language literacy development is thereby fostered by the exposure to the native speakers’ oral and textual styles.

Table 1. Common European Framework of Reference for Languages (CEF) descriptors.

Common European Framework of Reference for Languages (CEF) descriptors		
Students’ group	Proficiency level of students’ English- based professional and technical communication	Multimedia-content conformity advocating an effective ethical assistance to minimize the students’ educational inequalities
C	C1 (advanced)	<ul style="list-style-type: none"> • implicit semantic recognition (e.g., of the demanding clauses) • fluent and spontaneous ideational expression • effective and flexible language use (e.g., academic, professional, and social) • a detailed, well-structured textualization (e.g., of a cohesive essay on a complex subject matter)
	C2 (mastery)	<ul style="list-style-type: none"> • complete aural and reading comprehension • coherent information summarization and argumentation, based upon spoken or written sources • precise, spontaneous expression capacity

2.2. Educational context of the English in Digital Agriculture course

In our particular environment, situated at Josip Juraj Strossmayer University of Osijek’s Faculty of Agrobiotechnical Sciences (FABS), TEFL implies an EFL instruction at the Department of Bioeconomics and Rural Development’s Subdepartment of Foreign Languages and Physical Education, aspiring to stimulate the ELLs in Croatia as a European Union (EU) country—namely, in a nation whose vernacular language is other than English too. Hence, to assure the obtainment of a desirable students’ English proficiency level, the digitalization process and technological advancements in the agricultural sector are progressively relied on in our inclusive agronomist education as well.

Since FABS and the Faculty of Electrical Engineering, Computer Science, and Information Technology (FEECSIT) have jointly devised the Osijek-based Graduate Study Program in Digital Agriculture, whose lectures are delivered exclusively in English, the course methodically partially applies the aforementioned self-directed study-at-home, personalizing it in the form of technology-mediated blended learning while deploying Moodle as an e-learning platform. This in turn empowers the international course students, providing them with an opportunity of native speaker interaction and peer tutoring (Gordon, 2005, pp. 6–11). E-textbook thus contains numerous references to the students' necessary linguistic habits and internal mechanisms, engined by the formal and vernacular Standard American English (StAmE).

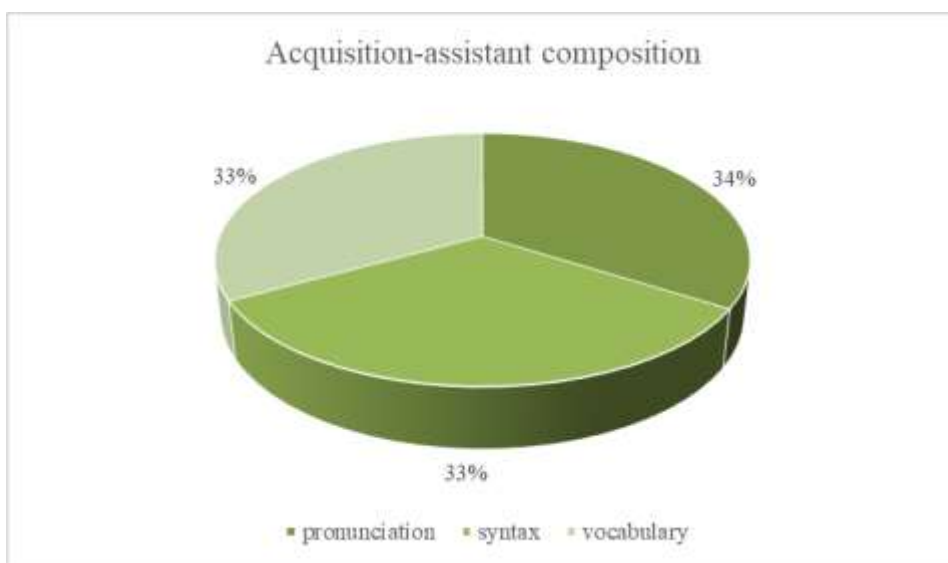


Fig. 1. Acquisition-assistant composition
of the *English in Digital Agriculture* e-textbook.

2.3. Anglo-American cultural immersion

As the course lectures of the Graduate Study Program in Digital Agriculture are delivered exclusively in English, thus empowering the students to experience a complete Anglo-American cultural immersion, native speaker interaction, and peer tutoring as well, this paper's objective is to examine the avenues in which the future *English in Digital*

Agriculture e-textbook might successfully reference the necessary linguistic habits and internal mechanisms to assist the students' acquisition of a proper pronunciation, syntax, and vocabulary, predominantly engined by the formal and vernacular English language of the United States of America.



Fig. 2. An illustration of advanced educational technologies: a formal-content learning material applying edutechs to assist the development of basic interpersonal communicative skills (BICS).

2.4. English for academic purposes; or, Academic English

To alleviate the difficulties and surmount the students' obstacles while being involved in an English for academic purposes (EAP) course, the aforementioned e-textbook applied a contrastive analysis approach to this type of English for specific purposes (ESP) scheme. In-text bolding and bookmarking were utilized in the English typescript to demarcate and define a new terminology of Digital Agriculture in a follow-up glossary, and the smartphone-scannable QR codes of the hyperlinked, thematically correspondent *YouTube* video clips were introduced to potentially eliminate the hypothetically problematic Croatian transfer effects, especially the students' false part-of-speech identification; an

occasionally objectionable mispronunciation of English diphthongs, interdentals such as /θ/ and /ð/, and silent letters; or the vocabulary-related false friends.

ESP is, on the one hand, hereby comprehended as a methodologically and psychologically purposeful neo-Maslowian subset of EFL dedicated to the second-year students of the Graduate Study Program in Digital Agriculture and their acquisition of necessary discourse conventions, genre knowledge, grammar, lexis, register variations, and study skills and techniques (Belcher, 2009; Maslow, 1943), while EAP, on the other hand, entails a skill-focused students' training in listening, pronunciation/speaking, reading, and writing, being a higher educational ESP form ("English for Academic Purposes," 2023).

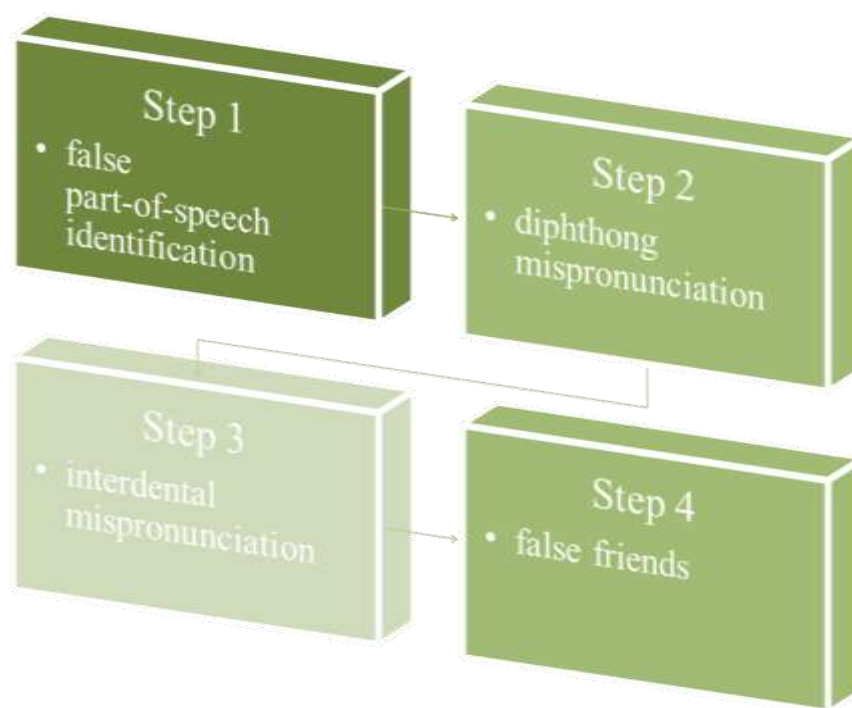


Fig. 3. Hypothetical problem elimination.

Table 2. A correlation between teaching English as a foreign language (TEFL), English as a foreign language (EFL), English for specific purposes (ESP), and English for academic purposes (EAP).


<i>Teaching English as a foreign language (TEFL)</i>	
	English as a foreign language (EFL)
	English for specific purposes (ESP)
	English for academic purposes (EAP)



Fig. 4. A stress-free class environment: the illustration of an emphasis placed on the students' cognitive academic language proficiency (CALP), promoting confidence and responsibility.

2.5. Grammatical and lexical adequacy

In terms of the English grammar, the e-textbook exercises provide for an adequate practicum material concerning the verbal aspects, moods, and tenses, with a special emphasis put on the auxiliaries and modals. Equal attention is meticulously devoted to the issues of English definite, indefinite, and zero articles, as well as to the topic of select agricultural and general idiomaticity. When it comes to the preselected English lexicon, however, the e-textbook incorporates the authentic articles styled in StAmE to illustrate

the collocations, most frequent phrasal verbs and prepositions, and word formation patterns. Eventually, to enhance the students' second-language literacy, to correctly contextualize the English vocabulary in the domain of Digital Agriculture, and to sociolinguistically rectify the students' recurrent register errors, a clear distinction is purposely made between the English colloquialisms, formal language, and slang as well.

With regard to an English grammar practicum, the e-textbook consequently offers an adequate material contextualization concerning verbal aspects, moods, and tenses (especially auxiliaries and modals). Special attention is thereby devoted to the issue of article insertion/omission—that is, to the definite, indefinite, and zero article use.

From a sociolinguistic aspect, the e-textbook thus incorporates select collocations and most frequent phrasal verbs and prepositions, as well as English word formation patterns in Digital Agriculture, warning the students against register errors—for example, colloquialisms versus formal language and slang.

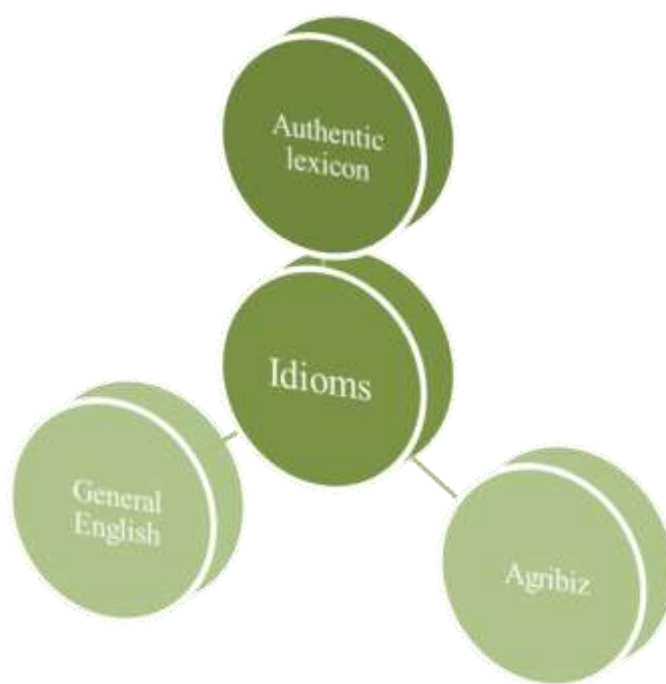


Fig. 5. The composition of English grammar practicum
within the e-textbook.

Considering its configuration, however, the e-textbook embraces an inquiry-oriented lesson format, whereby its multicultural facet is reflected in its deliberately individualizing, student-first character, streamlined to a modern, gamified computer-assisted language learning (CALL) and to a topical Web-based information search (Beatty, 2013, pp. 78–80).



Fig. 6. (Extracurricular) WebQuest.

3. CONCLUSION

Thanks to the benefits of the advanced educational technologies, or edutechs, deployed, the e-textbook aspires to create the foundation for a confidence-building, responsible, and stress-free class environment, completely equipped and suitable for a modern, slightly gamified computer-assisted language learning (CALL). While fully embracing the principle of a multicultural, inquiry-oriented lesson format, or WebQuest, the e-textbook

actually provokes the students to initiate a topical, Web-based information search of their own—occasionally in the form of an extracurricular activity—to finally overcome the language barriers, voice their opinions, and perfect their writing skills with respect to various issues in contemporary Digital Agriculture.

Qualifying the students for an ultimately elevated academic performance when it comes to their ESP expression, the e-textbook might consequently and conclusively be observed as a form an interactive, self-paced, and student-centered ecosystem that involves the students in an almost coauthorial, feedback-providing role in the field of the so-called citizen science, in this case ranging from the classical agronomic topics such as the viticultural terroirs all up to rurism—that is, a rural landscape beautification, increasingly performed by virtue of a digital transformation.

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ANALIZA ZASTUPLJENOSTI INFORMACIJSKIH TEHNOLOGIJA I OBRAZOVNIH SOFTVERA U PEDAGOŠKIM STANDARDIMA KANTONA SARAJEVO U BOSNI I HERCEGOVINI

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SAŽETAK:

Obrazovni sistem je neodrživ bez stalnog inoviranja i praćenja savremenih trendova i dostignuća. Jedino na taj način se djeca i omladina mogu pripremati za život u svijetu koji ih okružuje, umjesto da uče o svijetu kakav je nekada bio. Vodeće inovacije današnjice se dešavaju u domenu informacijskih tehnologija i softverskog dizajna i inženjeringa. Generalno inoviranje nastave se dešava na dva najčešća način: pojedinačnim inicijativama nastavnika koji se trude da nastavu realiziraju poštujući princip savremenosti nastave, te normativno kada nadležne obrazovne vlasti propisuju standarde koji se moraju ispoštovati.

U ovom radu su prikazani rezultati normativnog inoviranja kroz komparaciju Pedagoških standarda i općih normativa za osnovni odgoj i obrazovanje u Kantonu Sarajevo iz 2005. godine i 2018. godine.

Komparativnom analizom je utvrđeno da je prisutno puko prepisivanje u domenu propisivanja upotrebe informacijskih tehnologija i obrazovnih – edukativnih softvera te da propisana norma ne korespondira sa stvarnom ponudom izdavačkih kuća i knjižara, poglavito u dijelu obrazovnih softvera.

Pedagoški standardi u dobar način kako da se sistemski uvedu inovacije u nastavni proces i garancija da će istima biti obuhvaćena kompletna populacija. Na žalost, utvrđena je pojava pukog prepisivanja nastavnih sredstava i pomagala iz domena informacijskih tehnologija i obrazovnih softvera u pedagoškim standardima koje ne korespondira sa stvarnom ponudom nastavnih sredstava kod knjižara i izdavačkih kuća.

Ključne riječi: *obrazovni sistem, nastava, pedagoški standardi, obrazovna tehnologija, obrazovni (edukativni) softveri*

1. UVOD

U vrijeme pojave i munjevitog razvoja vještačke inteligencije, obrazovni sistemi nastavljaju sa duboko uvriježenim procesom fiksacije pristupa i aktivnosti, potpuno neosjetljivi ili samo djelimično osjetljivi na promjene u okruženju. I dok savremene inovacije svakodnevno pomjeraju granice naše svijesti i sve značajnije mijenjaju ustaljene obrasce naših života, obrazovni sistemi uporno naučavaju djecu o „svijetu kakav je nekada bio“. Taj antagonizam svijeta „kakav je nekada bio“ a koji se obavezno poučava u školi („čitaj prisilno“ jer osnovno i srednje obrazovanje je obavezno) i „svijeta kakav jeste danas“ odnosno naziranje i razvijanje vizija o „svijetu kakav nas tek očekuje“ ponajbolje se vidi u sve snažnijoj demotiviranosti djece za trud, učenje i zalaganje u okviru formalnog obrazovnog sistema. Izuzetak čine zalaganja učenika motivisana nagradama (dobre ocjene, stipendija i sl.), ali to spada u extrinzičnu motivaciju koja je ionako kratkog daha sa minimalnim obrazovnim rezultatima, a o odgojnim da i ne govorimo. U nastavku će biti predstavljeni rezultati istraživanja o tome koliko je obrazovni sistem „uporan“ u svojoj fiksaciji kroz primjer najdinamičnije kategorije savremenog svijeta, a to su svakako „obrazovni softveri“. I dok s jedne strane imamo sve veći broj učenika u srednjoškolskim klupama, pa čak i osnovnoškolskim, koji sami kreiraju razne aplikacije i čak na njima zarađuju, sa druge strane imamo „obrazovne birokrate“ koje doslovno prepisuju i u pedagoškim standardima koji su okvir odgojno-obrazovnog rada, nešto što ne postoji ili je potpuno nedostupno.

2. Šta su to obrazovni, tj. edukativni softveri

Kompjuter je nastao kao mašina i on ostaje mašina. Međutim, za razliku od drugih mašina koje su donedavno imale samo mehaničke, materijalne dijelove, kompjuter od početka ima i drugu komponentu, softver – tj. mehke nematerijalne dijelove. Savremeni IKT uređaji (kompjuter, mobitel, televizori i drugi) u stanju su izvršiti veliki broj funkcija (pisanje, crtanje, ilustriranje, računanje, primanje i slanje e-pošte, itd.) upravo zahvaljujući programima koji ih pokreću. Hardverdske komponente (svi materijalni dijelovi kompjutera i dr. uređaja) same po sebi su neupotrebljive bez adekvatnih softvera, bez obzira koliko bili savršeni. S obzirom da upravo softveri omogućavaju obavljanje velikog broja različitih funkcija jasno je da se radi o vrlo obimnom terminu. Kod nas se pojmovi softver i program često koriste kao sinonimi. Istina je da su u pitanju vrlo bliski i međusobno povezani pojmovi, ali ipak među njima postoji razlika. „Softver (*software*) je opći naziv za skup instrukcija pomoću kojih se upravlja nekim kompjuterom ili komunikacijskom mrežom, dok se pod programom podrazumijeva konkretan niz instrukcija kojima se kompjuteru saopćava na koji način treba da izvrši neku specifičnu akciju ili da riješi neki problem.“ (Seen, 2007: 74)

U tom segmentu nevidljivih dijelova kompjutera koji ga pokreću razlikujemo tri vida programa:

- **softver** – set upravljačkih programa, procesa, pravila i sa dokumentacijom, povezanih sa informacijskim procesnim sistemom,
- **korsver** – kompletan pedagoški programski „paket“ koji se koristi u nastavi pomoću kompjutera da bi se ostvarili određeni pedagoški ciljevi,
- **lesenver** – najmanja koherentna pedagoška cjelina koja se prezentuje učeniku da se ostvari specifični nastavni cilj.

Od njihovog kvaliteta izravno zavisi i kvalitet nastave, efekti koje kompjuter omogućuje učenicima kao izvor saznanja.

Najveći problem u masovnijem korištenju kompjutera predstavlja proizvodnja softvera, korsvera i lesenvera. Prema istraživanju eksperata UNESCO-a za jedan sat nastavnog programa koji se koristi uz pomoć mikrokompjutera potrebno je 200-300 časova rada, a prema istraživanjem stručnjaka OECD-a iz 1984. godine cijena jednog časa je između 10.000 i 50.000 dolara. (Mandić i Mandić, 1997) Osim toga javlja se i problem „kulture kolonijalizacije“ jer je jasno da će razvijenije zemlje imati priliku da kreiraju te programe u skladu sa svojim potrebama i interesima i nude ih siromašnijim zemljama.

Osim prethodno navedenih najčešće korištenih programa u zadnje vrijeme intenzivno se razvijaju i programi isključivo bazirani za obrazovne svrhe, tzv. **obrazovni softveri**. Iako se svi navedeni programi mogu koristiti u pedagoške svrhe, najveću pedagošku vrijednost ima obrazovni softver jer je koncipiran po didaktičkim zakonima i principima. „Softver u oblasti obrazovanja predstavlja intelektualnu tehnologiju i naziva se obrazovni softver, obuhvata programske jezike, pribore i organizaciju nastave i učenja, koja se bazira na logici i pedagogiji. Tako se pod pojmom obrazovni softver podrazumijevaju kako gotovi računarski programi, koji se mogu koristiti u nastavi, tako i program koji pomažu i usmjeravaju individualnu fazu učenja. Obrazovni softver sadrži različite nastavne programe namijenjene korisnicima. Iskustva u nekim razvijenijim zemljama govore da se obrazovni softver projektuje i razvija pod značajnim uticajem nauke, što je posljedica razvoja nauke o informatici u obrazovanju.“ (Nadrljanski, Soleša, Nadrljanski, 2008: 169)

S obzirom da obrazovanje obuhvata jako široki prostor, cjelokupnu stvarnost, i ovi programi su nastali s različitim namjenama. Tako npr. u SAD-u, Njemačkoj, Engleskoj i dr. zemljama postoje razne vrste ovih softvera:

- Softveri namijenjeni kao podrška redovnoj nastavi
- Softveri namijenjeni isključivo za individualno učenje i usavršavanje
- Softveri namijenjeni raznim oblicima funkcionalnog obrazovanja (seminari, kursevi, osposobljavanje za posao i sl.)

Upravo zbog ovog šarenila u domaćoj i stranoj literaturi različito se tumači pojam obrazovnog softvera, postoje različite klasifikacije tih softvera, a zbog dinamičnog razvoja ovog područja ni jedna definicija, niti klasifikacija se ne može smatrati konačnom, tim prije zato što svaka klasifikacija zahtijeva unifikaciju i standardizaciju. Pa ipak, zajedničko za sve njih je da predstavljaju podršku učenju u širem smislu i nastavi. Upravo zbog širokih zahtjeva i mogućnosti sve obrazovne softvere treba krasiti široka fleksibilnost, tj. mogućnost izmjena i adaptacija.

Od uobičajenih klasifikacija navest ćemo rusku klasifikaciju koja, prema **pedagoško-psihološkim kriterijima**, daje sljedeću taksonomiju obrazovnih softvera:

- **za razvoj vještina i navika;**
- **nastavnički programi;**
- **programi za modelovanje različitih situacija;**
- **programi bazirani na modelima i metodama igara i**
- **programi za samostalno obrazovanje – učenje.** (Nadrljanski, Soleša, Nadrljanski, 2008)

Posebno zanimljivu klasifikaciju obrazovnih softvera daju autori Nadrljanski, Soleša i Nadrljanski, koji softvere klasificira prema stepenu samostalnosti, tako da je na prvom mjestu obrazovni softver u potpunosti vodi učenika kroz proces učenja, a na zadnjem onaj koji mu daje punu slobodu i samostalnost u kreiranju i upravljanju procesa učenja. Njihova klasifikacija obrazovnih softvera obuhvata sljedeće kategorije:

- **Upravljački obrazovni softver** – je softver koji je dirigovan programom i u potpunosti vodi korisnika kroz proces učenja/obrazovanja, te uz elemente obrazovnih sadržaja ima i uputstvo za korištenje. Uputstvo daje korisniku sugestiju kada da prekine korištenje kompjutera i da učenje nastavi iz udžbenika i nekog drugog izvora, ili da napravi eksperiment;
- **Tutorski obrazovni softver** – predviđen je za učenje onih sadržaja koji se uče u vidu programiranih vježbi koje korisnik mora savladati prema datom redoslijedu (učenje mehaničkim zapamćivanjem). On u sebi ima ugrađene vrlo krute algoritme upravljanja na koje čovjek vrlo malo može utjecati;
- **Dijagnostički obrazovni softver** – koristi se za provjeru znanja, sposobnosti i spretnosti korisnika za neke sadržaje obrazovanja. Ovaj tip softvera daje korisniku informacije tipa povratne informacije (*feed back*), na osnovu kojih može da donosi upravljačke odluke o daljim tokovima učenja ili obrazovanja.
- **Obrazovni softver za vježbanje** – koristi se isključivo za utvrđivanje znanja ili izgradnju vještina. Korisnik upravlja svojim obrazovanjem i sam određuje težinu zadatka koje softver sadrži i na osnovu postignutih rezultata korisnik određuje zadatke koje treba da savlada.
- **Obrazovni softver tipa banke podataka** (znanja) koncipiran je u vidu specijalizovane enciklopedije znanja. To znači da korisnik može dobiti samo one informacije koje su po nekom načinu organizacije i sadržini interpretacije smještene u banci podataka. Korisnik na osnovu svojih obrazovnih ciljeva i zadataka sam strukturira proces učenja koristeći znanja iz banke podataka.
- **Obrazovni softver tipa eksperimenta** koristi se za oglede u laboratorijama i praktičnoj nastavi za mjerenje i upravljanje procesima, aparatima i mašinama. Tu se koristi i dodatna aparatura oprema uz računar. Korisnik uz pomoć kompjutera i specifičnog softvera upravlja procesom učenja empirijskim metodama.
- **Obrazovni softver simulacije** omogućuje da se neki realni sistemi predstave pomoću modela na računaru i da se na njemu simuliraju procesi tih sistema. Isto tako, pomoću simulacije moguće je da se otkriju funkcionalna i strukturalna

obilježja sistema koji se izučava. U zavisnosti od prethodnih znanja, korisnik može sam programirati svoje učenje i obrazovanje pomoću simulacionih modela koji su mu dati ili ih sam konstruiše. U primjeni softvera tipa simulacije do velikog izražaja dolazi individualno znanje o upravljanju procesima učenja i obrazovanja.

- **Softverska oruđa** predstavljaju programe koji su namijenjeni korisnicima za oblikovanje obrazovnih sadržaja koje sami savlađuju. Tu se, prije svega, misli na oruđa za obradu teksta, formiranje baza podataka, razna izračunavanja, grafiku i sl. Ti programski proizvodi daju velike mogućnosti za potpuno samostalno upravljanje, sticanje znanja, izgradnje vještina i stvaranja navika.
- **Intelligentni tutorski sistemi** su najviši nivo kvaliteta obrazovnog softvera i temelje se na ostvarenjima u oblasti vještačke inteligencije. Intelligentni tutorski sistemi su dijaloško orijentisani sistemi, koji na bazi komunikacija sa korisnikom daju potrebna znanja i savjete koje obrazlažu na adekvatan način. Takva znanja potiču od eksperata i razlikuju se od udžbeničkih. Za sada su i programi još u istraživanju i mali broj se koristi u nastavi i učenju. Intelligentni tutorski sistemi sa stanovišta upravljanja korisnika predstavljaju najviši stepen samostalnosti. (Nadrljanski, Soleša, Nadrljanski, 2008: 171-172)

Eksperti OECD-a (Organizacije za ekonomsku saradnju i razvoj) i CERi-a (Centar za istraživanja i inovacije Pariz) u studiji „*A taxonomy of educational software*“ kao polazište za klasifikaciju obrazovnog softvera uzimaju Tejlorov metod izložen u studiji „*Information Technologies and Basic Learning: Reading, Writing, Science and Mathematics*“, koji možemo i grafički predstaviti na sljedeći način:



(Sl.br. 1 - Shema korištenja IKT i obrazovnih softvera prema Taylorovom modelu)

Uočljiva je podudarnost u određenim segmentima sa prethodno navedenom klasifikacijom. Oni detaljno razrađuju svaku od navedenih komponenti.

Dakle, mogućnosti obrazovnih softvera su više nego respektabilne u nastavi i nastavnom procesu, međutim i najnoviji iPhone se može svesti na prvu verziju mobitela ako ga koristimo samo za pozive. Bez znanja o mogućnostima tehnologije, njena upotrebna vrijednost se svodi na minimalnu. Sada ćemo pogledati kako se obrazovni softveri tretiraju u pedagoškim standardima najrazvijenijeg i najdinamičnijeg dijela države Bosne i Hercegovine, u Kantonu Sarajevo.

U cijelom radu ćemo obrazovne i edukativne softvere koristiti kao sinonime.

3. Metodologija istraživanja i rezultati analize

Za potrebe ovog rada uzeli smo Pedagoške standarde i normative za osnovnu školu u Kantonu Sarajevo i to **Pedagoške standarde i opće normative za osnovni odgoj i**

obrazovanje i normative radnog prostora, opreme, nastavnih sredstava i učila po predmetima za osnovnu školu iz 2005. godine koje je na osnovu člana 22. i 24., stav 4. Zakona o Vladi Kantona Sarajevo (“Službene novine Kantona Sarajevo”, broj: 24/03 – prečišćeni tekst), donijela Vlada Kantona Sarajevo je na 109. sjednici održanoj 14. 04. 2005. godine, te one iz 2018. godine koje je na osnovu člana 26. i 28., stav (2) Zakona o Vladi Kantona Sarajevo (“Službene novine Kantona Sarajevo”, broj: 36/14 - Novi prečišćeni tekst i 37/14 – Ispravka) i člana 10 stav (3) a u vezi sa članom 118. Stav (1), alineja a) Zakona o osnovnom odgoju i obrazovanju (“Službene novine Kantona Sarajevo”, broj: 23/17 i 33/17), donijela Vlada Kantona Sarajevo je na 133. sjednici održanoj 06.07.2018. godine u vidu Odluke o **Pedagoškim standardima i normativima za osnovnu školu**, a koji su još uvijek važeći. Metodom analize pedagoških normativa i dokumentacije, uz korištenje ček liste, utvrđeno je sljedeće stanje u pogledu tretmana obrazovnih softvera iz 2005. i iz 2018. godine.

Analiza propisivanja obrazovnih, tj. edukativnih softvera u razrednoj nastavi

PREDMET	Obrazovni softveri u pedagoškim standardima iz 2005.	16. Obrazovni softveri u pedagoškim standardima iz 2018.
Bosanski, Hrvatski, Srpski jezik i književnost	Edukativni softveri – izbor tekstova prema NPP dramatizacija s poznatim glumcima	Edukativni softveri – izbor tekstova prema NPP dramatizacija s poznatim glumcima
Strani jezici	Edukativni softveri koji podržavaju programske sadržaje	Edukativni softveri koji podržavaju programske sadržaje
Matematika	-	-
Tjelesni i zdravstveni odgoj	-	-
Muzička/ Glazbena kultura	Programi za savladavanje osnova muzičke teorije i solfeđa za demonstriranje zvučnosti različitih muzičkih instrumenata, ljudskih glasova i stilskih pravaca u muzici	17. Programi za savladavanje osnova muzičke teorije i solfeđa za demonstriranje zvučnosti različitih muzičkih instrumenata, ljudskih glasova i stilskih pravaca u muzici
Likovna kultura	-	-
Priroda i društvo	-	-

Analiza propisivanja obrazovnih, tj. edukativnih softvera u predmetnoj nastavi

PREDMET	Obrazovni softveri u pedagoškim standardima iz 2005.	18. Obrazovni softveri u pedagoškim standardima iz 2018.
Bosanski, Hrvatski, Srpski jezik i književnost	Edukativni softveri – izbor tekstova prema novom NPP i dramatizacija s poznatim glumcima	Edukativni softveri – izbor tekstova prema novom NPP i dramatizacija s poznatim glumcima
Strani jezici	Edukativni softveri koji podržavaju programske sadržaje	Edukativni softveri koji podržavaju programske sadržaje
Matematika	Obrazovni softveri iz matematike koji podržavaju programske sadržaje Komplet računarskih programa koji podržavaju programske sadržaje	19. Obrazovni softveri iz matematike koji podržavaju programske sadržaje 20. Komplet računarskih programa koji podržavaju programske sadržaje
Informatika - specijalizirani kabinet	Softver Pored sistemskog softvera DOS i WINDOWS instalirati programski jezik BASIC za osnovnu školu.	21. Softver Pored sistemskog softvera WINDOWS instalirati programski jezik BASIC za osnovnu školu,
Tehnički odgoj - specijalizirana	-	22. -
Fizika specijalizirana učionica	Edukacioni softveri – fizika	Edukacioni softveri – fizika
Hemi	Edukacioni softveri – hemija	Edukacioni softveri – hemija

Biolo	Edukacioni softver za interaktivnu nastavu biologije koji podržavaju programske sadržaje	23. Edukacioni softver za interaktivnu nastavu biologije koji podržavaju programske sadržaje
Kultura življenja <i>specijalizirana učionica</i>	Edukativni softveri koji podržavaju programske sadržaje iz kulture življenja	Edukativni softveri koji podržavaju programske sadržaje iz kulture življenja
Historija / Povijest specijalizirana učionica	-	24. -
Geografija / Zemljopis specijalizirana učionica	-	25. -
Tjelesni i zdravstveni odgoj	-	26. -

Muzička Glazbena kultura specijalizirana učionica	Programi: za savladavanje osnova muzičke teorije i solfeđa i - za demonstriranje zvučnosti različitih muzičkih instrumenata, ljudskih glasova i stilskih pravaca u muzici	27. Programi: 28. - za savladavanje osnova muzičke teorije i solfeđa i 29. - za demonstriranje zvučnosti različitih muzičkih instrumenata, ljudskih glasova i stilskih pravaca u muzici
Likovna kultura specijalizirana učionica	-	30. Edukacioni softveri koji za interaktivnu nastavu likovne kulture koji podržavaju programske sadržaje
Vjeronauka / Vjeronauk specijalizirana učionica	<i>Edukacioni softveri koji podržavaju programske sadržaje</i>	-
Alternativni predmeti	-	-
Obrazovanje za demokratiju i građanske slobode specijalizirana učionica-2005./ Građansko obrazovanje 2018.	Edukacioni softveri koji podržavaju programske sadržaje	Edukacioni softveri koji podržavaju programske sadržaje

Kao što je vidljivo iz tabele u slučaju nekih predmeta odgovorne osobe koje su pripremile „pedagoške standarde“ uopće ne vide, niti znaju za postojanje „edukativnih – obrazovnih softvera“, čak ni u slučajevima kada je za predmet predviđena „specijalizovana učionica“. U svim ostalim slučajevima na djelu je puko prepisivanje teksta i prenošenje iz Pedagoških standarda iz 2005. u Pedagoške standarde iz 2018. godine. U periodu munjevitog razvoja softvera i otvaranja mnoštva studijskih programa na univerzitetima usmjerenih na razvoj softvera Pedagoški standardi su u periodu od dvije decenije bili „dovoljno osjetljivi“ za svega tri izmjene: i to

1. u predmetu Informatika izbačen DOS
2. u predmetu Likovna kultura su doslovno prepisana rješenja iz drugih predmeta
3. u predmetu Vjeronauka umjesto ranije odredbe „Edukacioni softveri koji podržavaju programske sadržaje“ uključena nova formulacija „Medijski sadržaji sa snimljenim tekstovima koji prate udžbenik“.

Slijepi za munjeviti softverski razvoj i pojavu online nastave, te vještačke inteligencije, sa druge strane, koliko su na Pedagoški standardi „savremeni“ govori i činjenica da se više puta navodi i propisuje oprema koja se može naći još jedino u gradskim muzejima ili prašnjavim školskim ostavama, poput gramofona, epidijaskopa, itd.

Pa ipak, Pedagoški standardi imaju i svoju bolju dimenziju. Naime, jednostavnim uvidom u Pedagoške standarde u KS uočava se da su za skoro sve predmete predviđeni edukativni, odnosno obrazovni softveri. **Obrazovni softveri** (pod različitim nazivima *edukacioni softveri, programi*) u Pedagoškim standardima iz 2005. Kao i iz 2018. se **spominju 22 puta**, od toga 4 puta u razrednoj nastavi i 14 puta u predmetnoj nastavi, što je ipak određeni pomak i omogućuje saznanje da ta specifična nastavna sredstva postoje.

Zakonsko i stručno uporište za aktivnije uvođenje ovog inovativnog nastavnog materijala koji je u isto vrijeme i nastavno sredstvo i nastavno pomagalo datira još od 2005 godine, kada su i doneseni Pedagoški standardi i doslovno je prepisano u „novim“ i još uvijek važećim Pedagoškim standardima iz 2018. godine.

Međutim, na osnovu provjere po knjižarama može se zaključiti da su obrazovni softveri samo još jedno mrtvo slovo na papiru, a da su od svakodnevne nastavne prakse i života učenika skoro potpuno udaljeni.

Na žalost u toku nastanka ovog rada nismo imali priliku doći do tih softvera i uvjeriti se da li se radi o jednom softveru koji se obrađuje kroz sve navedene godine, ili se pak radi o više vrsta softvera od kojih je svaka posebna za određeni razred. Ono što je poznato, jeste da tehničke mogućnosti omogućavaju i jednu i drugu opciju.

4. Analiza ponude digitalnih sadržaja i obrazovnih softvera u odobrenim udžbenicima u FBiH

Budući da je Kanton Sarajevu u okviru Države Bosne i Hercegovine pozicioniran u entitetu Federacija Bosne i Hercegovine (FBiH), da bi se utvrdilo stvarno značenje „obrazovnih softvera“ i mogućnosti njihove nabavke putem obrazovnog sistema, analiziran je spisak odobrenih udžbenika u FBiH za osmogodišnje i devetogodišnje obrazovanje. U spiskovima je utvrđeno sljedeće stanje u pogledu zastupljenosti ponude digitalnih sadržaja i obrazovnih softvera uz uobičajene printane knjige.

Analiza je pokazala da se u okviru devetogodišnjeg obrazovanja, u odobrenim udžbenicima prateći CD sadržaji i obrazovni softveri nalaze samo u okviru nekih predmeta (Bosanski jezik i književnost, Matematika, Muzička i likovna kultura, Engleski jezik i to neujednačene frekvencije, kako po predmetima, tako i po razredima, pri čemu polovina ukupnog broja registriranih CD-ova i obrazovnih softvera otpada na muzičku kulturu i to samo u prva četiri razreda osnovne škole. Ovi podaci su više nego zabrinjavajući, s

obzirom na aktuelno vrijeme i kretanja u globaliziranom svijetu. Posebno zabrinjava činjenica da, i pored stanovitih napora da se dođe do ovih softvera u tome se nije uspjelo, jer najopremljenije knjižare u Sarajevu ne posjeduju te sadržaje, nisu ih nikada ni imale, i uopće ne postoje u registru njihovih proizvoda, što upućuje na činjenicu da je roditeljima jako teško doći do tih sadržaja.

Posebno žalosti činjenica što je stanje u tzv. „staroj“, tj. osmogodišnjoj školi, barem o spisku odobrenih udžbenika i njihove opremljenosti digitalnim sadržajima i obrazovnim softverima bilo bolje nego u novoj, naprednijoj i reformiranoj školi.

I dok u devetogodišnjem obrazovanju imamo nešto bogatiji spisak, kako po autorima, tako i po vrstama pratećih digitalnih sadržaja u osmogodišnjem obrazovanju imamo spisak od 34 digitalna sadržaja od samo jednog jedinog autora koji se ne mogu naći u najopremljenijim knjižarama u Sarajevu i koje ih nikada nisu imale u svojoj ponudi.

Očigledno je stvarno stanje u pogledu ponude digitalnih sadržaja, a pogotovo ponude obrazovnih softvera znatno teže nego što to govori spisak.

Ako se pažljivije posmatraju digitalni sadržaji i obrazovni softveri uočava se jako zanimljiva pojava, tj. da se broj od 4 propisanih sadržaja u školskoj 2022/2023. u suštini sastoji od, 2 udžbenika za muzičku kulturu sa CD-om i 1 udžbenik s CD-om za engleski jezik. U ranijem osmogodišnjem školovanju, od 34 navođenja CD i obrazovnog softvera imamo u suštini **ukupno 8 zasebnih naslova** koji se ponavljaju. Dakle od 440 odobrenih udžbenika za osmogodišnje obrazovanje 34 udžbenika ili 7,72% su edukativni softveri od jednog jedinog autora, Marijana Dovern!!!

Pravi odnosi se uočavaju tek kada se ovi podaci predstave tabelarno:

	Osmogodišnje obrazovanje Spisak odobrenih udžbenika iz 2005.			Devetogodišnje obrazovanje Spisak odobrenih udžbenika iz 2022.		
Razred	Broj odobrenih udžbenika u FBiH	br.udžbenika sa digitalnim sadržajima (CD i softver)	%	Broj odobrenih udžbenika u FBiH	br.udžbenika sa digitalnim sadržajima (CD i softver)	%
I	40	2	5	31	-	0
II	29	2	6,89	22	-	0
III	40	3	7,5	27	-	0
IV	36	2	5,55	50	3	6
V	72	6	8,33	49	1	2,04
VI	64	6	9,37	38	-	0
VII	82	7	8,54	64	-	0
VIII	77	6	7,79	58	-	0
IX	-	-	-	19	-	0

UKUPNO	440	34	7,72	358	4	1,11
Ukupan broj odobrenih udžbenika je 798, od toga 38 je opremljeno digitalnim sadržajima (CD,DVD ili obrazovni softver) što u procentima iznosi 8,83%. Međutim, u 2022/2023. godinu svega 1,11 % odobrenih udžbenika sadrži odobreni digitalni sadržaj. U doba koje se svugdje u svijetu sve više naziva Informacijsko doba i za rad sa generacijama koje se sve više nazivaju digitalne – internet – net – generacije, ovaj podatak je više nego poražavajući za glavni grad BiH.						

(Tabela br. 2 – Odnos ukupnog broja odobrenih udžbenika za osmogodišnju i devetogodišnju školu, te br. udžbenika sa digitalnim sadržajima)

„Skriveni“ digitalni sadržaji

Prilikom posjete školama i intervju sa direktorima i pedagozima u potrazi za „obrazovnim softverima“ u svakodnevnom školskom životu, evidentirano je **postojanje skrivene konkurencije** u ovom pogledu. Naime, primijećeno je, i u školama je to općepoznato, da **pojedini izdavači prodaju svojih odobrenih udžbenika pospješuju na taj način što uz njih nude i razne druge sadržaje koji se ne nalaze na spisku**. Tako je dosta čest slučaj da se uz odobreni udžbenik nude CD/DVD-ovi sa raznovrsnim sadržajima poput razrađenih operativnih godišnjih i mjesečnih planova, gotovih priprema, gotovih prezentacija, itd. S obzirom na činjenicu da na samo 1 CD, a pogotovo DVD-u može stati daleko više sadržaja nego što se nudi u bilo kojem udžbeniku, a da ti sadržaji nisu prošli recenziju i dobili opću verifikaciju upotrebne vrijednosti od strane nadležnog ministarstva mora se konstatovati da se ovo pitanje mora čim prije urediti.

5. Zaključak

Obrazovni sistem je neodrživ bez stalnog inoviranja i praćenja savremenih trendova i dostignuća. Jedino na taj način se djeca i omladina mogu pripremati za život u svijetu koji ih okružuje. Vodeće inovacije današnjice se dešavaju u domenu informacijskih tehnologija i softverskog dizajna i inženjeringa. Generalno inoviranje nastave se dešava na dva najčešća način: pojedinačnim inicijativama nastavnika koji se trude da nastavu realiziraju poštujući princip savremenosti nastave, te normativno kada nadležne obrazovne vlasti propisuju standarde koji se moraju ispoštovati.

U ovom radu su prikazani rezultati normativnog inoviranja kroz komparaciju Pedagoških standarda i općih normativa za osnovni odgoj i obrazovanje u Kantonu Sarajevo iz 2005. godine i 2018. godine.

Komparativnom analizom je utvrđeno da je prisutno puko prepisivanje u domenu propisivanja upotrebe informacijskih tehnologija i obrazovnih – edukativnih softvera te da propisana norma ne korespondira sa stvarnom ponudom izdavačkih kuća i knjižara, poglavito u dijelu obrazovnih softvera.

Pedagoški standardi u dobar način kako da se sistemski uvedu inovacije u nastavni proces i garancija da će istima biti obuhvaćena kompletna populacija.

Na žalost, utvrđena je pojava pukog prepisivanja nastavnih sredstava i pomagala iz domena informacijskih tehnologija i obrazovnih softvera u pedagoškim standardima koje ne korespondira sa stvarnom ponudom nastavnih sredstava kod knjižara i izdavačkih kuća. Rezultati istraživanja su pokazali pojavu ponavljanja jednog naslova sa softverskim rješenjem više puta, što ukazuje da je na sceni potpuna nepoznanica u normativnom propisivanju ovog važnog pitanja.

Utvrđeno je da, umjesto da svijest o edukativnim softverima narasta, u odnosu na 2005. ona u stvari opada u Pedagoškim standardima iz 2018. godine. Također je utvrđena pojava da je samo jedan autor, Marijan Dover, u stvari najveći „krivac“ za većinu „edukativnih softvera“ i CD-ova sa digitalnim sadržajima u propisanim udžbenicima, što je samo po sebi indikativno. Njegovi materijali su propisani i u 2022/2023. Godini, samo što su sada „izmješteni“ u srednju školu.

U pogledu digitalnih nastavnih sadržaja, koji mogu uključivati i obrazovne softvere, utvrđena je pojava „skrivenog kurikulum“, naime, utvrđeno je da brojne izdavačke kuće uz svoje udžbenike često nude i dodatne „poklone“ u vidu CD-ova i „DVD-ova“ koji su pratioci udžbenika, ali koji nisu vidljivi na zvaničnom spisku odobrenih udžbenika.

Ukratko, očigledno je u pitanju svojevrsna „digitalna džungla“ u koju smo uvedeni i u kojoj se naziru samo osnovni putevi za izlaz, ali i da su dosta prisutna „lutanja“ u pogledu digitalnih materijala koji kolaju školama i normativnim aktima.

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**ANALYSIS OF THE REPRESENTATION OF INFORMATION
TECHNOLOGIES AND EDUCATIONAL SOFTWARE IN THE
PEDAGOGICAL STANDARDS OF THE CANTON OF SARAJEVO IN BOSNIA
AND HERZEGOVINA**

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ABSTRACT:

The education system is unsustainable without constant innovation and monitoring of contemporary trends and achievements. Only in this way can children and youth prepare for life in the world around them, instead of learning about the world as it once was. Today's leading innovations are happening in the field of information technology and software design and engineering. General innovation of teaching occurs in two most common ways: individual initiatives of teachers who try to implement teaching respecting the principle of modernity of teaching, and normative when competent educational authorities prescribe standards that must be respected.

This paper presents the results of normative innovation through a comparison of Pedagogical Standards and general norms for basic education in Sarajevo Canton from 2005 and 2018.

Through comparative analysis, it was determined that genuine mere copying is in the domain of prescribing the use of information technologies and educational software, and that the prescribed norm does not correspond to the actual offer of publishing houses and bookstores, especially in the area of educational software.

Pedagogical standards in a good way to systematically introduce innovations into the teaching process and guarantee that the entire population will be covered by them. Unfortunately, the phenomenon of mere copying of teaching aids and aids from the domain of information technologies and educational software in pedagogical standards has been established, which does not correspond to the actual offer of teaching aids at bookstores and publishing houses.

Keywords: *educational system, teaching, pedagogical standards, educational technology, educational (educational) software*

WEB PLATFORMA ZA EDUKACIJU ZASNOVANA NA PRINCIPIMA GEJMIFIKACIJE

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SAŽETAK:

Današnji studenti su odrasli uz digitalne tehnologije i imaju drugačiji odnos prema procesu učenja i drugačije motive za sticanje novih znanja. Izazov je zadržati pažnju i posvećenost studenata postizanju definisanih ciljeva i ishoda predmeta. Da bi obezbjedilo da studenti budu aktivni učesnici sa snažnom motivacijom i angažovanjem, neophodno je primeniti savremene nastavne metode i pristupe. Savremene pedagoške paradigme i trendovi u obrazovanju, ojačani upotrebom IKT, stvaraju preduslove za korišćenje novih pristupa i tehnika u cilju sprovođenja aktivnog učenja. Gejmifikacija kao sastavni deo obrazovanog procesa je jedan od ovih trendova. Gejmifikacija podrazumeva dodavanje zabavnih elemenata igara (ispunjenje konačnog cilja kroz redovne zadatke, skupljanju poena, prelazak na više nivoa, takmičenje sa drugim igračima), ili njihove mehanike i principa u druge aktivnosti sa svrhom podsticanja učešća.

U ovom radu su predstavljeni elementi gejmifikacije koji se mogu primeniti u obrazovanju. Takođe, prezentovani su praktični primeri online platforme za edukaciju koja je razvijena i primenjuje se na Akademiji tehničko-vaspitačkih strukovnih studija u Nišu na predmetu Web programiranje, a zasnovana je na principima gejmifikacije. Osnova web platforme je realizovana u Python programskom jeziku na serverskoj i klijentskoj strani. Jedan deo korisničke strane je realizovan u Unity Game Engine-u korišćenjem C# programskog jezika, koji se koristi za razvoj igara. Web platforma omogućava unos pitanja za testove, podelu pitanja na težine i nivoa, kreiranje testova različite težine i igranje multiplayer kviza u cilju podsticanja takmičarskog duha između studenata.

Ključne reči: gejmifikacija u obrazovanju, elementi igara u edukaciji, online edukativna platforma, learning management system (LMS)

1. UVOD

Poslednjih godina industrija razvoja igara predstavlja najbrže rastuću industriju. To predstavlja veliku poslovnu priliku za razvojne timove jer sve veći broj ljudi provodi mnogo vremena u igranju igara. Sa druge strane osnovni principi su postavljeni još u starom Rimu i primenjivani su u koloseumima, a impresioniraju mnoštvo ljudi kroz vekove. To asocira mnoge ljude da primene te principe u različitim oblastima i podignu motivisanost ljudi za učešće. Postoji mnogo razloga zašto ljudi provode dosta vremena u igranju igara. Igranje igara može biti sjajan način za opuštanje i zabavu, posebno nakon

napornog dana ili radne nedelje. Igranje igara može pružiti izazov i takmičenje, što može biti motivišuće za mnoge ljude ali i sjajan način za povezivanje i druženje s prijateljima, porodicom ili drugim ljudima koji dele iste interese. Igranje određenih igara može pomoći u učenju novih vještina ili poboljšanju postojećih, kao što su matematika, jezik, logika, *problem-solving* itd. Ukratko, ključni razlozi za igranje igara uključuju zabavu, izazov, društvo, učenje i razvoj, opuštanje i smanjenje stresa.

Danas se osnovni koncepti igara sve više koriste u drugim oblastima. Osnovni princip svake igre je da igrači slede određena pravila i takmiče se jedni protiv drugih kako bi postigli cilj igre. Bez obzira da li je cilj osvojiti nagradu, izvršiti zadatak, pobediti drugog takmičara ili biti prvoplasiran na rang listi, rad na postizanju cilja uključuje motivaciju, angažovanje, emocije i određeni obrazac ponašanja. S obzirom na navedeno, nije iznenađujuće što se elementi igre danas implementiraju u mnogim drugim oblastima, kao što je marketing, biznis, e-trgovina, obrazovanje, društveni mediji itd. Ovaj proces je definisan kao gejmfikacija [1].

Gejmfikacija (engl. *gamification*) kao pojam se prvi put pominje 2008. godine i od tada su mnogi radovi napisani na ovu temu [2]. Kroz razvoj naprednih tehnologija i masovno usvajanje od strane korisnika, gejmfikacija je postala odličan alat za pridobijanje novih korisnika i zadržavanje postojećih. Međutim, učenje zasnovano na igri (engl. *game based learning*) je nešto stariji fenomen, koji datira iz 1970-ih godina [3]. Dok gejmfikacija koristi mehaniku igre za transformaciju iskustva učenja u igri, učenje zasnovano na igri integriše igre u proces učenja kako bi unapredili specifične vještine ili postiglo cilj učenja. Igre se koriste kao aktivnosti učenja da bi se učenicima dala prilika za sticanje novih znanja ili skupova vještina na zabavan i privlačan način.

2. KLJUČNI ELEMENTI IGARA

Opisivanje ključnih elemenata igara može pomoći u razumevanju kako se igre dizajniraju i kako funkcionišu. Neki od osnovnih elemenata opisani su u nastavku.

- Cilj predstavlja glavni zadatak ili svrhu igre koju igrači treba da ostvare. Cilj može biti različit za različite igre, a može biti definisan kao pobjeda u igri, dostizanje određenog nivoa ili sakupljanje određenih resursa.
- Pravila igre su definisana pravila ponašanja i aktivnosti koja igrači moraju poštovati. Pravila mogu biti različita za različite igre, a njihovo poštovanje može biti ključno za postizanje cilja igre.
- Igranje uloga je igračeva sposobnost da preuzme određenu ulogu u igri. Igrači mogu preuzeti ulogu različitih likova u igri, što može uticati na njihovu strategiju igranja, sposobnosti i način na koji pristupaju igri.
- Izazov se odnosi na nivo težine igre i na težinu zadataka koje igrači moraju rešiti. Visok nivo izazova može biti motivacija za igrače da se bolje angažuju i trude da postignu cilj igre.

- Nagrade su element igre koji igračima daje motivaciju za igranje. Nagrade mogu biti u obliku poena, medalja, novčića, bedževa ili drugih virtualnih nagrada koje igrači mogu osvojiti za postizanje cilja igre.
- Interakcija se odnosi na način na koji igrači komuniciraju sa igrom. To može uključivati korišćenje kontrola igre, komunikaciju sa drugim igračima, ili korišćenje funkcija kao što su chat ili forumi.
- Strategija je način na koji igrači pristupaju igri i kako koriste svoje veštine i resurse da postignu cilj igre. Strategija može biti ključna za uspeh u igri i može biti različita za različite igre.

Ukratko, ovi elementi igara su ključni za razumevanje kako igre funkcionišu i kako se dizajniraju. Kombinacija ovih elemenata može stvoriti različite vrste igara i iskustava za igrače.

3. GEJMIFIKACIJA I UČENJE

Gejmifikacija i učenje su dva koncepta koja se mogu povezati na interesantan i efektivan način. Gejmifikacija se odnosi na primenu elemenata igara u situacijama koje nisu igračke kako bi se povećala motivacija, angažovanost i uključenost korisnika. U kontekstu učenja, gejmfikacija se koristi kako bi se učenje učinilo zabavnijim, lakšim i efikasnijim.

Postoje mnogi načini na koje se gejmfikacija može primeniti u obrazovanju. Neki od primera su:

- Bodovanje i rangiranje: Sistem bodovanja i rangiranja se može primeniti kako bi se podstaklo takmičenje među studentima. Studenti mogu zaraditi bodove za rešavanje zadataka ili odgovaranje na pitanja i takmičiti se sa drugim učenicima za više pozicije na rang listi.
- Nagrade i dostignuća: Nagrade i dostignuća se mogu koristiti kao podsticaj za učenje, prelazak kroz lekcije kao kroz nivoe igrice i postizanje ciljeva. Na primer, učenici mogu zaraditi medalje ili bedževe za dostizanje određenih ciljeva, kao što je završavanje određenog broja zadataka ili osvajanje određenog broja bodova.
- Izbegavanje dosade: gejmfikacija može pomoći u izbegavanju dosade i monotone prirode učenja. Na primer, dodavanjem elemenata igara kao što su mini-igre ili animirani elementi u interaktivne lekcije može značajno poboljšati uključenost učenika.
- Društveni elementi: Društveni elementi se mogu koristiti za podsticanje saradnje među učenicima. Na primer, učenici mogu raditi zajedno kako bi osvojili nagrade ili postigli zajednički cilj, što može pomoći u razvoju timskog rada i saradnje.

Ukratko, gejmfikacija se može koristiti kako bi se učenje učinilo zabavnijim, lakšim i efikasnijim. Postoje mnogi načini na koje se gejmfikacija može primeniti u obrazovanju, a ključno je obezbediti uravnotežen pristup koji podstiče učenje i angažman ali i zadržava fokus na suštini učenja.

Softveri koji se nazivaju virtuelna okruženja za učenje (engl. *Virtual Learning Environments*) i sistemi za upravljanje procesom učenja (engl. *Learning Managment Systems*) se obično koriste za implementaciju gejmfikacije u obrazovanju. Ovakvi softveri pružaju sve funkcionalnosti potrebne da podrže aktivnosti gejmfikacije u učenju. U većini igara postoje tri osnovna dela: aktivnosti fokusirane na cilj, mehanizmi nagrađivanja i praćenje napretka [4]. Jedna od najpoznatijih online edukativnih platformi koja koristi ključne elemente gejmfikacije je Duolingo [5]. Duolingo je besplatna platforma za učenje stranih jezika koja koristi različite elemente igara kako bi motivisala korisnike da uče i ohrabruje ih da kontinuirano unapređuju svoje znanje. Neke od ključnih karakteristika Duolinga koje se mogu smatrati elementima gejmfikacije uključuju:

- Bodovi i nagrade (engl. Points and rewards): Korisnici dobijaju bodove i virtualne nagrade za uspešno rešavanje lekcija i obavljanje zadataka.
- Praćenje napretka (engl. Progress bar): Duolingo prati napredak učenika i pokazuje im njihov procenat, što može da ih motiviše i podstakne da nastave da uče.
- Rang lista (engl. Leaderboard): Duolingo ima rang liste koje omogućavaju učenicima da se takmiče sa drugima i vide kako se rangiraju, što može stvoriti osećaj konkurencije i motivisati učenike da daju sve od sebe.
- Niz (engl. Streak): Duolingo podstiče učenike da vežbaju svaki dan koristeći nizove, koji prate broj uzastopnih dana koje je učenik vežbao. Ovo utiče na to da učenik kontinuirano i svakodnevno radi na sticanju novih znanja.
- Izazovi (engl. Challenges): Korisnici mogu učestovati u takmičenjima s drugim korisnicima kako bi testirali svoje znanje i veštine.
- Prilagodljivo učenje (engl. Adaptive learning): Duolingo koristi adaptivni algoritam učenja koji se prilagođava snagama i slabostima svakog učenika, pružajući personalizovane povratne informacije i preporuke koje pomažu učenicima da se poboljšaju.

4. REZULTATI KORIŠĆENJA ELEMENATA GEJMIFIKACIJE U UČENJU

Današnji studenti su odrasli uz digitalne tehnologije i imaju drugačiji stil učenja, novi odnos prema procesu učenja i drugačije motive za sticanje novih znanja. Kako bi zadržali pažnju i posvećenost studenata postizanju definisanih ciljeva i ishoda predmeta, mnogi univerziteti i akademske institucije traže nove pristupe u edukaciji. Da bi se obezbedilo da studenti budu aktivni učesnici uz povećanu motivaciju i angažovanje, često se uključuju

elementi gejmfikacije kao sastavni deo obrazovanog procesa. To se čini dodavanjem zabavnih elemenata igara (ispunjenje konačnog cilja kroz redovne zadatke, skupljanje poena, prelazak na više nivoe, takmičenje sa drugim igračima), ili njihove mehanike i principa u edukativni proces sa svrhom podsticanja učešća. Najčešći primeri su dodavanje elemenata igara u online platforme za učenje. Odličan pregled primene sa ostvarenim rezultatima dali su autori rada u [6].

Istraživanje koje je uradio Sillatos [7], [8] predstavlja analizu primene gejmfikacije u visokom obrazovanju. Autori su koristili elemente igre u onlajn kursu uz odgovarajuće preimenovanje standardnih pedagoških naziva. Na primer, učenici su se zvali igrači, nastavnik je bio majstor igre, zadaci su bili misije, ispit je bio „borba sa velikim šefom“, ocene su bile nivoi itd.

U drugom istraživanju, koje je opisao Peer Vise u [9] istraživači su ugradili elemente nagrađivanja u svoj onlajn kurs. Softver je omogućavao studentima da kreiraju, dele i moderiraju bazu pitanja i odgovora. Učenici su mogli da kreiraju svoja pitanja o bilo kojoj temi, nude odgovore, učestvuju u onlajn diskusijama i ocenjuju druge učenike i njihove teme. Autori su koristili bedževe – korisnici su mogli da osvoje različite bedževe/nagrade na osnovu specifičnih radnji koje su podeljene u grupe.

U istraživanju [10] istraživači su gejmfikovali svoj kurs „Kvalifikacija za korisnike IKT“, u kojem su učenici različitih nivoa znanja naučili kako da koriste uobičajene IKT alate. Istraživači su kroz svoj rad koristili nivoe – lekcije su organizovane u hijerarhiji nalik stablu, zahtevano je stalno učešće i pružanje povratne informacije a takođe je kreiran virtuelni sistem nagrađivanja koji se aktivira kada je zadatak završen. Napravljena je rang lista uspeha, tako da su učenici mogli da se takmiče kako bi postigli viši rang.

Istraživanje Elektronskog fakulteta [11] je još jedan primer gde su istraživači uključili nekoliko elemenata igre u svoj onlajn kurs. Na primer, dodali su identitet ličnog profila za svakog učesnika (engl. *avatar*). Za praćenje ukupnog napretka kreirali su rang listu, gde su učenici rangirani na osnovu bodova koje su zaradili tokom časa. Takođe, implementirali su traku napretka (engl. *progress bar*) i trenutne povratne informacije, tako da su učenici mogli kontinuirano da prate svoj napredak.

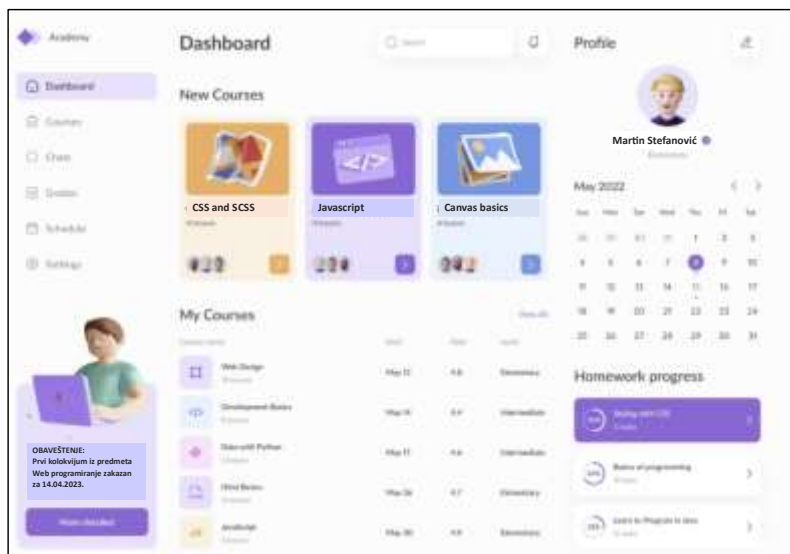
Slično drugim istraživanjima, JFDI akademija [12] je uključila osnovnu mehaniku igara što je omogućilo studentima da napreduju i takmiče se na rang listi sa drugim studentima. Slično kao u [7], koristili su i rečnik igara: zadaci su se zvali „misije“, dodatna pitanja su bila označena kao „sporedne misije“, a za učešće i pohađanje nastave, kao i neku drugu terminologiju, koristili su fraze iz univerzuma „Ratova zvezda“. Kurs je ispričan iz perspektive trećeg lica, a stripovi su započinjali svaku misiju. Kroz sistem automatskog ocenjivanja, instruktori su takođe mogli da dobiju povratne informacije o napretku učenika tako što su videli koliko puta je učenik pokušao da postavi pitanje, šta je pogrešio i prosečno vreme po zadatku utrošio.

Da bi mogli da identifikuju kako je gejmfikacija uticala na motivaciju i angažovanje studenata, svi navedeni autori, bez izuzetka, izabrali su za metodologiju merenja anketu studenata. Rezultati svih istraživanja dodavanja gejmfikacije u proces učenja su uglavnom pozitivni u smislu povećane motivacije i angažovanja u zadacima kao i uživanja u njima. Najuspešnije su implementirani bedževi, rang liste i povratne informacije koje su imale pozitivan uticaj u svim ispitivanim studijama. Kada se govori o negativnom ili lošem uticaju na motivaciju učenika autori ističu avatare i merenje vremena. Upotreba avatara nije izazvala veću posvećenost [12] gde su se studenti složili da to nije promenilo njihovo ponašanje. Vremensko praćenje je stvorilo negativan efekat najviše zbog toga što su učenici osećali pritisak, posebno u slučajevima kada razlog neuspeha nije bio nedostatak znanja nego vremena.

5. PRIMER PRAKTIČNE REALIZACIJE WEB PLATFORME ZA UČENJE SA ELEMENTIMA GEJMIKACIJE

Jedan praktičan primer online platforme za edukaciju je razvijen i primenjuje se na Akademiji tehničko-vaspitačkih strukovnih studija u Nišu na predmetu Web programiranje, a zasnovana je na principima gejmfikacije. Osnova web platforme u tehničkom pogledu je web servis realizovan u Python programskom jeziku na serverskoj strani. Podaci su smešteni u *MariaDB* relacionoj bazi podataka. Jedan deo korisničke strane je realizovan u Unity Game Engine-u korišćenjem C# programskog jezika, koji se koristi za razvoj igara. Na razvoju platforme su radili studenti u okviru VTŠ Apps Tima, što daje dodatnu vrednost jer su kroz to sticali praktična znanja i veštine i povećali zainteresovanost studenata za korišćenje jer su platformu stvarali oni ili njihovi vršnjaci.

Izgled platforme iz studentskog ugla je prikazan na Slici 1. Sa leve strane se nalazi meni za odabir sekcija. U okviru sekcije *Courses* se mogu grupisati lekcije, video materijali, pdf fajlovi koji pomažu studentima u pripremi gradiva. U okviru sekcije *Chats* studenti imaju priliku da postavljaju pitanja ili nedoumice u vezi sa zadatkom, što omogućava nastavnicima da im blagovremeno pomognu. Deo pod nazivom *Grades* nudi pregled ostvarenih poena, rang liste, kao i brojeve poena koje student treba da osvoji za svaku ocenu. Sekcija *Schedule* omogućava postavljanje rasporeda polaganja kolokvijuma i ispita. U donjem levom uglu se nalaze najvažnija obaveštenja. Pored navedenog, student može da prati napredovanje i uspeh u savladavanju domaćih zadataka i određenih oblasti (kurseva) u okviru predmeta.



Slika 1. Prikaz početne stranice platforme

Najzanimljiviji modul studentima je **Multitplayer modul** u kome mogu učestvovati u takmičenjima s drugim studentima kako bi testirali svoje znanje i veštine. Ovaj deo je razvijen na principima *multiplayer* igara u kojima više od jednog igrača može da bude u istom okruženju (sobi) u istom vremenu i takmiči se u realnom vremenu protiv drugih takmičara. Ciljevi *multiplayer* igara mogu biti različiti, od sarađivanja sa drugim igračima kako bi se zajedno postigao cilj ali i da se igrači takmiče međusobno kako bi osvojili bolju nagradu, više poena, brže prešli na viši nivo. Razvijeni multiplayer modul omogućava korisnicima sledeće funkcionalnosti:

- Registraciju, prijavu i obnavljanje lozinke kako bi čuvali svoje podatke o napredovanju,
- Dodavanje prijatelja kako bi takmičenje bilo zanimljivije,
- Uvid u rang listu radi upoređivanja rezultata igrača,
- Mogućnost kreiranja prijateljskih i takmičarskih mečeva kroz takmičarske sobe,
- Mogućnost da do 25 igrača može igrati istu igru.

Prijava korisnika je realizovana tako da omogućava korisnicima da sa različitih uređaja mogu pristupiti platformi bez bojazni da će izgubiti informaciju o napretku i postignutim rezultatima. U modulu su implementirane dve vrste soba/mečeva: prijateljski i regularni. Kako bi se počeo prijateljski meč potrebno je da barem 2 igrača budu u sobi, a sobi se pristupa preko njenog imena ili preko poziva prijatelja. Na kraju meča nema nagrada za učesnike kako bi se sprečila zloupotreba ostvarenih poena. Što se tiče regularnih mečeva, da bi se pokrenuli neophodno je 5 igrača i samo server može da pokrene igru kada se soba

napuni, na kraju igre svi preživeli igrači dobijaju odgovarajući broj bodova dok svi igrači koji su izgubili gube bodove ukoliko trenutno imaju više od 10 bodova.



Slika 2. Prikaz *multiplayer* modula za takmičenje

U toku takmičarskog meča svaki takmičar je predstavljen svojim avатарom koji stoji na kuli (Slika 2.). Svaki netačan odgovor utiče da kula tone u pesak, dok svaki tačan odgovor utiče da kula raste i budete dalje od dna. Na taj način se elementi gejmfikacije koriste da motivišu takmičara da što bolje spremi gradivo jer ga tačni odgovori „spašavaju propadanja u pesak“, a nepoznavanje tačnih odgovora do gubitka u igri.

Sobe se koriste i za organizaciju testiranja, kolokvijuma i ispita. Generisana pitanja za test se dodeljuju sobi a studenti se prijavljuju za ulazak u sobu, što se može tumačiti kao jedna grupa pitanja za testiranje. Na taj način studenti koji u toku ispita sede jedni do drugih u računarskoj laboratoriji se uvode u različite sobe (grupe) i dobijaju različita pitanja kako bi se sprečila zloupotreba.

Web platforma iz profesorskog ugla omogućava unos pitanja za testove (igre), podelu pitanja na težine i nivoe, kreiranje testova različite težine odabirom broja pitanja iz svake kategorije koja će činiti test, kao i uvid u rezultate postignute u svakom trenutku.

Nakon prve godine korišćenja sproveden je upitnik među studentima kako bi se ocenio uticaj novog načina sticanja i provere znanja na motivaciju ali i postignute rezultate. Svi rezultati ukazuju na pozitivne promene u smislu povećane motivacije i angažovanja u zadacima kao i uživanja u njima. Najbolje su ocenjeni implementirani bedževi, rang liste i *multiplayer* modul.

6. ZAKLJUČAK

Mnogi autori su pokazali da uključivanje gejmfikacije u proces obrazovanja kroz online platforme ima pozitivne efekte na učenje i motivaciju učenika. Davanjem nagrada, bodova, rangiranja ili drugih elemenata gejmfikacije omogućava se učenicima da se takmiče i napreduju kroz obrazovni sadržaj. Učenici postaju aktivniji i zainteresovaniji za učenje kada se materijal predstavi na način koji je interaktivniji i zabavniji. Kroz izazove, mini-igre ili druge aktivnosti koje zahtevaju primenu znanja koje su učenici stekli kroz nastavni materijal, dolazi se do boljeg razumevanja i usvajanja nastavnog materijala. Autori ovog rada su zajedno sa studentima na smeru za Savremene računarske tehnologije kreirali sopstvenu online platformu sa multiplayer modulom za takmičenje koji je nakon prve godine korišćenja dokazao pozitivne efekte uključivanja gejmfikacije u obrazovni proces.

Međutim, važno je napomenuti da gejmfikacija nije univerzalno rešenje za unapređenje nastavnog procesa i poboljšanje rezultata učenja. Potrebno je pažljivo planiranje i implementacija gejmfikacije kako bi se postigao optimalni efekat. Takođe, gejmfikacija ne sme da bude jedini način predstavljanja nastavnog materijala, već treba da bude dodatak tradicionalnom nastavnom procesu. U nastavku rada autori rada planiraju proširenje broja funkcionalnosti i načina kombinovanja sa drugim vidovima nastave kao i testiranje efekata sa većim brojem studenata i na drugim studijskim programima, a ne samo u oblasti informaciono-komunikacionih tehnologija.

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WEB PLATFORM FOR EDUCATION BASED ON GAMIFICATION PRINCIPLES

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ABSTRACT:

Today's students have grown up with digital technologies and have a different learning style, a new attitude toward the learning process, and different motivations for acquiring new knowledge. The challenge is to keep students' attention and commitment to achieving the defined goals and outcomes of the course. In order to ensure that students are active participants with strong motivation and engagement, it is necessary to apply modern teaching methods and approaches. Contemporary pedagogical paradigms and trends in education, strengthened by the use of ICT, create prerequisites for the use of new approaches and techniques in order to implement active learning. Gamification as an integral part of the educational process is one of these trends. Gamification means adding the fun elements of games (achieving the final goal through regular tasks, collecting points, moving to higher levels, and competing with other players) or their mechanics and principles in other activities with the purpose of encouraging participation.

This paper presents elements of gamification that can be applied in education. Also, practical examples of the platform for education that was developed and applied at the Academy of Technical-Educational Vocational Studies in Niš on the course of web programming, and based on the principles of gamification, were presented. The basis of the web platform is implemented in the Python programming language on the server and client side. One part of the user side is implemented in the Unity Game Engine using the C# programming language, which is used for game development. The web platform allows inserting questions for tests, dividing questions into difficulties and levels, creating tests of different complexity, and playing multiplayer quizzes in order to encourage a competitive spirit between students.

Keywords: gamification in education, game elements in education, online platform for education, learning management system (LMS)

OSTVARIVANJE AFEKTIVNOG I KOGNITIVNOG SOCIJALNOG PRISUSTVA U ONLINE NASTAVI KROZ PRIZMU STUDENATA ISLAMSKIH FAKULTETA U BOSNI I HERCEGOVINI

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SAŽETAK:

Predmet istraživanja: Dosadašnje studije su pokazale da efektivnost online nastave ovisi o ostvarenosti afektivnog i kognitivnog prisustva. Fokus rada je na studentskoj percepciji afektivnog i kognitivnog socijalnog prisustva kroz svrsishovitu interakciju u online nastavi.

Metodologija: Studija je provedena među studentima islamskih fakulteta u Bosni i Hercegovini: Univerziteta u Sarajevu, Univerziteta u Zenici i Univerziteta u Bihaću. Za empirijski dio rada podaci su prikupljeni anketnim upitnikom na uzorku od n=100 ispitanika. Upitnik se sastoji iz tri dijela: pitanja o demografskim podacima ispitanika, pitanja o ostvarivanju afektivnog prisustva i pitanja o ostvarivanju kognitivnog socijalnog prisustva prema adaptiranim upitnicima Kathy N. Shen i Mohamed Khalifa (2008) i D. Randy Garrison (2017). Podaci su obrađeni u SPSS-u (engl. Statistical Package for the Social Science).

Glavni nalazi studije: Utvrđena je disperzija odgovora po ponuđenim pitanjima pri čemu ne postoji značajna razlika u odgovorima muških i ženskih ispitanika.

Zaključak: Rezultati rada potvrđuju mogućnost ostvarenja afektivnog i kognitivnog socijalnog prisustva u online nastavi, uz uvažavanje činjenice da je nastava složeni konstrukt u kome djeluje istovremeno mnoštvo faktora.

Ključne riječi: online nastava, socijalno prisustvo, kognitivno prisustvo, interakcija.

1. UVOD

Koncept nastave na daljinu kao učenja posredovanog informacijsko-komunikacijskim tehnologijama koje obezbjeđuju komunikaciju profesora i studenta koji se nalaze na različitim geografskim položajima datira iz 19. vijeka, te nije nov koncept u obrazovanju. Razvojem weba 1.0 koncept nastave na daljinu razvija se u specifičan oblik poznat pod pojmom online nastave, iako za ovaj koncept prema Vandana Singh i Alexander Thurman

(2019) postoji 19 različitih termina u engleskom jeziku. Međutim, razvoj Weba 2.0 „čiji je fokus na dinamičkoj podjeli sadržaja“ (Harasim, 2017: 27) značajno je izmijenio obrazovnu ekologiju. Iako se često miješaju koncepti nastave na daljinu i online nastave između ova dva koncepta postoji „kritičan diferencijacijski faktor, a to je da je online nastava temeljno grupni fenomen“ (Harasim, 2000: 50). Online nastava kao grupni fenomen bazirana je na interakciji koja ima za cilj ostvariti afektivno i kognitivno socijalno prisustvo kao nužan element za uspješnost ishoda učenja. Njen zadatak je osigurati gradnju znanja i gradnju relacija.

Stoga, internet obrazovna ekologija postavlja pred nauku zadatak kako odgovoriti na ispunjenje kognitivnih, afektivnih i socijalnih učinaka nastave.

2. PREGLED DOSADAŠNJIH ISTRAŽIVANJA

Dosadašnja istraživanja pokazuju prednosti online nastave u odnosu na tradicionalnu nastavu u smislu olakšanog prevazilaženja geografskih udaljenosti, fleksibilnosti, komoditeta koji omogućava usklađivanje privatnih i poslovnih obaveza, studenti II i III ciklusa studija su skloniji samostalno učiti i određivati vlastiti tempo učenja, te im ovakav vid nastave osigurava i komoditet, ali i značajne ekonomske uštede (Janicki, T i Janicki, J. 2001; Arbaugh, J.B., 2000; Poluehktova i dr. 2020; Swan; 2003). Prema Syeda Raza Zareen i dr. (2023) većina ispitanika Univerziteta u Karachi-ju pozitivno je ocijenila sposobnost nastavnika da učine predavanja interaktivnim. Sinhorna online nastava se je pokazala pozitivan učinak na interakciju (Dietrich i dr. 2020, Zhang i dr. 2023, Toti i Alipour, 2021). Također, internet ima značajno mjesto u dostupnosti izvora informacija, različitim dizajnima informacija, te omogućava veću saradnju univerziteta među državama i olakšava interdisciplinarnu pristupe u edukaciji.

Međutim, istraživanja pokazuju da online nastava ima i značajne nedostatke kao što su osjećanje nepovezanosti sa drugima i osjećaj psihološke distance između profesora i studenata (Abirami i dr., 2022: 3279). Manjak socijalnih interakcija pokazao je negativan učinak na uspješnost ishoda učenja (Zawacki-Richter i dr., 2009: 8). Mnogobrojna istraživanja pokazuju da su socijalne interakcije i upotreba interaktivnog dizajna u online nastavi unaprjeđuju grupnu koheziju, te imaju pozitivne učinke na zadovoljstvo i motivaciju studenata, te su ključni faktor za unaprjeđenje rezultata učenja (Boling i dr., 2012; Janicki, T. i Janicki, J., 2001; Northrup i dr., 2002; Mehall, 2020; Richardson i Swan, 2003; Muilenburg i Berge, 2005; Poluehktova i dr., 2020). Također, istraživanja pokazuju povećano zadovoljstvo studenata kada je feedback personaliziran, te njegov utjecaj na postizanje boljih akademskih rezultata, za razliku od kolektivnog feedback-a (Gallien i Oomen-Early, 2008: 474). Praćenje paralingvističkih aspekata govora u online nastavi je otežano, te je nedostatak neposredne komunikacije također jedna od zamjerki u online nastavi (Wang i Woo, 2007, Mehall, 2020, Bullen, 1998; Borup i dr., 2012, Kruger, 2000). Manjak interakcije sa profesorima i drugim kolegama utjecao je na povećano nezadovoljstvo studenata (Cole, Shelley & Swartz, 2014). Veliki broj naučnika (Garrison, 1985; Berge, 1999; Mehall, 2020., Northrup, Lee i Burgess, 2002) ističu da kvantitet interakcija ne doprinosi većem zadovoljstvu studenata i boljim rezultatima, već

njihov kvalitet. Istraživanja pokazuju da nedostatak neverbalne komunikacije utječe na smanjenje interakcije student-profesor i otežava postignuća akademskog uspjeha (Coman i sar., 2020), te da upotreba kamera tokom online nastave doprinosi grupnoj koheziji i povećanoj motivaciji (Lin & Gao, 2020).

U Bosni i Hercegovini online nastava je malo i nedovoljno istraživana. Dosadašnja istraživanja u Bosni Hercegovini pokazuju da je smisljena interakcija ključni element za postizanje socijalnog prisustva, te da olakšava učenje i motivaciju studenata (Đolović i Injac, 2022; Kovačević i dr., 2021; Koso-Drljević i dr., 2021) što je saglasno sa istraživanjima u drugim zemljama. Istraživanja su ustanovila da studenti imaju interakciju i sa neljudskim entitetima kao što su platforme, elektronske biblioteke, edukacijski sajtovi i sl. (Okičić i dr., 2020; Koso-Drljević i dr., 2021; Tešanović i dr., 2019; Lemeš, 2021). Istraživanje Lejla Turčilo i Damir Šehanović (2021) autobiografskom metodom komunikacije između profesora i studenta doktorskog studija pokazuje da je online komunikacija u nastavi odnos između studenta i profesora učinila fleksibilnijim u pogledu vremena i uzajamnog razumijevanja, a geografska udaljenost je postala irelevantna. Također, iako je doprinio većoj fleksibilnosti između individua, bile su i veće vanjske distrakcije kroz nestabilnost konekcije ili nedostatak opreme. S druge strane, hijerarhija odnosa je ostala nepromijenjena, kao i ispunjavanje akademskih ciljeva. Rezultati studije Lucije Bačić i Krstinić Marije (2020) pokazuju da je dvije trećine ispitanika, studenata 2. godine Strojarskog odjela Tehničkog veleučilišta u Zagrebu, zadovoljno izvođenjem online nastave. Rezultati Ilić Mladena (2021) pokazuju da samo jednoj četvrtini ispitanika nedostaje neposredna interakcija, dok je interakcijom u online nastavi uglavnom zadovoljno tri četvrtine ispitanih studenata.

Iz svega navedenog evidentno je da je percepcija afektivnog i socijalnog prisustva u online nastavi ambivalentna.

3. DEFINIRANJE POJMOVA

U tradicionalnoj učionici je fizičko prisustvo studenata nužan uslov, ali nedovoljan za ostvarivanje učenja, tako i u online nastavi činjenica da je uređaj konektovan jeste nužan uslov, ali nedovoljan u smislu uključenosti studenta u sam proces učenja. Uključenost studenta se dešava različitim vrstama interakcije u nastavnom procesu. Garrison D. Randy (2017) ističe da interakciju u online nastavi ne možemo posmatrati samo kao puku razmjenu informacija između studenta i profesora, niti između studenata s obzirom na činjenicu da online učenje ima specifičan diferencijacijski faktor kao grupni fenomen zasnovan na konekciji i kolaboraciji „mi učimo da kolaboriramo i kolaboriramo da bismo učili“ (Garrison, 2017: 12). Interakcija je stoga svrsishodan proces čiji ishodi su “društveno vrijedno i lično značajni“ (Garrison, 2017: 15). Svako učenje podrazumijeva gradnju ličnih konstrukata po osnovu prošlih iskustava, ali i njihovu potvrdu ili provjeru u društvenoj zajednici kroz zajedničko razumijevanje. Tony Bates (2019) naglašava da se u nastavnom procesu ne ostvaruje samo konstrukcija znanja, već da je njegova neodvojiva komponenta i ostvarivanje relacija. Interakcija u online nastavi je način, put kojim se ostvaruju socijalno i kognitivno prisustvo u nastavi. Socijalno prisustvo ima cijeli niz

definicija (Shen i Khalifa, 2009: 51-52), dio naučnika se u definicijama socijalnog prisustva referira na „osjećaj“ (Gunawardena, Charlotte, 1995; Mardziah, Hayati Abdullah, 2004; Kozan, Kadir i Richardson, S. Jennifer, 2014; Swan, K. & Shih, L-F., 2005), dok se dio naučnika referira na kognitivne aspekte (Garrison i dr., 2000 prema Garrison i dr., 2001: 11). Dio naučnika ima multidimenzionalan pristup koji različito kategorizira socijalno prisustvo. Garrison (2017) u svom pristupu posebno diferencira socijalnu, kognitivnu i prisutnost podučavanja, Krejns, Kirschner i Jochems (2002) razlikuju dvije vrste interakcija, onu koja se odnosi na socijalno-psihološku dimenziju ličnosti, te onu koja se odnosi na sadržaj, Chic-Hsiung Tu i Marina McIsaac (2002) kategoriziraju tri aspekta socijalnog prisustva i to orijentiranost na zadatak, svojstva jezika i interaktivnost. Shen i Khalifa (2008) proširuju socijalno prisustvo i na interakcije sa neljudskim akterima.

U ovom radu ćemo razlikovati dvije osnovne kategorije socijalnog prisustva: afektivno i kognitivno. Pod afektivnim socijalnim prisustvom ćemo podrazumijevati sposobnost učesnika da se „identifikuju sa grupom, otvoreno komuniciraju u okruženju od povjerenja i razviju lične i afektivne odnose progresivno kroz projektovanje njihovih ličnosti“ (Garrison 2009 prema Garrison 2017: 26). Dok radnje koje vode ka interakciji sa ciljevima učenja, sadržajima, načinima i ishodima svrstat ćemo u kognitivno prisustvo. U tom smislu kognitivno socijalno prisustvo u nastavi je „usmjereno na akademske aktivnosti“ (Garrison 2017: 30). U ovom radu ćemo pod kognitivnim prisustvom podrazumijevati interakciju i njeno usmjeravanje na problem predmeta izučavanja u nastavnom procesu i misaonu manipulaciju sadržajima predmeta, odnosno razumijevanju problema i koncepata, pronalaženju relevantnih informacija i rješenja, te transferu u druge sfere života.

4. ISTRAŽIVAČKA PITANJA

Nesporno je da medijatizovana komunikacija u online nastavi ima zadatak da ostvari svrsishodne interakcije kojima će se postići afektivno i kognitivno socijalno prisustvo kao važan element motivacije i zadovoljstva studenata za postizanje akademskog uspjeha. U Bosni i Hercegovini nije dovoljno istraženo ostvarivanje afektivnog i kognitivnog socijalnog prisustva u online nastavi. Ovo istraživanje polazi od pitanja:

- Da li interakcije tokom online nastave omogućavaju osjećaj afektivnog socijalnog prisustva studenata u kontekstu pripadnosti grupi, samoizražavanju i percepciji drugih studenata?
- Da li interakcije tokom online nastave omogućavaju studentima osjećaj afektivnog socijalnog prisustva profesora/ice?
- Da li interakcije tokom online nastave omogućavaju studentima kognitivno socijalno prisustvo u nastavi?

31.

5. METOD

Cilj istraživanja je ustanoviti kako studenti u Bosni i Hercegovini percipiraju interakcije u online nastavi sa drugim studentima/icama i sa profesorima/icama. U empirijskom dijelu rada proveden je anketni upitnik. Anketirano je 100 studenata I, II i III ciklusa studija Fakulteta islamskih nauka Univerziteta u Sarajevu, Islamskog pedagoškog fakulteta Univerziteta u Zenici i Islamskog pedagoškog fakulteta Univerziteta u Bihaću. Upitnik je dizajniran posebno za ovo istraživanje prilagođavanjem ranije korištenih upitnika iz oblasti socijalnog i kognitivnog prisustva Kathy N. Shen i Mohamed Khalifa, (2008), te upitnika koji je za potrebe naučnih istraživanja razvio Garrison M. Randy (2017). Korišteni upitnik sadrži ukupno 40 pitanja u 4 cjeline: demografski podaci, pitanja o procjeni afektivnog socijalnog prisustva, pitanja o procjeni kognitivnog socijalnog prisustva, te pitanja o procjeni učinkovitosti online nastave. Pitanja o demografskim podacima studenata postavljena su u nominalnoj skali, dok su sva ostala pitanja pripremljena po modelu petostepene Likertove skale. Upitnik su provela ukupno 3 anketara, u online formi i licem u lice. Online forma je korištena zbog udaljenosti geografske lokacije anketara koji se nalaze u Sarajevu, Luxemburgu i Beču. Urađeno je anketiranje 28 ispitanika licem u lice, dok su 72 odgovora prikupljanja putem online ankete. Podaci su obrađeni u SPSS-u (engl. Statistical Package for the Social Sciences). Za analizu su korišteni testovi deskriptivne statistike: frekvencije, aritmetičke sredine i aritmetička sredina aritmetičkih sredina.

6. REZULTATI ISTRAŽIVANJA

U anketnom istraživanju je učestvovalo 100 ispitanika koji pohađaju Fakultet islamskih nauka u Sarajevu, Islamski pedagoški fakultet u Zenici i Islamski pedagoški fakultet u Bihaću.

Tabela 1. Struktura po spolu, fakultetu i godini studija

		Frekvencija	%
Spol	Muški	47	47,0
	Ženski	53	53,0
Fakultet	Fakultet islamskih nauka u Sarajevu	27	27,0
	Islamski pedagoški fakultet u Zenici	53	53,0
	Islamski pedagoški fakultet u Bihaću	20	20,0
Godina studija	I	6	6,0
	II	11	11,0
	III	31	31,0
	IV	33	33,0
	Magistarski studij	15	15,0
	Doktorski studij	4	4,0
Ukupno		100	100,0

Iz tabele 1 vidljivo je da je većina ispitanika sa Islamskog pedagoškog fakulteta u Zenici. Karakteristike ispitanika po spolu su relativno ujednačene, te je 47% muških i 53% ženskih ispitanika. Među ispitanicima je najmanje studenata III ciklusa studija 4%, zastupljeno je 15% studenata II ciklusa studija, te 64% studenata bachelor studija III i IV godine, dok je 17% studenata I i II godine bachelor studija. Iz uzorka je vidljivo da je većina studenata pohađala nastavu tokom pandemije korona virusa koja je započela u martu 2020. godine. Važno je napomenuti da sve članice Univerziteta u Sarajevu i nakon završetka pandemije imaju obavezan dio nastave koji se odvija online. Islamski pedagoški fakultet u Bihaću je nakon pandemije zadržao oblike online nastave posebno u slučajevima gdje nastavu izvode profesori koji su u statusu vanjskog saradnika i mjestom stanovanja su udaljeni od Bihaća.

Anketom je ispitivano koji kanal komunikacije studenti preferiraju u online nastavi. Ponuđeni odgovori su se odnosili na kanale koji su prvenstveno zasnovani na razmjeni tekstualnih poruka – e-mail i instant poruke kao što su messenger grupe i viber, društvene mreže – facebook, instagram, tik-tok, snapchat), kanali koji omogućavaju vizuelnu komunikaciju sudionika nastave - zoom ili neki drugi oblik video konferencije i online classroom sa uključenim kamerama, te kanali zasnovani na kombinaciji auditivne i tekstualne komunikacije kao što je online classroom bez korištenja kamera.

Tabela 2. Preferirani kanali komunikacije u online nastavi

U online nastavi kao kanal komunikacije preferiram:				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid e - mail	16	16,0	16,0	16,0
Zoom ili neki drugi oblik video konferencije	23	23,0	23,0	39,0
Online classroom sa korištenjem kamera svih prisutnih učesnika	27	27,0	27,0	66,0
Online classroom koji uključuje audio i chat, bez korištenja kamera	16	16,0	16,0	82,0
Društvene mreže (facebook, instagram, tik-tok, snap chat)	1	1,0	1,0	83,0
Instant poruke (viber, messenger grupe)	17	17,0	17,0	100,0
Total	100	100,0	100,0	

Iz tabele 2 je evidentno da 50% ispitanika preferira kanale koji omogućavaju vizuelnu komunikaciju, 33 % ispitanika preferiraju kanale koji omogućavaju tekstualnu komunikaciju, te 16% ispitanika preferira online classroom bez uključene kamere koji omogućava auditivnu i tekstualnu komunikaciju, a samo 1% ispitanika se opredijelilo za društvene mreže kao kanal komunikacije u online nastavi. Rezultati istraživanja su u

skladu sa dosadašnjim istraživanjima i pokazuju važnost neverbalne komunikacije koja doprinosi kvalitetnijoj nastavi kroz praćenje facijalnih ekspresija i paralingvističkih aspekata govora (Wang i Woo, 2007, Mehall, 2020, Bullen, 1998; Borup i dr., 2012, Kruger, 2000) što omogućava uključenost kamera tokom online nastave (Lin & Gao, 2020).

Drugim dijelom ankete se ispitala percepcija studenata o afektivnom socijalnom prisustvu. Anketa je ispitala 5 oblasti percepcije afektivnog socijalnog prisustva: afektivno socijalno prisustva profesora, poticanje saradnje među studentima od strane profesora, feedback koji su studenti primali od profesora, afektivno socijalno prisustvo vršnjaka i omogućavanje samoizražaja studenta. Utvrđena je disperzija odgovora po ponuđenim pitanjima, te je bilo potrebno izračunati aritmetičku sredinu aritmetičke sredine za svaku grupu pitanja.

Afektivno socijalno prisustvo profesora je obuhvatalo 5 pitanja: 1) Profesor/ica je u toku online nastave jasno komunicira važne teme predmeta, 2) Profesor/ica je u toku online nastave jasno komunicira ciljeve predmeta, 3) Profesor/ica je u toku online nastave jasno daje instrukcije na koji način da aktivno učestvujem u procesu učenja, 4) Profesor/ica je u toku online nastave jasno komunicira zadatke svakog studenta i vremenski okvir za njihovo izvršenje i 5) Uspio/la sam steći jasne utiske tokom online nastave o profesoru/ici. Oblast afektivnog socijalnog prisustva vršnjaka obuhvaćena je pitanjima 1) Uspio/la sam steći jasne utiske tokom online nastave o drugim studentima kroz predstavljanje ili zajednički online rad i 2) Primjećivao/la sam prisustvo drugih individua tokom online nastave. Oblast percepcije omogućavanja samoizražaja studenta obuhvaćena je pitanjima: 1) Imao/la sam priliku da tokom online nastave iskažem svoje prisustvo, 2) Online nastava mi je pomogla razviti osjećaj saradnje i 3) Online komunikacija je izvrstan medij za ostvarivanje socijalnih interakcija.

Tabela 3. Percepcija afektivnog socijalnog prisustva

Afektivno socijalno prisustvo		
	Oblasti percepcije afektivnog socijalnog prisustva	Aritmetička sredina aritmetičkih sredina
1	Afektivno socijalno prisustvo profesora	4,07
2	Afektivno socijalno prisustvo vršnjaka	3,24
3	Omogućavanje samoizražaja	3,63

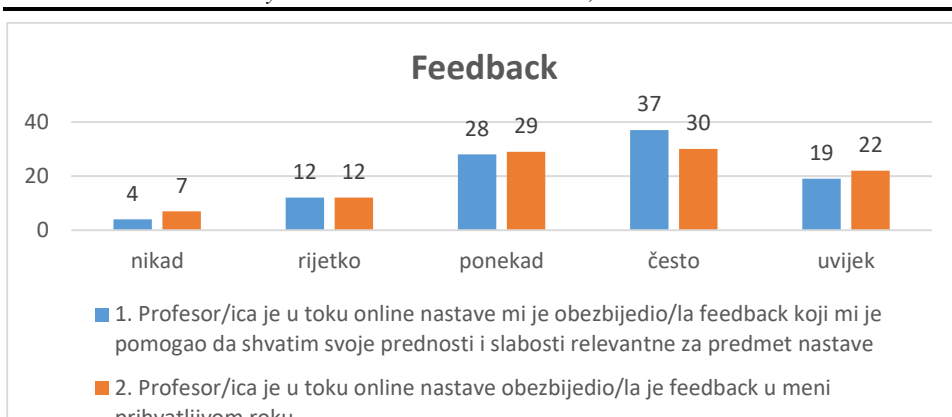
Rezultati prikazani u Tabeli 3 pokazuju da studenti vrlo visoko percipiraju afektivno socijalno prisustvo profesora koje se odvija kroz aktivnosti samog profesora na predavanju kao što je komunikacija teme predavanja, ciljeva, davanje instrukcija za aktivan rad studenata, i uglavnom studenti percipiraju jasno zadatke i vremenske okvire koje profesor postavlja. Sticanje utiska o profesoru/ici je percipirano nešto nižom ocjenom 3,71. Studenti druge kolege i kolegice vršnjačke grupe percipiraju dosta lošije. Aritmetička sredina aritmetičkih sredina je 3,24, za razliku od percepcije profesora sa 4,07. Studenti

su relativno zadovoljni mogućnostima samoizražavanja sa aritmetičkom sredinom aritmetičkih sredina 3,63 koja je viša od percepcije kolega i kolegica. Rezultati ove studije potvrđuju prethodna istraživanja da online nastava koja je organizirana tako da podiže nivo socijalnih interakcija povećava zadovoljstvo studenata i pospješuje akademske rezultate (Zawacki-Rihter i drg., 2009., Richardson i Swan, 2003), te da interakcije koje su smislene pozitivno utječu na afektivno socijalno prisustvo (Đolović i Injac, 2022; Kovačević i dr., 2021; Koso-Drljević i dr., 2021).

Tabela 4. Poticanje saradnje među studentima od strane profesora

Poticanje saradnje među studentima od strane profesora		
	Pitanje	Proječna ocjena
1.	Profesor/ica je u toku online nastave ohrabruje diskusiju među studentima	3,85
2.	Profesor/ica je u toku online nastave pomaže u razumijevanju slaganja i neslaganja mišljenja studenata o temi	3,82
3.	Profesor/ica je u toku online nastave usmjerava i vodi produktivan dijalog među studentima	3,8
4.	Profesor/ica je u toku online nastave razvija osjećaj zajedništva među studentima	3,56
	Aritmetička sredina aritmetičkih sredina	3,75

Rezultati u Tabeli 4 pokazuju profesori uglavnom dobro fasilitiraju saradnju među studentima kroz poticanje diskusije, upravljanje diskusijom i dijalogom, dok je nešto niža percepcija studenata o učinku profesora na razvijanje osjećaja zajedništva u grupi 3,56. Aritmetička sredina aritmetičkih sredina iznosi 3,75. Komparacija rezultata iz Tabele 3 i Tabele 4 pokazuje da profesori imaju bolji učinak u predstavljanju sebe nego u fasilitiranju grupne kohezije. Rezultati su u skladu sa dosadašnjim istraživanjima da poticanje i ostvarivanje grupne kohezije pozitivno utječe na rezultate učenja ((Boling i dr., 2012; Janicki, T. i Janicki, J., 2001; Northrup i dr., 2002; Mehall, 2020; Richardson i Swan, 2003; Muilenburg i Berge, 2005; Poluehktova i dr., 2020).



Grafikon 6. Feedback

Grafikon 1 iako dominira dobra percepcija feedbacka pokazuje da su studenti više zadovoljni sadržajem feedback-a, nego vremenom u kojem je isporučen. Aritmetička sredina aritmetičkih sredina iznosi 3,51. Važnost feedback-a, kako sadržajna tako i brzina feedback-a imaju pozitivan utjecaj na afektivno socijalno prisustvo (Gallien i Oomen-Early, 2008: 474), te visoka prosječna ocjena studenata o pitanjima feedback-a i afektivnog socijalnog prisustva su kompatibilne.

Tabela 5. Osjećaj povjerenja

Neslaganje sa drugim studentima ili sa profesorom/icom nije narušilo osjećaj povjerenja			
		Frequency	Percent
Valid	nikad	12	12
	rijetko	6	6
	ponekad	22	22
	često	34	34
	uvijek	26	26
	Total	100	100

U tabeli 5 je uočljivo da 18% ispitanika ima osjećaj narušenog povjerenja usljed neslaganja sa vršnjacima, 22% nisu opredjeljena po ovom pitanju, što čini ukupno 40% ispitanika kojima neslaganje sa profesorima i studentima narušava ili lako može narušiti osjećaj povjerenja. Podizanje osjećaja povjerenja u svim interpersonalnim odnosima, pa tako i online podiže produktivnost, omogućava lakšu diskusiju, a time i razmjenu mišljenja.

Najniža ocjena percepcije afektivnog socijalnog prisustva je vidljiva kod percepcije drugih kolega i kolegica, te rezultati ukazuju na relativno lahko urušavanje povjerenja što može negativno utjecati na osjećaj društvene kohezije.

Kognitivno socijalno prisustvo je mjereno u tri kategorije: nastavno prisustvo, kognitivna vršnjačka saradnja i transfer znanja. Nastavno prisustvo je obuhvatalo 6 pitanja: 1) Način na koji su postavljeni problemi tokom online nastave su povećali moje interesovanje za predmet, 2) Aktivnosti na časovima online nastave probudile su moju zainteresiranost za predmet, 3) Osjećao sam se motiviranim da istražim pitanja u vezi problema predmeta tokom online nastave, 4) Profesor/ica je u toku online nastave pomaže studentima da ostanu usmjereni na temu, 5) Profesor/ica je u toku online nastave podstiče studente da istraže nove koncepte vezane za temu predavanja i 6) Koristio sam razne izvore informacija tokom online nastave kako bih istraživao probleme postavljene u predmetima koje sam slušao u online nastavi. Oblast kognitivne vršnjačke saradnje je obuhvatala 5 pitanja: 1) Aktivnosti u online nastavi su uključivale brainstorming i pronalaženje relevantnih informacija koje su mi pomogle da riješim određene zadatke vezane za predmet, 2) Bio/la sam podstaknut da učestvujem u online diskusijama, 3) Učestvovanje u online diskusijama mi je pomoglo da cijenim druge perspektive, 4) Učenje u online diskusijama pomoglo mi je da razumijem osnovne koncepte i 5) Tokom online nastave kreirao sam vlastite materijale vezane za temu predmeta koji su korišteni tokom časova. Oblast transfera znanja je obuhvatala 3 pitanja: 1) Mogu opisati načine testiranja i primjene znanja stečenog tokom online nastave, 2) Razvio/la sam rješenja različitih problema koja mogu primijeniti u praksi i 3) Znanja stečena tokom online nastave mogu primijeniti na druge oblasti života koje se ne odnose na pojedinačni predmet.

Tabela 6. Percepcija kognitivnog socijalnog prisustva

Kognitivno socijalno prisustvo		
	Oblasti percepcije kognitivnog socijalnog prisustva	Aritmetička sredina aritmetičkih sredina
1	Nastavno prisustvo	3,54
2	Kognitivna vršnjačka saradnja	3,51
3	Transfer znanja	3,55

U tabeli 6 je evidentno da nema velikih razlika u tri dimenzije percepcije kognitivnog prisustva. Sve tri dimenzije kognitivnog socijalnog prisustva: manipuliranje sa sadržajem kroz motivaciju i vođenje profesora, percepcija ostvarene kognitivne saradnje među studentima i kao najviši nivo transfer znanja na druge oblasti se ostvaruju malo iznad prosjeka. Kvalitet interakcija kako u gradnji odnosa tako i u gradnji znanja ima pozitivan učinak na rezultate učenja (Garrison, 1985; Berge, 1999; Mehall, 2020., Northrup, Lee i Burgess, 2002). Također, ispitanici koriste različite izvore informacija u online sferi, te tako ostvaruju i interakcije sa neljudskim entitetima, što je u skladu sa prethodnim istraživanjima (Okičić i dr., 2020; Koso-Drljević i dr., 2021; Tešanović i dr., 2019; Lemeš, 2021).

Postavljeno pitanje: Smatram da povećan broj interakcija tokom online nastave podiže nivo socijalnog prisustva, ocijenjeno je prosječnom ocjenom 3,63, dok na pitanje:

Smatram da veći osjećaj pripadnosti grupi na mene utječe pozitivno u smislu postizanja boljih rezultata, je ocijenjeno prosječnom ocjenom 3,70. Studenti su na pitanje: Koliko ste zadovoljni učinkom online nastave na Vašem fakultetu? – odgovorili sa prosječnom ocjenom 3,69, dok su na pitanje: Koliko ste zadovoljni angažmanom profesora i fakulteta po pitanju materijalno-tehničkog kvaliteta realizacije online nastave? – odgovorili prosječnom ocjenom 3,75. Rezultati pokazuju da ostvareno afektivno i kognitivno socijalno prisustvo u online nastavi utječe na povećano zadovoljstvo studenta (Richardson & Swan, 2003).

7. ZAKLJUČAK

Proglašenjem pandemije korona virusa Covid 19 koja je počela u proljeće 2020. godine, univerziteti u Bosni i Hercegovini, kao i u većini drugih zemalja svijeta, su morali odgovoriti na nove izazove u hitnim okolnostima. Danas, iza organizacije online nastave stoje tri godine iskustva i očekivano je poboljšanje ka boljem uspostavljanju i snalaženju u sferi online nastave. U ovom radu je analizirana percepcija studenata u online nastavi islamskih fakulteta u Bosni i Hercegovini o ostvarivanju afektivnog i kognitivnog socijalnog prisustva koje doprinosi povećanom zadovoljstvu studenata i boljem akademskom uspjehu. Razmatrana su tri istraživačka pitanja:

- Da li interakcije tokom online nastave omogućavaju osjećaj afektivnog socijalnog prisustva studenata u kontekstu pripadnosti grupi, samoizražavanju i percepciji drugih studenata?
- Da li interakcije tokom online nastave omogućavaju studentima osjećaj afektivnog socijalnog prisustva profesora/ice?
- Da li interakcije tokom online nastave omogućavaju studentima kognitivno socijalno prisustvo u nastavi?

Istraživanjem je potvrđen relativno visok stepen percepcije afektivnog socijalnog prisustva u online nastavi u percepciji profesora i mogućnosti samoizražavanja, dok je percipiranje vršnjaka nešto niže. Najvišim nivoom percepcije afektivnog socijalnog prisustva ispitanici su detektirali profesora/icu. Važno je istaći da studenti preferiraju upotrebu alata koji omogućavaju makar dijelove neverbalne komunikacije, što je u skladu sa rezultatima pozitivnog učinka sinhrono online nastave kod autora Dietrich i dr. 2020, Zhang i dr. 2023, Toti i Alipour, 2021, Ilić, 2021, Bačić i Krstinić, 2020. Upotreba kamera od strane prisutnih u nastavnom procesu je pozitivno percipirana, te je nalaz u skladu sa istraživanjem Lin i Gao, 2020 . Također, ispitanici percipiraju relativno visok nivo kognitivnog socijalnog prisustva, mogućnost korištenja različitih izvora znanja što potvrđuje rezultate Okičić i dr., 2020; Koso-Drljević i dr., 2021; Tešanović i dr., 2019; Lemeš, 2021. Transfer znanja, kao najviši nivo učenja, je relativno dobro percipiran.

Iako među studentima postoje razlike koje se ogledaju u velikoj disperziji odgovora, istraživanje je pokazalo da interakcije tokom online nastave uglavnom omogućavaju osjećaj afektivnog socijalnog prisustva studenata u kontekstu pripadnosti grupi,

samoizražavanju i percepciji drugih studenata, percepciji afektivnog socijalnog prisustva profesora/profesorce na visokom nivou, ali i kognitivno socijalno prisustvo, što doprinosi povećanom zadovoljstvu studenata i boljem akademskom uspjehu.

S obzirom na činjenicu da su rezultati studentske percepcije afektivnog i kognitivnog socijalnog prisustva relativno visoki u ovoj grupi ispitanika, koji su svi studenti fakulteta islamskih nauka, u narednim istraživanjima bi trebalo ispitati da li studenti koji pohađaju fakultete islamskih nauka imaju povišen nivo odgovornosti i samomotivacije u odnosu na studente drugih fakulteta, te da li postoje razlike u percepciji kognitivnog i socijalnog prisustva između studenata različitih naučnih disciplina

Nedostatak ovog istraživanja je relativno mali broj ispitanika.

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**ACHIEVING AFFECTIVE AND COGNITIVE PRESENCE IN ONLINE
LEARNING ACCORDING TO PERCEPTION OF STUDENTS OF ISLAMIC
FACULTIES IN BOSNIA AND HERZEGOVINA**

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ABSTRACT:

Purpose of study: Previous studies have shown that the effectiveness of online learning depends on the achievement of affective and cognitive social presence. This paper focus is on the student perception of affective and cognitive social presence through purposeful interaction in online classes.

Methodology: The study was conducted among students of Islamic faculties in Bosnia and Herzegovina: University of Sarajevo, University of Zenica and University of Bihać. Data for the empirical study was collected by survey questionnaire on a sample n=100 respondents. The questionnaire consists of three parts: respondents' demographic data, questions about the realisation of affective presence and questions about the realisation of cognitive presence according to the adopted questionnaires of Kathy N. Shen i Mohamed Khalifa (2008) i D. Randy Garrison (2017). The data were processed in SPSS (Statistical Package for the Social Science).

Main results: The dispersion of answers to the questionnaires was determined, whereby there is no significant difference in the answers of male and female respondents.

Conclusion: The results confirm the possibility of realizing affective and cognitive social presence in online learning, while respecting the complex construct in which many factors operate simultaneously

Keywords: online learning, affective presence, cognitive presence, interaction

USING ESCAPE ROOMS IN SUPPORTING LEARNING IN STEM COURSES: AN EXAMPLE OF AN ESCAPE ROOM IN GENERAL CHEMISTRY

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ABSTRACT:

The potential of gamification in teaching science, technology, engineering, and mathematics (STEM) courses has been increasingly recognized. One of the strategies to gamify teaching and learning is to use escape rooms. Escape rooms are a modern educational tool based on problem tasks, include time limitations, and require students' active participation and cooperative activities. Previous research has indicated that escape rooms can foster the development of subject-specific and soft skills such as cooperation, problem-solving skills, and creativity. Empirical evidence indicates that escape rooms are well accepted in classrooms and that students generally positively perceive them. Furthermore, students reported that using escape rooms enhances subject-specific and general skills. In this paper, we aimed to outline escape rooms as a modern educational tool in teaching chemistry and provide recommendations for using them. Finally, we presented the example of an escape room that is designed for teaching general chemistry.

Keywords: escape rooms, STEM, chemistry teaching

1. INTRODUCTION

Natural sciences, especially chemistry and physics, are often difficult for students to learn, which is why they lose motivation to study and rarely decide to study them during their studies. Difficulties in learning chemistry are related to the nature of learning chemistry and the methods by which chemistry is usually taught [1]. Teachers try to motivate and encourage students to learn in a more fun way compared to the traditional lecture format by applying various modern educational tools through interactive and fun activities such as various games [2, 3], the application augmented and virtual realities [4], flipped classroom [5] and similar. However, most of these activities have an individual approach and do not encourage team building and group communication [6].

In recent years, escape rooms (ER - "escape from the room") have become one of the leading leisure activities around the world, and soon their potential was recognized in education as well. López-Pernas et al. [7] define ERs as live games in which players discover clues, solve puzzles and tasks in one or more rooms in order to achieve a specific goal (usually room escape). Learning in this environment depends on interactions and cooperation among students. ERs are a modern educational tool that creates a unique

learning environment that includes solving tasks based on solving mysteries, adventures and problems from everyday life in a limited period of time. ERs have attracted the interest of educators because of the opportunity to nurture and develop subject-specific skills, as well as questioning and problem-solving skills, creativity, teamwork, initiative-taking, leadership and communication [8].

There is empirical evidence of the successful use of educational ERs in a wide range of disciplines: in STEM courses [9], chemistry [8, 6], biology [10], mathematics [11], engineering [12], and pharmacy [13]. ER has been shown to be well accepted and positively perceived by both students [14, 15] and teachers [16].

Gamification is known to create a positive emotional environment and improve student motivation [5, 17]. Although it can be assumed that gamification is more suitable for earlier stages of education, ER is considered particularly attractive for adults [7] and is suggested as an alternative educational activity in the chemistry classroom for high school and university students [6].

2. OBRAZOVNI ESCAPE ROOMS

Classic ERs are usually performed in rooms that are specialized for this purpose and equipped with the necessary equipment and materials such as cabinets, closets, doors, secret cabinets [6]. However, making such a room is financially very demanding. Taking students to such rooms (if they exist) is both organizationally and financially difficult. For the purposes of educational ER, a classroom, laboratory, or other room can be turned into an escape room.

When creating a scenario for this game, it is necessary to follow certain rules. Peleg et al [18] list six elements for designing ER: system, players, artificial, conflict, rules, and measurable outcome.

System - ER represents a system consisting of several separate/separate elements/activities that interact with each other. In other words, the solution of one activity leads to another, that is, to the goal of the game.

Players - ER is a game designed for teamwork. There must be more than one participant in the game. Participants work in a group to solve set puzzles and activities.

Artificial - ER should be separated from real life both in time and space. It is necessary to create an environment with all the necessary props that will lead through the set story.

Conflict - there must be a conflict to resolve it, for example, the conflict is the challenge of finding and deactivating the hidden bombs in the lab.

Rules - there must be clear rules about what is allowed and what is not allowed in the game. These rules are laid out clearly at the beginning of the game. For example, under no circumstances should force be used to solve any puzzle. Instructions for working in the laboratory, etc., must be followed.

Measurable outcome – players must be able to determine whether they have won or lost. They know if the bomb went off or if they managed to escape in time.

In addition to these rules that apply to all ERs, designing ERs for educational purposes must include the following considerations [18]:

Curriculum - activities must be in accordance with the prescribed curriculum for the intended age.

Large groups - classes often contain a large number of students. All students should fit in the room. It is necessary to form several smaller groups and design their activities so that they can carry out them without interruption.

Mobility – all necessary props, materials and accessories must be mobile so that they can be transferred to the required laboratory or to another room. A fixed room for that purpose would cause a financial burden.

Costs - the required props, accessories and equipment should be cheap but suitable for the needs of the game.

Due to the given conditions for designing an escape room for educational purposes, it is useful to create a virtual ER, set in the digital space. There are computers that can connect several 3D spaces and provide a virtual tour through them. Different tasks can be set in different spaces, and feedback is provided to the participants so that they can move on from one task to another by finding codes for the exit. Virtual ER is easier and cheaper to organize, it does not require a special room and props, and it can be played on a computer or on the cell phone. The only requirement is a stable internet connection.

Digital ER can be used for learning new content, but it is usually used as a fun way to practice problems and review of content.

3. AN EXAMPLE OF GENERAL CHEMISTRY ESCAPE ROOM

The designed ER covers the contents of general chemistry. ER begins after a mysterious introduction to the story -students are kidnapped and locked in the chemical laboratory in which there is a bomb which will go off in 30 minutes. In order to deactivate it, students need to solve 7 tasks and leave the laboratory. The tasks can be solved independently of each other, and the feedback obtained after solving the task is a part of the code needed to reach the goal. Interactive PSE and additional interactive materials or .pdfs are provided in the library as a form of help if students have problems solving tasks. The picture shows the floor plan of the escape room and the placement of different activities.

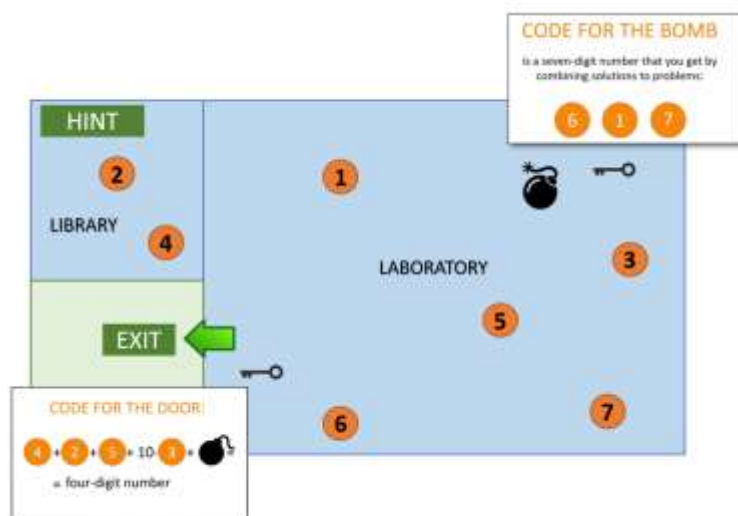


Fig. 1. Floor plan and placement of tasks 1-7

The tasks included in ER are of a different type. In the first task, students are required to sort the structural formulas of compounds according to their polarity. After solving the problem, a picture is revealed showing a model of an atom. Students are required to identify the element in question and to determine its mass number. The problem is shown in Fig. 2.

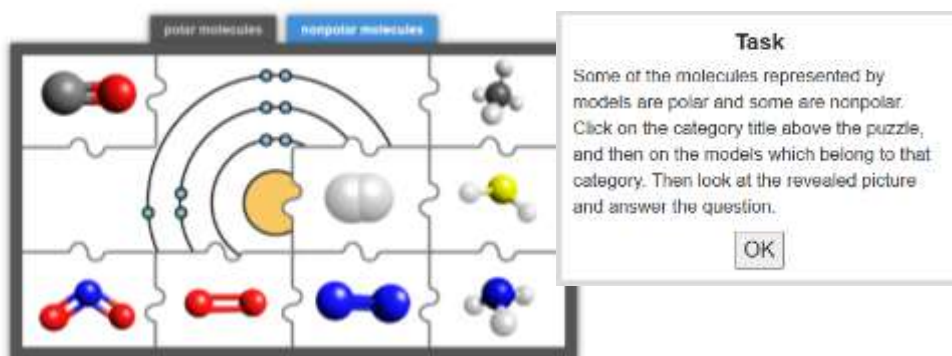


Fig. 2. Task No. 1

The second task is a crossword, and the solution is a name of an alkaloid. The part of the code is a number of nitrogen atoms in a molecule of that alkaloid (Fig. 3).



Fig. 3. Task No. 2

In tasks no. 3 and 7 students should watch video clips incorporated in the virtual ER. Both videos show the preparation of solutions (solution of NaCl and ethanol) and to calculate quantitative composition of these solutions. The results are also parts of the code. Video clips are didactically shaped and students were instructed to pay attention to the given data.

Tasks no. 4, 5 and 6 are related to the chemical kinetics and chemical equilibrium. Students are required to calculate the reaction rate, or select the beaker in which the precipitate will be formed first. In the sixth task a list of different changes in the system is provided, such as change of temperature and pressure, or addition of certain reactant or the reaction products. Students are required to categorize the changes into two groups – those that affect the given equilibrium, and those that do not (Fig. 5).

Calculate the rate of this reaction:

$$\text{Zn (s)} + 2\text{HCl (aq)} \rightarrow \text{ZnCl}_2 \text{ (aq)} + \text{H}_2 \text{ (g)}$$

v = ?

Use some of the following data:

V (reaction vessel) = 2 dm³

n(Zn) = 5 mol n(ZnCl₂) = 2 mol

n(HCl) = 4 mol n(H₂) = 3 mol

k = 0.1

$$\text{Na}_2\text{S}_2\text{O}_8 + 2\text{HCl} \rightarrow \text{SO}_2 + \text{S} + \text{H}_2\text{O} + 2\text{HCl}$$

Write prepartate appears first in the beaker labelled _____

Factors which have no effect

Factors which have an effect

Fig. 5. Tasks No. 4, 5 and 6

3. CONCLUSION

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development of problem-solving skills, strengthening motivation, cooperation, teamwork, and creativity. The paper describes a virtual escape room created for learning general chemistry, which is intended for high school and college students to review the covered content. After they get acquainted with the story, they find themselves in the virtual laboratory where the bomb was placed. In order to deactivate it, it was necessary for them to solve 7 tasks from the field of general chemistry. This scenario can be modified physically in the laboratory, which requires good organization of space and time with the use of chemicals.

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VREDNOVANJE, SAMOVREDNOVANJE I VRŠNJAČKO VREDNOVANJE U FUNKCIJI PRAĆENJA UČENIČKIH POSTIGNUĆA

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SAŽETAK:

Mjerenje i praćenje učeničkih postignuća zahtjeva kontinuitet i namjeru u tom složenom pristupu. Pratiti znači unaprijed odrediti pojavu praćenja, suočiti je s jasnim koracima i sa svim elementima tog procesa. Od presudne važnosti je upoznati svakog učenika sa svim elementim koji će se pratiti i vremenski okvir u kom će se to realizirati. Sve navedeno ima za cilj praćenje odgojno-obrazovnih ishoda i efikasnosti mjera koje se donose na osnovu tih rezultata. Ovakvo predstavljanje praćenja postignuća vodi ubrzanom razvoju mentalnih sposobnosti i psihičkih funkcija jer svi žele ostvariti visok uspjeh, a osigurano je aktivno i kontinuirano učenje. Svi postupci mjerenja zanimljivi su učenicima iako nose određeni stepen stresa, kao njihovim nastavnicima tako i roditeljima. Uz to, samovrednovanje i vršnjačko vrednovanje može umanjiti taj stres i obezbijediti veću uključenost i dodatni kontinuitet ovom procesu. Razliku čini monogo faktora, a neke od njih istražili smo putem istraživanja koje smo proveli u tu svrhu. Vrednovanje kojim se određuje stepen postignuća učenika u toku, za vrijeme i neposredno nakon učenja u smislu ovladavanja znanjima, vještinama i datim kompetencijama spada u najvažnije segmente odgojno-obrazovnog rada. Cjelokupan proces praćenja i vrednovanja ishoda učenja zauzima visoko mjesto u hijerarhiji nastavnih vrijednosti. Provođi se svakodnevno, periodično, povremeno, ciljano i spontano, na pojedince i grupe usmjereno. Različitim pristupima prikuplja se što više različitih informacija i elemenata posmatranih pojava. Njihovo tumačenje nastaje kao rezultat sistemskog propitivanja i praćenja ispitanika. Vrednovanju u nastavnom procesu treba pribjegavati često, na različite načine i redovno. U tom procesu učenici mogu i trebaju biti aktivni saveznici.

Ključne riječi: vrednovanje, praćenje postignuća, samovrednovanje, vršnjačko vrednovanje

1. Uvod

Praćenje i procjenjivanje učeničkih postignuća ima za cilj unapređenje procesa učenja i podučavanja sa svrhom napretka učenika. Planiranje učenja i podučavanja sastavni je dio očekivanih ishoda učenja, odnosno, ukupnih ishoda odgoja i obrazovanja koji se ostvaruju putem nastavnog procesa. Kačapor i Vilotijević (2005) posebno ističu značaj nastavnog procesa kroz njegove ishode, a prvenstveno iz ugla ocjenjivanja učeničkih znanja. Mjerenjem i praćenjem prikupljaju se relevantne informacije o napretku učenika, a trebaju poslužiti unapređenju odgojno-obrazovne stvarnosti. Dalje provođenje uslovljeno je ciljevima i očekivanim ishodima datog predmeta (npr. maternjeg ili stranog jezika) ili oblasti (npr. prirodno-matematičke). Tako je zastupljeno dijagnostičko koje se provodi na početku nastave, formativno vrednovanje koje je prisutno u svim periodima tokom učenja i sumativno koje se provodi na kraju procesa učenja i podučavanja ili određenog obrazovnog razdoblja.

U početnim koracima podučavanja, od upoznavanja ciljeva i ishoda datog predmeta ili oblasti, odmah načiniti konkretne korake procjene nivoa znanja učenika. Prevladavajuća procjene koja se provodi u svrhu provjere određene vještine i kompetencije, predstavljajući rješenje nekog problema ili situacije koja je dio svakodnevnog života, smatra se autentičnom procjenom (Brown, 2001). Tada trebaju biti upoznati učenici sa svrhom njihovog praćenja, kao i svim elementima praćenja i vremenskom razdoblju u kom će se ta namjera realizirati. Cilj je prepoznati njihove sklonosti, prednosti i nedostatke, kako bi se planiranje podučavanja stavilo u funkciju napretka i kako bi se obezbijedio kontinuirani napredak svih učenika. Takvo planiranje poduke vodit će kvalitetnijoj nastavi i stvaranju odgovarajućeg ambijenta za ostvarivanje postavljenih ishoda učenja na datom uzrastu. Naravno, nije isti skrining na svakom uzrastu niti su isti pokazatelji vjerodostojni u smislu njihove ostvarivosti posredstvom ovog 'skeniranja stanja'. Nastavnici ovim stiču prednost u samoj realizaciji nastave jer su unaprijed spremni odgovoriti svim izazovima koje pred njih stavlja savremena nastava.

Teorijska i empirijska istraživanja imaju kontinuiranu progresiju praćenja pokazatelja mjerenja, vrednovanja, evaluacije učeničkih postignuća. Kako se nastavnici oslanjaju na informacije koje dobijaju ocjenjivanjem koje ih vode do donošenja evaluacijskih odluka, tako i nauka kroz redovne aktivnosti istraživanja donosi sud o svim pojavama koje prate navedene procese. Sve te pojave oduvijek su zauzimale visoko mjesto na ljestvici istraživača što će vjerujemo i ostati praksa. Na isti način se odnosimo prema ovoj pojavi u našoj školskoj praksi i otuda interes za njeno detaljnije istraživanje. Oduvijek nas je privlačila povezanost ocjene i procjene sa stvarnim znanjem učenika. Kako se njihova opredijeljenost za neki predmet formira i da li tu ima uporišta za simpatije prema nastavnom osoblju i materiji koja se prezentira kako kroz udžbenike tako i na samim časovima. U kojoj mjeri takva interesovanja zavise od prakse mjerenja znanja i postignuća.

U ovom radu predstaviti ćemo vezu između prilike za učenike da sami procjenjuju svoje kompetencije (samoevaluacija), zatim vršnjačku evaluaciju i nastavničku opredijeljenost da stvori takve uslove i ambijent za učenje posredstvom direktne provjere. Ukazati ćemo na pristup u praksi koji se pokazuje najuspješniji i koji daje najbolje rezultate u učenju.

Nada sve, jasno će se izdvojiti strategije i načini podučavanja ukršteni sa interesovanjima učenika i njihova opredijeljenost za određene segmente ovog rada, uz uvid njihovog pristupa kojim uzimaju učešće u tom procesu.

Nastavnik je u tradicionalnom smislu i mjerni instrument i mjerilac, te je s toga već jasno da čovjek nije u stanju udovoljiti zahtjevima koje stavlja pred sebe kao kreatora postupaka mjerenja. Pedagoški posmatran predmet mjerenja stavlja dilemu pred tog kreatora da li sam definira predmet mjerenja prema svojim mogućnostima ili drugim kriterijima. Zato je važno imati valjana mjerila kojima će se pravilno izmjeriti posmatrana pojava.

Učenici znaju da trebaju učiti, ali često ne znaju kako i na koji način postići uspješno učenje. Još manje znaju na koji način to pokazati i kako će sve biti podvrgnuti provjerama njihovih sposobnosti. Često znaju dobiti podršku u vidu često korištenih riječi; bravo, super, ti to znaš, napreduješ, može i bolje, što ih dodatno zbunjuje i dovodi u konfuziju. Kad se desi loša ocjena i neočekivan rezultat, skoro po pravilu izostaje smjernica i uputstvo kako to popraviti. Razumljivo je da će splasnuti motivacija i posvećenost kako učenika, tako i nastavnika. Vraćanje temeljnim odrednicama učenja i podučavanje vratit će i narušeno povjerenje koje dalje može donijeti progres u ostvarivanju boljih rezultata u učenju.

2. Vrednovanje, samovrednovanje i vršnjačko vrednovanje

Procjena je jedan od najvažnijih aspekata u obrazovanju kojim bi se nastavnik trebao baviti u toku i nakon procesa podučavanja i učenja. Igra značajnu ulogu u dokazivanju nivoa postignuća učenika. Što je pouzdanija, to je veći doprinos nastavi. Ona postaje važno sredstvo za podršku uspjehu učenja i pružanja povratne informacije učenicima. U tradicionalnom stilu učenja i podučavanja nastavnik ima presudnu ulogu u procjeni koju donosi, a učenici bi trebali prihvatiti samo ono što nastavnik presudi. U novijoj praksi učenici bi trebali biti uključeni u procjenjivanje vlastitih postignuća ili napretka u učenju. Aktiviranjem na ovaj način, naučit ćemo učenike da procjenjuju sami sebe što je sastavni dio cjelokupnog procesa učenja u kojem omogućavamo veću odgovornost prema svom učenju i prosuđivanju o onome što nedostaje i u kom dijelu je ostvaren napredak. Značajna procjena je procjena koja pruža autentično razumijevanje i kontekstualnu simboliku (Johnson & Johnson, 2002). U samoprocjeni učenici prave prosudbe o vlastitom radu, dok u vršnjačkoj procjeni donose prosudbu o radu ostalih učenika. Oboje je zasnovano na platformi kojom se želi poboljšati autentičnost procjene. Brown (2001) govori o prednosti ovog pristupa kroz brzinu, direktno uključivanje, podsticanje autonomije i povećanje motivacije jer se uključuju u proces učenja. Aktivnim učešćem u kreiranju ocjene, izborima kriterija i odlučivanju, održiva je priprema za kontinuirani radni angažman, a sutra i njihovu karijeru.

Uspjeh učenika u osnovi je proizvod aktivnosti ukršten sa očekivanim ishodima učenja. Vrednovanje se izvodi na temelju kontinuiranog praćenja učeničkih postignuća i uspjeha u ostvarivanju zadata nastavnog predmeta. To se ostvaruje nakon što je učenik imao aktivnosti učenja. Te aktivnosti će rezultirati maksimalnim uspjehom ukoliko se željeni rezultat postigne izuzetnim i efikasnim rezultatima u pogledu uštede vremena, troškova i truda. Jedan od načina da se sazna rezultat procesa učenja je povratna informacija od

nastavnika, vršnjaka i samoga sebe. Klasificirati faktore učeničkih postignuća moguće je kroz tri dimenzije: unutrašnji, vanjski i faktor pristupa učenju (Shah, 2001).

Ključ za dobijanje podataka i rezultata o uspjehu učenika leži u pokazateljima za određena postignuća koja se odnose na vrste postignuća koja će se izraziti ili mjeriti (Shah, 2001). U nastojanju da se postignu visoka postignuća učenika pristupit će se diferenciranoj ulozi svih aktera u procesu učenja i podučavanja. Na ovaj način uspostavlja se put samovrednovanju i vršnjačkom vrednovanju.

Može se reći da se postignuće učenja mjeri kao stečena sposobnost, postignuta ili prikazana kao dokaz osobi koja vrši učenje. Da bi utvrdio uspješnost učenika u procesu učenja, nastavnik je zadržao ocjenu ocjenjujući učenike. Poboljšanje postignuća učenika u školi zahtjeva izmijenjenu ulogu nastavnika s tim da sada ima partnera u tom učeniku, jer uspjeh učenika zavisi od kvaliteta nastavnika u kreiranju nastavnih situacija i poticanju samovrednovanja. Podsticajno djeluje na razvoj kognitivnih, afektivnih i socijalnih kompetencija odnos nastavnika i učenika.

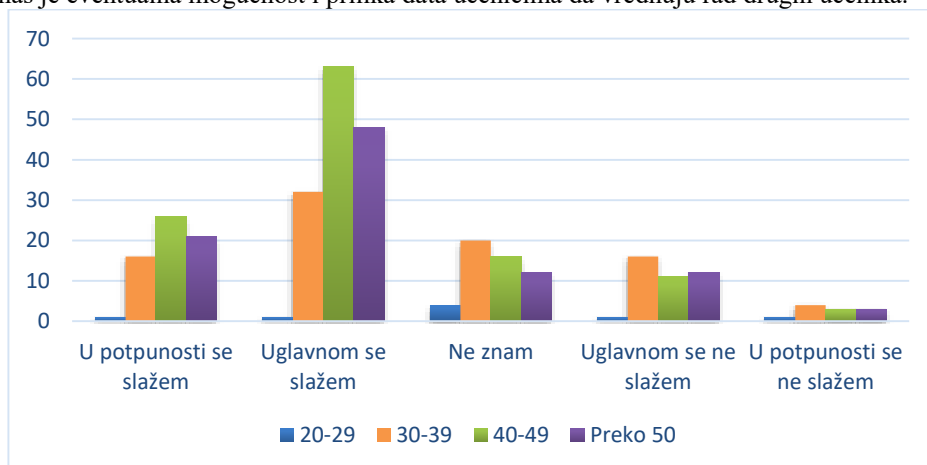
Provodeći refleksiju u reflektirajućoj nastavnoj praksi, učenici su osposobljeni za procjenu, kako sebe tako i drugih. Korištenje samoprocjene pomoću samoprovjere i popunjavanjem samoprocjenjujućih upitnika i vanjske provjere koja uključuje i vršnjake stvara se plan provjere i analize pokazatelja uspjeha. Govorimo o vrstama autentične procjene čiji je cilj učenicima omogućiti da pokažu svoje stvarne sposobnosti. Samim tim oni su u mogućnosti da sagledaju stvarno stanje, te da otkriju snage i slabosti. Postupak promišljanja o učenju važna je dužnost nastavnika koja će uticati na unapređenje nastave i učenje učenika.

Evaluacija je jedna od glavnih aktivnosti koje obično obavljaju nastavnici s ciljem pružanja povratne informacije, a sada govorimo o sve većoj uključenosti učenika. Walvoord (2010) je posmatra kao sistematsko prikupljanje informacija radi donošenja odluke o njihovim (učeničkim) postignućima. Samoprocjena je vrsta autentičnog postupka procjene formativnog ocjenjivanja tokom kojeg učenici razmišljaju o tome i ocjenjuju kvalitet svoga rada. Dvije su ključne aktivnosti u samoprocjenjivanju učenika; praćenje i evaluacija kvalitete njihovog razmišljanja i ponašanja pri učenju, a potom i prepoznavanje strategija koje poboljšavaju svoje vještine i razumijevanje. Samoprocjena se javlja kada učenici procjenjuju vlastiti rad s ciljem poboljšanja trenutnog uspjeha jer time utvrđuju razliku trenutne i željene učinkovitosti. To je strategija kojom se promišlja o greškama i slabostima pri korištenju jezika, organizacije misli i diskusija, kako bi se poboljšao proces učenja. Kroz samoprocjenu učenici su u stanju razlučiti šta znaju, a šta ne i tako mogu prepoznati šta dalje raditi. Time se podstiču da postave veći cilj i angažuju više ličnih resursa ili napora za njih. Pravilno izvršena samoprocjena angažuje unutrašnju motivaciju i osnažuje ih da sami upravljaju učenjem i internalizira kriterije za ocjenjivanje uspjeha. Na osnovu ovih stavova, samoprocjena i vršnjačka procjena nije samo cilj strategije evaluacije u kojoj učenici procjenjuju njihove snage i slabosti, jer je važnija kao strategija učenja i podučavanja koja učenicima donosi korist čime su osposobljeni da rade ono što uče, da se prilagođavaju, da promijene svoje mišljenje i da se usavršavaju kako bi ostvarili ciljeve. Usput, nastavnici prikupljaju informacije o problemima i potrebama svojih učenika.

Poznate su studije koje su dokazale značaj samoprocjene i vršnjačke procjene; Ross (2006) dokazuje pravilnu implementaciju procjene kojom se povećava motivacija, samopouzdanje i postignuća učenika; Munoz i Alvarez (2007) putem studije iz Kolumbije opravdavaju pozitivan stav samoprocjene; Panadero i dr. (2012) otkrili su da samoprocjena utječe na samoregulirano učenje i samoefikasnost; Sharma i dr. (2016) otkrivaju snagu korištenja samoprocjene kojom se poboljšava motiviranost za predmet koji se izučava, a ograničenje je u pogledu potrošnje vremena. Samoprocjena i vršnjačka procjena potiču učenike na učenje koje je smislenije i radi promišljanja i radi povratne informacije. Bilo da je fokus na kvantitativnoj ili kvalitativnoj studiji u osnovi je otkrivanje percepcije učenika o korištenju samoprocjene i kako će se to odraziti na učenje.

2.1. Interpretacija i diskusija

Nerijetko se i učenici nađu u ulozi ocjenjivača. Nastavnici to rade ponekad ciljano i s namjerom da potaknu i ovaj vid učenja i tako razvijaju osjećaj za pravilno i pravedno ocjenjivanje. Pošto ocjenjivati mogu samo oni koji imaju određeno znanje, isto dolazi do izražaja i u ovim situacijama. Pomno praćenje nastavnici može donijeti dodatne informacije o njihovim učenicima i tako upotpuniti procjenu koju oni izvode. Zanimala nas je eventualna mogućnost i prilika data učenicima da vrednuju rad drugih učenika.



Grafikon 1. Tvrdnje nastavnika o prilici procjenjivnja rada učenika od strane vršnjaka

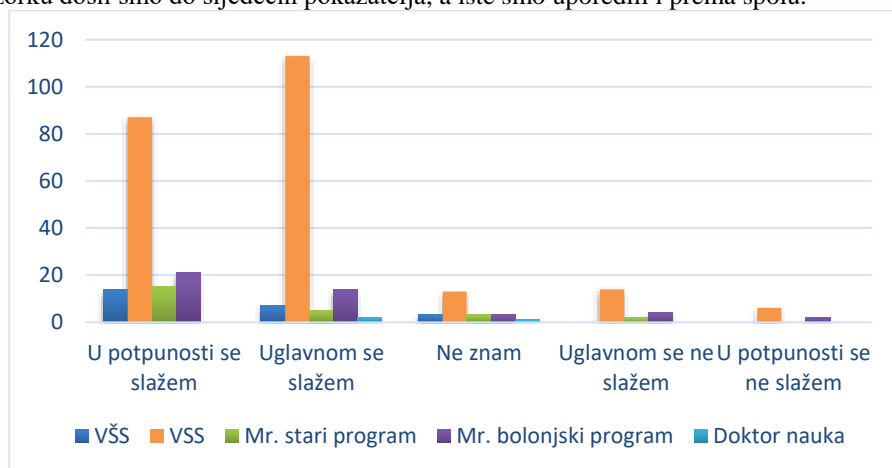
Tabela 1. Hi kvadrat testa mogućnosti procjene vršnjaka

	Value	df	Asymptotic Significance (2- sided)

Pearson Chi-Square	18.920 ^{a1}	12	.090
Likelihood Ratio	17.284	12	.139
Linear-by-Linear Association	4.106	1	.043
N of Valid Cases	327		

Prema rezultatima Hi kvadrat testa, $\chi^2=18.920$, $p=0.090$, postoji statistički značajna razlika na nivou od $\alpha = 0.10$ između dobne skupine ispitanika i prilike učenicima da vrednuju rad vršnjaka, tj. nastavnici (ne)pružaju priliku učenicima da vrednuju rad vršnjaka.

Sharma i dr. (2016) otkrivaju snagu korištenja samoprocjene kojom se poboljšava motiviranost za predmet koji se izučava, a ograničenje je u pogledu potrošnje vremena. Samoprocjena i vršnjačka procjena potiču učenike na učenje koje je smislenije i radi promišljanja i radi povratne informacije. Visok stepen slaganja svih ispitanika prisutan je kod tvrdnje da nastavnici koriste vrednovanje i samovrednovanje učenika kao podršku učenicima u ostvarivanju boljih rezultata. Uzimajući u obzir školsku sprema na ovom uzorku došli smo do sljedećih pokazatelja, a iste smo uporedili i prema spolu.



Grafikon 2. Prikaz vrednovanja i samovrednovanja kao vida podrške učenicima

Tabela 2. Hi kvadrat testa vrednovanja i samovrednovanja kao vida podrške učenicima

Nastavnici prema stručnoj spremi	Nastavnici prema spolu
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¹ Prigovor analizi: U našoj tabeli sedam ćelija (35.0%) ima očekivane frekvencije manje od 5. Minimalni očekivani rezultat je .34.

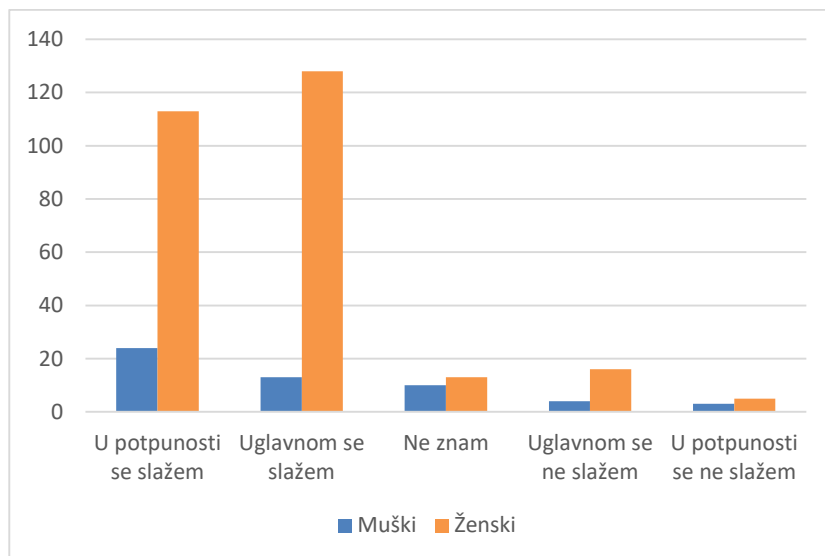
	Value	df	Asymptotic Significance (2-sided)	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23.908 ^{a1}	16	.092	20.501 ^{a2}	4	.000
Likelihood Ratio	26.533	16	.047	17.798	4	.001
Linear-by-Linear Association	.804	1	.370	2.998	1	.083
N of Valid Cases	329			329		

Prema rezultatima Hi kvadrat testa, $\chi^2=23.908$, $p=0.092$, postoji statistički značajna razlika na nivou od $\alpha = 0.10$ između školske spreme ispitanika i korištenja vrednovanja i samovrednovanja učenika kao podrške učenicima u ostvarivanju boljih rezultata, tj. procesi vrednovanja i samovrednovanja različito se posmatraju u pogledu podrške ostvarivanju boljih rezultata u učenju.

Jedna od bitnih karakteristika ovog procesa je samovrednovanje. Ono treba polaziti od edukatora i pružati konstantnu podršku učenicima. Savremena nastava i učenje idu u smjeru samoučenja i samoevaluacije. Nastavnici, učenici, koristeći posmatranje, ispitivanje, dobijaju evaluacijske povratne informacije, a za veći značaj znanja u nastavnom programu zalagali su se Wheelahan (2010) i Young (2013). Stoga nas je zanimalo kako *nastavnici koriste vrednovanje i samovrednovanje učenika kao podršku učenicima u ostvarivanju boljih rezultata*. Iako nastavnici izvještavaju da to koriste u nastavi procjenjivanja postignuća, značajan je rezultat $p=0.000$ na uzorku učenika koji nas upućuje na statističku razliku njihovih stavova.

¹ Prigovor analizi: U našoj tabeli četrnaest ćelija (56.0%) ima očekivane frekvencije manje od 5. Minimalni očekivani rezultat je .07.

² Prigovor analizi: U našoj tabeli tri ćelije (30.0%) imaju očekivane frekvencije manje od 5. Minimalni očekivani rezultat je 1.31.



Grafikon 2. Korištenje vrednovanja i samovrednovanja u svrhu ostvarivanja boljih rezultata

Na uzorku nastavnika u pogledu spolne zastupljenosti, a prema rezultatima Hi kvadrat testa, $\chi^2=20.501$, $p=0.000$, postoji statistički značajna razlika na nivou od $\alpha = 0.01$ između spola ispitanika po pitanju korištenja vrednovanja i samovrednovanja učenika u svrhu ostvarivanja boljih rezultata, tj. nastavnici različito postavljaju procjenjivanje kao podršku učenicima u ostvarivanju boljih rezultata.

Dugogodišnje studije za ocjenjivanje ukazuju na ocjenu kao odraz brojnih faktora koje nastavnici vrednuju (prisustvo, uključenost, sposobnost, radne navike, trud, zalaganje, itd.) zavisno od toga šta nastavnik uzima kao relevantan pokazatelj ocjenjivanja (Brookhart i dr., 2016).

3. ZAKLJUČAK

Nastavna situacija podređena učenju je svaka ona koja će pružiti aktivnim sudionicima da ostvare ili na novi način upotpune bilo koju ambiciju. Željeli oni nešto samo naizgled promijeniti ili uspostaviti novi model koji će funkcionisati, učenje će se odvijati i tokom same procjene tih postignuća. Jasno i nedvosmisleno ukazujemo na to da svaka situacija treba stvoriti priliku da se ostvari učenje, a da ono rezultira razumijevanjem i saradništvom na relaciji nastavnik-učenik.

Sudionici otvorenog pristupa i kritičkog promišljanja osigurati će pravilnu ulogu svakom od njih. Prije nego nastavnici pokušaju razviti fleksibilnije nastavne stilove, oni trebaju stvoriti ideju za promjenu, počevši s njihovim uvjerenjima o ulozi učenika u okruženju učenja (Pedler i Evans, 2011). Saradnja je time zagarantovana i stavljena u funkciju kompetentnih pojedinaca. U ovim okolnostima osim što su upućeni jedni na druge, oni su

sada i blisko povezani. Uloga ovakve odgojno-obrazovne stvarnosti osigurat će svima podjednake šanse da potpuno opravdaju odlike savremene nastave i na taj način zadovolje ambicije svoje uloge. Nekada smo imali nametnute i unaprijed osmišljene zadaće unutar te stvarnosti, a danas je svaka od njih upućena na onu drugu s uporištem na jasnu zadaću koju ima i onim što se od nje očekuje.

Procjenu aktivne uključenosti donosit će svako zasebno, a potom istu argumentovano prezentirati u svom užem okruženju. Svaku planiranu procjenu učiniti aktivnom prilikom za učenje tokom procjenjivanja i uvećati šanse za primjenu naučenog kao i produbljivanje stečenog. Ovim će se unaprijediti kriteriji jasnoće, kao i strukturiranosti i objektivnosti cijelog procesa. Mogućnosti za učenike su višestruke, od samovrednovanja, do vršnjačkog vrednovanja. Samoaktualizacija koja je, čini se važnija nego ikada do sada, samoobrazovanje, te saradništvo, nude brojne benefite svima kojih se s obzirom na okolnosti niko ne smije odreći. Diskusija je važav element ovakve procjene i omogućit će svima podjednaku pažnju i privrženost mjerenju postignuća. Upravo i taj pristup osigurava iskustvo procjene koje odražava interese i ciljeve kako nastavnika tako i njihovih učenika. Ostvarenje samovrednovanja i vršnjačkog vrednovanja započinje iznošenjem ličnih stavova i zastupanjem određenih teza. Ovim sučeljavanjem lične procjene s onim očekivanim ishodima učenja, zapravo počinje i odvija se učenje kao i procjenjivanje, te samoprocjenjivanje, jer procjenjivati mogu samo oni koji posjeduju određeno znanje zahvaljujući kojem će to i realizovati. Vršnjačko procjenjivanje može ponuditi još jedan alat kojim će se nastavno osoblje okoristiti u ovom sistemu „mjeriteljstva“. Samovrednovanje je kao i samoobrazovanje postalo neizbježno u vremenu u kom živimo. Uslov pravilnoj primjeni zahtijevat će valjanu pripremu i odgovor na pitanje kako upotrijebiti vrednovanje i samovrednovanje u svrhu ostvarivanja boljih rezultata. Nastavnici već koriste samovrednovanje kao podršku postizanju boljih rezultata. Uz redovno prilagođavanje metoda provjeravanja znanja individualnim potrebama učenika, ostvaruje se i podrška ostvarivanju boljih rezultata. Tu procjenu aktivne uključenosti donosit će svako zasebno i koristiti prema ličnoj procjeni u odnosu na svoja postignuća. Od izuzetnog značaja je da se u toku ovog procesa isprate i podržavaju nastavnici, savjetnici, direktori, kreatori obrazovnih politika. Sama postignuća prate podučavanje kroz koje se i ostvaruju. Zato u njima s punim pravom trebaju učestvovati kako edukatori tako i učenici. Sve češće govorimo da savremena škola donosi izmijenjenu ulogu nastavničke profesije, ali i kompetencije učenika.

Očito je da neke promjene važne za sistem odgoja i obrazovanja u dijelu mjerenja postignuća tek trebaju da zažive u praksi. Stoga je neophodno načiniti veoma važne korake koji će obezbijediti dalji napredak u trenutnim okolnostima. Kada govorimo o praćenju, mjerenju i evaluaciji, očigledan je kontinuitet i težnja da se optimizuje ovaj izuzetno važan proces. Izuzev toga što se primarno posmatra kroz pisanu i usmenu provjeru, a periodično i praktičnu, praksa otkriva parametre koji sugerišu mnogo više od toga. Nastavnici koriste različite „mjere“ i „mjerila“, kako u onim najčešćim, pisanim i usmenim, tako i u identičnim oblastima; predmetima. Ponekad taj diferencirani pristup može biti prednost, ali češće je nedostatak upravo zbog nekonzistentnosti.

Nadalje dolazimo do tumačenja takvih procjena koja su različita. Vizavi „mjera i mjerila“ koja su takva, tumačenja su predodređena za razilaženje. Dodatno je onemogućeno razumijevanje onima na koje se odnosi u prvom redu, a to su učenici. Ta konačna prosudba bi njima trebala biti poznata od samog početka do kraja jer su direktni sudionici kompletnog procesa.

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EVALUATION, SELF-ASSESSMENT AND PEER EVALUATION IN THE FUNCTION OF MONITORING STUDENT ACHIEVEMENTS

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ABSTRACT:

Measuring and monitoring student's achievement requires continuity and intention in this complex approach. To monitor means to determine in advance of the occurrence of monitoring, to approach it with clear steps and with all the elements of that process. It is of crucial importance to familiarize each student with all the elements that will be monitored and the time frame in which it will be realized. All of the above is aimed at monitoring educational outcomes and the effectiveness of measures adopted, based on those results. This presentation of achievement monitoring leads to accelerated development of mental abilities and psychological functions, because everyone wants to achieve high success, therefore active and continuous learning is ensured. All measurement procedures are interesting for students, although they carry a certain degree of stress, trying not to let down teachers and parents. In addition, self-evaluation and peer evaluation can reduce this stress and provide greater involvement and additional continuity to this process. The difference is made by many factors, and some of them were investigated through the research we conducted for this purpose. Evaluation, which determines the level of student achievement during, during and immediately after learning in terms of mastering knowledge, skills and given competencies, belongs to the most important segments of educational work. The entire process of monitoring and evaluating learning outcomes occupies a high place in the hierarchy of teaching values. It is carried out daily, periodically, occasionally, targeted and spontaneous, aimed at individuals and groups. Various approaches are used to collect as much different information and elements of observed phenomena as possible. Their interpretation is the result of systematic questioning and monitoring of respondents. Evaluation in the teaching process should be resorted often, in different ways and in regular terms. In this process, students can and should be active allies.

Keywords: evaluation, achievement monitoring, self-evaluation, peer evaluat.



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