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S poštovanjem,

Dr Dejan Kojić, vanredni profesor
Glavni i odgovorni urednik

EDITORS' INTRODUCTION

Dear fellow authors, distinguished readers,

In the front of you is the second issue of the scientific journal of social and technological development - STED Journal in 2024, published by the University of Business Engineering and Management. The first issue in 2024 includes 7 papers. Published papers have got a positive review by two independent reviewers. Reviews are anonymous and reviewers do not know the authors identity. Reviewers have also suggested the sorting of papers into scientific and expert categories. Reviewers have given their consent for publishing of paper based on their assessment of originality, novelty, used methodology and literature of paper.

Each paper is assigned COBISS, UDC and DOI number by the National and University Library of the Republic of Srpska. The journal has its analytically revised articles which are published in the current national bibliography, and it is included in the central electronic catalogue. All members of the editorial board have scientific or educational titles from the narrow scientific fields covered by the journal. The journal is included in the DOAJ, ERIH+, CEEOL, INDEX COPERNICUS, GOOGLE SCHOLAR and OPAC citation databases.

On the last pages of the journal, there is also the bibliography of papers published in the second issue in 2023.

We thank the reviewers of papers whose professionalism and critical approach have greatly contributed to the quality of published papers.

With best wishes,

Dr Dejan Kojić, docent
Editor-in-Chief

SADRŽAJ – TABLE OF CONTENTS

ANTICANCER POTENTIAL OF NOVEL PALLADIUM(II) COMPLEXES WITH ACYL PYRUVATES AS LIGANDS: DNA AND BSA INTERACTIONS AND MOLECULAR DOCKING STUDY

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ORIGINAL SCIENTIFIC PAPER

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ABSTRACT

Bearing in mind that some palladium complexes showed good antitumor potential while exhibiting less kidney toxicity comparing to cisplatin, to discover a new agents for chemotherapy with improved properties two novel palladium(II) complexes [Pd (L)$_2$] (**3A** and **3B**) with acyl pyruvates (*O,O* bidentate ligands) were synthesized and characterized by spectral (UV-Vis, IR, NMR, ESI-MS) and elemental analysis. The novel palladium(II) complexes were analyzed for their cytotoxic potential on human cancer cell lines (HeLa and MDA-MB 231) and normal fibroblasts (MRC-5). Results showed that complex **3A** displayed very good cytotoxic activity, while complex **3B** had moderate activity on the tested tumor cell lines. After 48h incubation with complex **3A**, his IC$_{50}$ values were similar to the IC$_{50}$ values of cisPt. Notably, all IC$_{50}$ of complex **3A** on human fetal lung fibroblasts (MRC-5) were higher than 100 μM, indicating good selectivity. In addition, complex **3A** induced apoptotic type of cell death, cell cycle arrest in G0/G1 phase in both HeLa and MDA-MB 231 cell lines. In addition, we revealed that **3A** can be useful as adjuvants in cancer therapy by reducing the dose of cisplatin and in this manner its' side effects. For the investigations of interactions between novel palladium(II) complex **3A** and CT-DNA or bovine serum albumin (BSA) fluorometric titrations method was used. The obtained results implied that **3A** has great affinity to displace ethidium bromide (EB) from the EB-DNA complex through intercalation, suggesting strong competition with EB. Results in fluorescence titration of BSA with complex **3A** showed that the fluorescence quenching of BSA happens because of the formation of the **3A**-BSA complex. Obtained K$_a$ value is in the optimal range signifying that appropriate amount of **3A** can be transported and distributed through the cells. In order to better understand the binding of newly synthesized complex **3A** to BSA or DNA, molecular docking study was further performed.

Keywords: Palladium(II) complexes, acyl pyruvates, anticancer activity, protein binding study, DNA interactions, molecular docking.

INTRODUCTION

Since finding the cisplatin metal-based compounds have gained great importance in medicinal science (Rosenberg, Van Camp, & Krigas, 1965; Desoize, & Madoulet, 2002). Although platinum-based drugs have been used extensively as anticancer drugs they are showing many shortcomings such as acute drug resistance on some tumors, nephrotoxicity, and neurotoxicity (Ott, & Gust, 2007; Hartmann, & Lipp, 2003; Sastry, & Kellie, 2005). Therefore, the examination for novel anticancer agents with enhanced properties has been focused on the discovery of some other metal-based drugs. The similar coordination behavior of platinum(II) and palladium(II) was one of the greatest interests for the development of the antitumor palladium based drugs (González, et al., 1997; Ali, et al., 2002). Investigations showed that palladium complexes hold better, or at least comparable antitumor activity compared to cisplatin (Lee, et al., 2015; Mazumder, Beale, Chan, Yu, & Huq, 2012). It has been also reported that numerous Pd complexes displayed less kidney toxicity comparing to cisplatin and other Pt complexes (Trevisan, et al., 2002). In addition, palladium complexes with organic ligands showed very good cytotoxic activity on various cancer cell lines compared to cisplatin (Chiririwa, Moss, Hendricks, Meijboom, & Muller, 2013; Krogul, et al., 2012; Abu-Surrah, et al., 2010; Ajloo, et al., 2015).

Organic ligands such as acyl pyruvates have been broadly used as starting substrates in medicinal chemistry to obtain novel potential drugs (Guo, et al., 2016; Shehab, & El-Bassyouni, 2018; Stepanova, Dmitriev, & Maslivets, 2019; Kulakov, et al., 2017). This structural fragment can be found in many biologically active compounds and natural products. Their crucial feature in acyl pyruvate molecule is the presence of keto-enol tautomerism, where the equilibrium of the ketone and the enol forms in is strongly shifted towards the enol form due to the formation of the distinct resonance structure as a six-membered ring (Zalesov, Kataev, Pulina, & Kovylyaeva, 2002). The most important, the capacity to form stable complexes with most metals is a direct consequence of the occurrence of such compounds in the enol form. Also, the combination of highly electrophilic character and oxygen-rich coordination sites combined with the capacity to form stable complexes with most metals is making acyl pyruvates excellent candidates for synthesis of novel metal-based compounds (Prokop, Gelbrich, Sieler, Richter, & Beyer, 2001). Therefore, new metal-based agents such as palladium complexes appear to be promising for the development of novel and improved chemotherapeutic drugs.

It is very important to study the binding modes with DNA molecule and potential drug in order to examine the probable mechanism of antitumor activity. DNA is major target for the multiplicity of drugs and small molecules (Lazić, Arsenijević, Puchta, Bugarčić, & Rilak, 2016; Li, et al., 2015; Sánchez, Penas, Vásquez, & Mascareñas, 2014). Conventionally, a small molecular size compound can interact with DNA through covalent or noncovalent interaction (Lauria, et al., 2014; Bork, et al., 2014; Abd Karim, et al., 2014). Investigations of this mode of interactions are very useful in the discovery of a good efficiency drug, their mechanism of action or to examine its toxic properties (Zhang, & Liu, 2011; Shen, Shao, Xu, Li, & Pan, 2011; Hartwig, 2010). For the molecules that showed good antitumor property, it is imperative to investigate the mode of binding to transport proteins, to better verify the potential use of a drug in clinical practice in future. The serum albumins exhibit a significant role in the transport and deposition of the biologically significant molecules or drugs in the circulatory system (Kandagal, et al., 2006). Furthermore, it is very important for a small molecule or a potential drug to bind reversibly to serum albumins (Bertucci, & Domenici, 2002).

RESULTS AND DISCUSSION
Synthesis and characterization

The Claisen condensation reaction between diethyl oxalate and different methyl ketones 1 under basic conditions was used to obtain *O,O*-bidentate ligands **2A** and **2B** (**Scheme 1**). The synthesis of the ligands was performed according to the early published procedure (Andrzejak, et al., 2010). The reaction procedure that we published earlier, between $K_2[PdCl_4]$ and acyl pyruvates ligands in 1 : 1 water/methanol solution, was used for obtaining two novel palladium(II) complexes **3A** and **3B** (**Scheme 1**) (Joksimovic, et al., 2020). In a short reaction time (~10 min) at

room temperature this salt yielded complexes **3A** and **3B** with corresponding ligands. The obtained yields for complexes **3A** and **3B** were 86% and 83%, respectively.
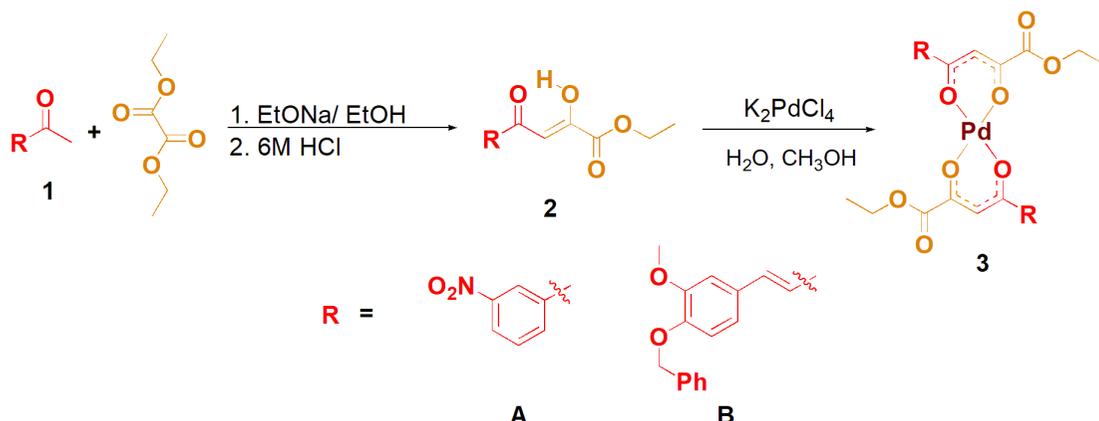
Scheme 1. Synthesis of acyl pyruvate ligands **2A** and **2B** and their palladium(II) complexes **3A** and **3B**.

Both new complexes were characterized *via* spectral (UV-Vis, IR, NMR, ESI-MS) and elemental analysis. As in the previously published palladium complexes with similar ligands (Joksimovic, et al., 2020), IR spectra of complexes **3A** and **3B** showed bands approximately at 1570 and 1510 cm^{-1} that are assigned to ν(C=C) coupled with ν(C=O) and ν(C=O) coupled with ν(C=C) respectively. The IR spectra of all complexes compared to corresponding spectra of ligands showed that ν(γ-C=O) is approximately 15 cm^{-1} negative shifted. The absence of intense bands near 1270 cm^{-1} in the spectra of complexes, that appears in the spectrum of corresponding ligands as the consequence of bending O–H vibrations in the plane (dos Santos, & Cavalheiroll, 2014; Zolezzi, Decinti, & Spodine, 1999) is caused by the coordination of the ligand to palladium(II) which is followed by the deprotonation of the O–H group.

Anticancer potential

The antitumor potential and selectivity of two novel palladium(II) complexes **3A** and **3B** was investigated on two tumor cell lines (HeLa and MDA-MB 231) and one normal MRC-5 cell after 24 and 48h treatment with a range of concentrations. Based on the achieved results, IC$_{50}$ values were calculated and presented in **Table 1**.

As shown in **Table 1**, complex **3A** showed very good cytotoxic activity, while complex **3B** showed moderate activity on the tested tumor cell lines. After 48h incubation with complex **3A**, his IC$_{50}$ values were similar to the IC$_{50}$ values of cisPt. Tested cells, MDA-MB 231 and HeLa, showed diverse sensitivity on tested complexes. Obtained IC$_{50}$ values were lower in HeLa cells, thus indicating a higher sensitivity of these cells compared to MDA-MB 231.

Based on obtained results, we carefully chose complex **3A** for further investigation. To determine its selectivity, the cytotoxic effects of complex **3A** were examined on human fetal lung fibroblasts. MRC-5 cells were treated with the same concentrations of complex **3A** for 24 and 48 hours. The determined IC$_{50}$ values are given in **Table 1**. Notably, all IC$_{50}$ values were higher than 100 μM, indicating good selectivity of complex **3A**. This is crucial since good selectivity is one of the main factors for a new antitumor drug candidate.

Joksimović, N., et al. (2024). Anticancer potential of novel palladium(II) complexes with acyl pyruvates as ligands: DNA and BSA interactions and molecular docking study. *STED Journal, 6*(1), 1-14.

Table 1. In vitro inhibitory activity (IC$_{50}$) (μM) of novel palladium(II) complexes **3A** and **3B** on human cancer cell lines (HeLa and MDA-MB 231) and human fibroblasts (MRC-5) after 24 and 48 h of treatment. Cisplatin was used as a positive control. (n.d. - not determined).

	MDA MB 231		HeLa		MRC-5	
	24h	**48h**	**24h**	**48h**	**24h**	**48h**
3A	158.6±45.4	95.8±52.5	58.2±7.0	5.9±3.2	>100	>100
3B	183.0 ± 43.4	94.5 ± 20.4	99.7 ± 11.0	43.8 ± 0.3	n.d.	n.d.
cisPt	101.2±6.7	53.8±2.8	25.7 ± 2.9	8.7 ± 1.3	183.7 ± 16.2	43.1 ± 8.8

Palladium(II) complex 3A induced apoptosis and cell cycle arrest in HeLa and MDA-MB 231 cells

The obtained results showed, when annexin V-FITC/7-AAD staining of cells were treated with IC$_{50}$ concentration of **3A,** that complex induced apoptotic type of cell death in both HeLa and MDA-MB 231 cell lines (**Figure 1 (A)**). The investigations were performed by the procedure we previously published (Joksimovic, et al., 2020). Treated cells were primarily early or late apoptotic, and a slight percentage of cells were necrotic. Necrosis is type of cell death that induce inflammation and injury of surrounding tissue, opposite to apoptosis that is restricted to the individual cells. Therefore, induction of apoptosis in cancer cells and their elimination without induction of undesirable inflammatory response is the aim of anticancer therapy.

In addition, it is important to emphasize that the cell cycle progression is well-controlled process controlled by conserved mechanisms. Regulatory pathways monitoring proper progression through the cell cycle are referred to as cell cycle checkpoints. To maintain tissue homeostasis, cell proliferation and cell death are equally important. Based on those facts it can be concluded that apoptosis and cell cycle share certain regulatory molecules. In case of harm or cellular stress these regulatory molecules can arrest cell cycle until the damage is repaired or stress signals eliminated, while in contrary apoptotic death program is activated. Thus, apoptosis can be activated by the agents that induce cell cycle arrest. The investigations of cell cycle arrest were performed by the procedure we previously published (Joksimovic, et al., 2020). Obtained results in cell cycle analysis displayed that complex **3A** induces cell cycle arrest on both tested cell lines, and its influence on cell cycle is presented on **Figure 1 (B)**. As can be noticed, in both HeLa and MDA-MB 231cells, complex **3A** induced cell cycle arrest in G0/G1 phase. These results suggest that the cell cycle arrest is probably linked with apoptosis induction.
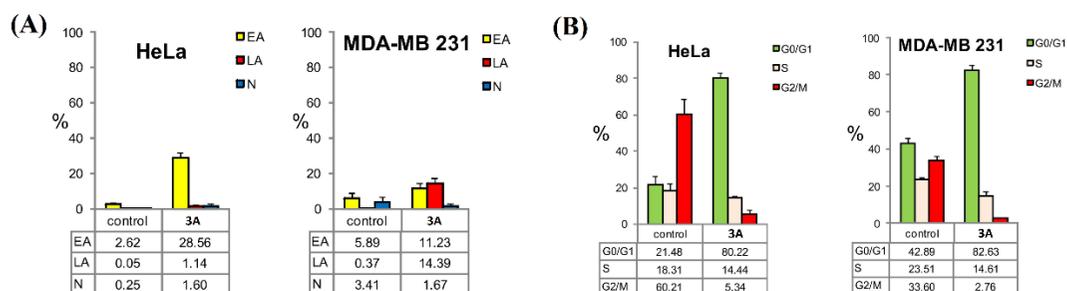
Figure 1. (A) Flow cytometric analysis of Annexin V-FITC/7-AAD staining. Graphs showing percent of early apoptotic (EA), late apoptotic (LA) and necrotic cells (N) in untreated (control) and treated HeLa and MDA-MB 231 cells with complex **3A**. Results are presented as an average of two independent experiments; **(B)** Cell cycle analysis**.** Graphs showing cell cycle distribution in untreated (control) and treated HeLa and MDA-MB 231 cells with complex **3A**. Results are presented as an average of three independent experiments.

The interactions of cisplatin and palladium(II) complex 3A

The cytotoxic effect of cisplatin and complex **3A** separately and different concentrations of **3A** on HeLa cells (**Figure 2**) were used for determining combination index (CI). The investigations were performed by the procedure we previously published (Joksimovic, et al., 2020). F_a indicates fraction of cell viability affected (**Figure 2**). F_a=0.05-0.97 corresponds to 5-97% toxicity. The results indicated that combinations of the lowest concentrations of both cisplatin and complex **3A** were most effective, considering that CI value showed strong (the lowest concentrations of **3A**) to moderate synergism (the lowest concentrations of cisplatin and higher concentrations of **3A**). These results imply that **3A** can be useful as adjuvants in cancer therapy by reducing the dose of cisplatin and in this manner its' side effects.
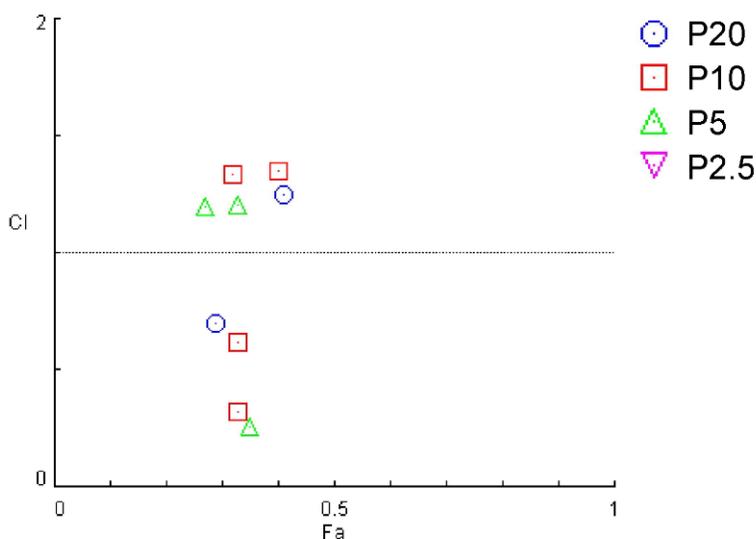
Figure 2. Combination Index Plots presenting the combined effects of palladium(II) complex **3A** and cisplatin on HeLa cells. Various concentrations of **3A** were combined with cisplatin concentrations: 20μM (Pt20), 10μM (Pt10), 5μM (Pt5) and 2,5μM (Pt2,5).

Interactions of palladium(II) complex 3A with DNA

Ethidium bromide (EB) is a chemical with a favorably planar structure. Because of its structural characteristics, there is an opportunity of intercalating into molecule of DNA. These interactions lead to an increase in fluorescence intensity. Fluorescence emission comes as a result of effective intercalation between the base pairs of DNA and EB. Emission of EB-DNA complex that is formed can be quenched by adding some potential drug. If a drug or small molecule intercalates into DNA molecule the binding positions of DNA accessible for EB decreases, resulting in quenching of the fluorescence of the EB–DNA system (Bertucci, & Domenici, 2002). Therefore, we tested the competitive binding mode of **3A** with EB-DNA complex using the procedure described earlier (Joksimovic, et al., 2020). Fluorescence quenching spectra of titration EB–DNA with **3A** (**Figure 3**), were recorded in the range of 550–750 nm. These spectra at 610 nm pointed a decreasing trend with the increasing concentration of **3A**, implying that EB was replaced by the compounds **3A**.

Joksimović, N., et al. (2024). Anticancer potential of novel palladium(II) complexes with acyl pyruvates as ligands: DNA and BSA interactions and molecular docking study. *STED Journal, 6*(1), 1-14.
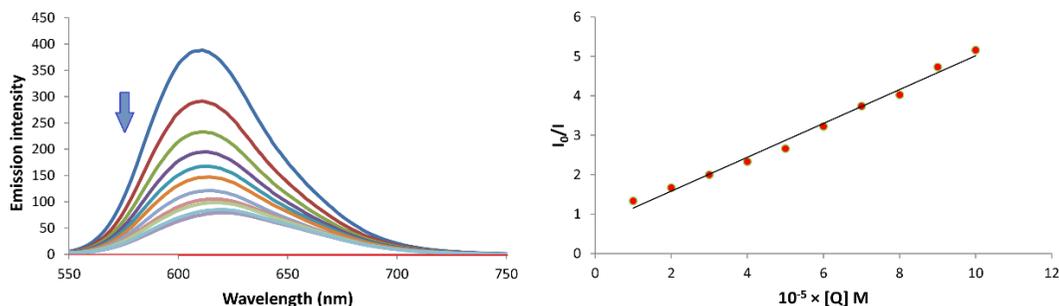
Figure 3. Left: emission spectra of EB-DNA in the absence (blue lines) and presence of compounds 3A. The red lines denote solutions: buffer + quencher. [EB] = 100 μM; [DNA] = 100 μM; [3A] = 0–100 μM; pH = 7.4; λ_{ex} = 500 nm. Right: plots of I_0/I versus [Q].

A quenching constant (K_q) was determined by examining the dependency of I_0/I on [Q] (**Figure 3**) using Sterne-Volmer equation **(1)** (Lakowicz, & Weber, 1973). These investigations were performed in order to better understand the binding strength of compound **3A** to CT-DNA. The quenching constants for **3A** that are given in **Table 2** specify that **3A** has the competence to displace EB from the EB–DNA complex by binding to DNA through intercalation (Petronijević, et al., 2018).

$$I_0/I = 1 + k_q\tau_0[Q] = 1 + K_{SV}[Q] \qquad (1)$$

Table 2 The bimolecular quenching rate constant (k_q), Stern–Volmer constant (K_{sv}), and correlation coefficient (R) for compound **3A**.

Compound	k_q [M^{-1} s^{-1}]	K_{sv} [M^{-1}]	R
3A	$(4.3 \pm 0.2) \times 10^{13}$	$(4.3 \pm 0.2) \times 10^5$	0.994

Interactions of palladium(II) complex 3A with bovine serum albumin

Bovine serum albumin (BSA) which has very similar structural properties to human serum albumin (HSA) is frequently used in studies of the interactions with drugs or small molecules and proteins, doe to it is responsible for the transport of drugs in biological systems. Since the efficiency of potential drugs depends on their capacity to bind to transport proteins, we investigated the binding mode of **3A** with BSA using the procedure we described previously (Joksimovic, et al., 2020). The fluorescence spectroscopy titration method was used to investigate the binding of different compounds to serum albumins, giving binding results mechanism, binding method, and binding sites in the protein. The fluorescence emission spectra were obtained in the wavelength range of 310–500 nm (**Figure 4**).

The binding constant (K_a) and a number of binding sites for each BSA molecule (n) were determined using the equation **(2)** (Strekowski, & Wilson, 2007):

$$\log(I_0-I/I) = \log K_a + n \log[Q] \qquad (2)$$

I_0 is the emission intensity in the absence of **3A**, I is the emission intensity for the complexes **3A**–BSA. [Q] is the concentration of **3A**. The K_a values and n are determined by investigating the dependence of $\log[(I_0-I)/I]$ versus $\log[Q]$ (**Figure 4**). The obtained K_a values, given in **Table 3,** indicate that **3A** has a strong binding affinity to BSA. The number of binding site for **3A** (n≈2, **Table 3**) shows that **3A** binds to BSA in the molar ratio 2 : 1

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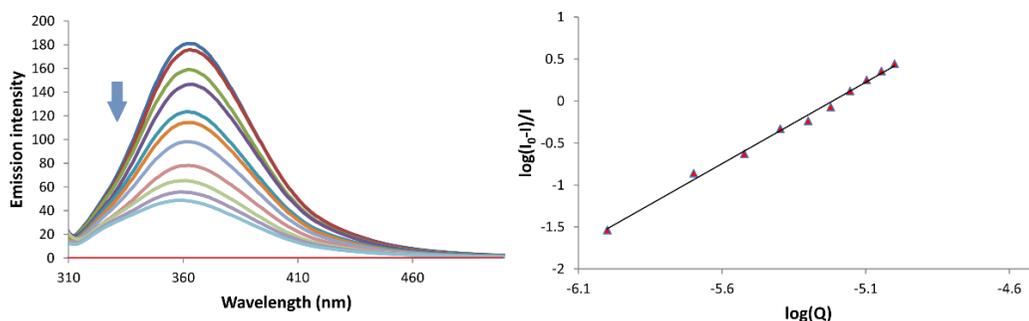
Figure 4. Left: emission spectra of BSA in the absence (blue lines) and presence of compound **3A**. The red lines denote solutions: buffer + quencher. [BSA] = 10.0 μM; [**3A**] = 0–10 μM; pH = 7.4; λ_{ex} = 280 nm. Right: the dependence of $\log(I_0-I/I)$ on $\log[Q]$.

Table 3. Binding parameters (K_a and n) and the correlation coefficient (R) for interactions of **3A** with BSA.

Compound	K_a [M^{-1}]	n	R
3A	$(2.4 \pm 0.2) \times 10^5$	1.94	0.996

Docking study of palladium(II) complex 3A with DNA and BSA

Simulations of binding of complex **3A** to DNA or BSA were performed using molecular docking tools in order to further confirm results obtained from study of interactions with DNA and BSA and to examine possible modes of binding. Results of the docking experiments are given in Table **4**. In case of complex **3A** with BSA the obtained value of ΔG was -7.98 kcal·mol^{-1}, while with DNA was is -6.93 kcal·mol^{-1}. Thus, represented data (**Table 4**)

predicts strong binding to DNA and **3A** complex system. The best docking poses are presented in **Figure 5** (between **3A** and BSA) and **Figure 6** (between **3A** and DNA).

As far as interaction is concerned, in case of complex **3A** with BSA protein primary comes from van der Waals force and conventional hydrogen bonds (**Figure 7**). In the case of the same complex with DNA molecule contributions are also given by conventional hydrogen bonds and by van der Waals force (**Figure 8**).

Table 4. Overview of molecular docking calculations for tested complex **3A** with BSA and DNA.

Label	Complex	ΔG^a
3A	**3A** with BSA	-7.98
3A*	**3A** with DNA	-6.93

^{a}kcal·mol^{-1}.

Joksimović, N., et al. (2024). Anticancer potential of novel palladium(II) complexes with acyl pyruvates as ligands: DNA and BSA interactions and molecular docking study. *STED Journal, 6*(1), 1-14.
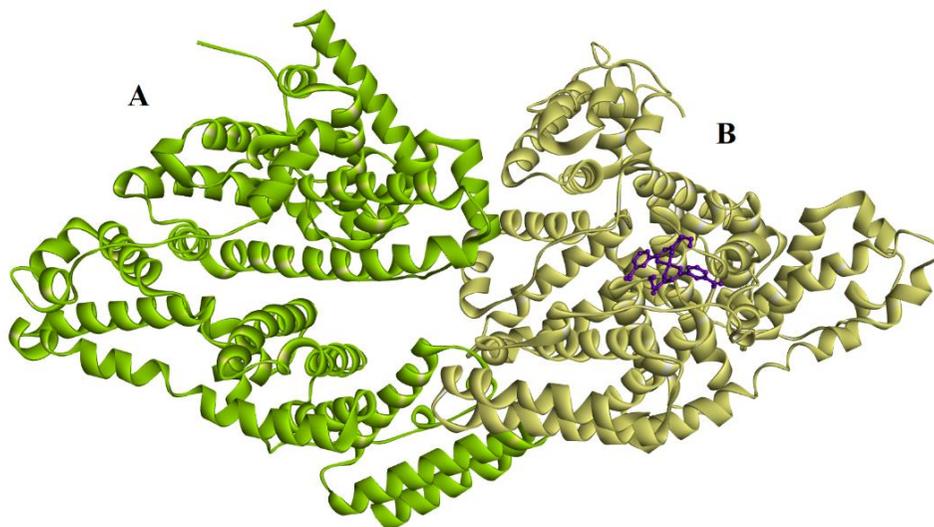
Figure 5. Best docking pose of complex **3A** (purple colored) with BSA protein (with domains A (green colored) and B (yellow colored).
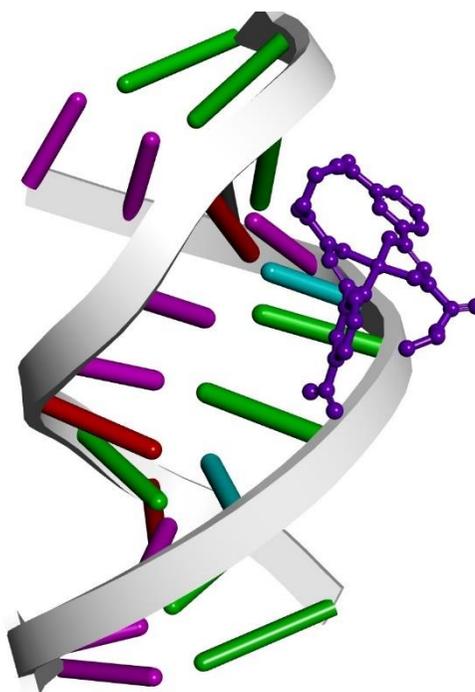
Figure 6. Best docking pose of complex **3A** (purple colored) with DNA molecule

Joksimović, N., et al. (2024). Anticancer potential of novel palladium(II) complexes with acyl pyruvates as ligands: DNA and BSA interactions and molecular docking study. *STED Journal, 6*(1), 1-14.
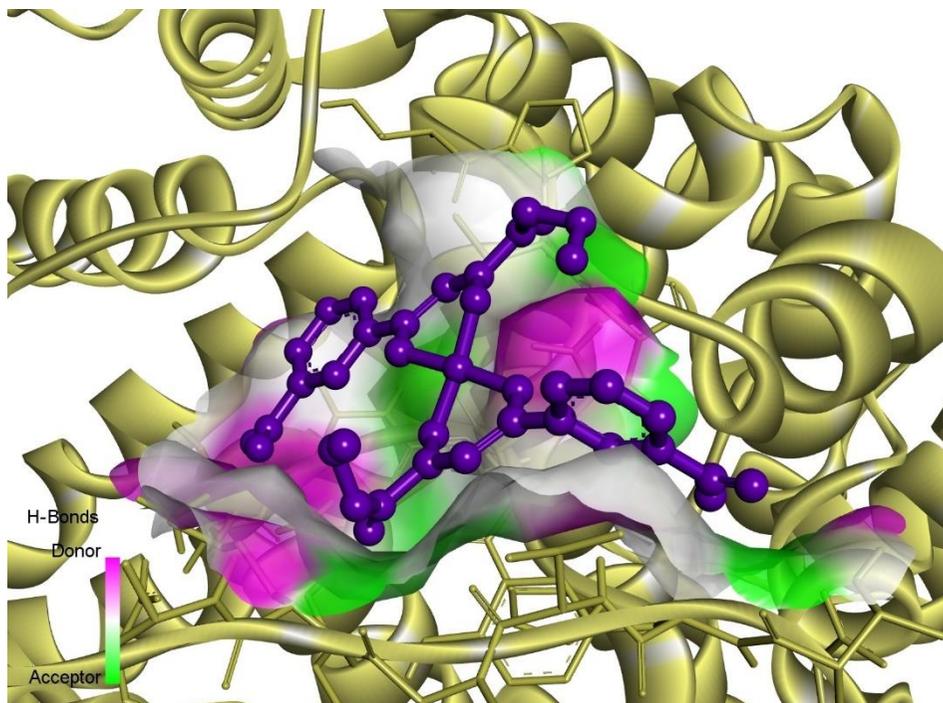
Figure 7. Interaction contributions for the complex **3A** with BSA protein.
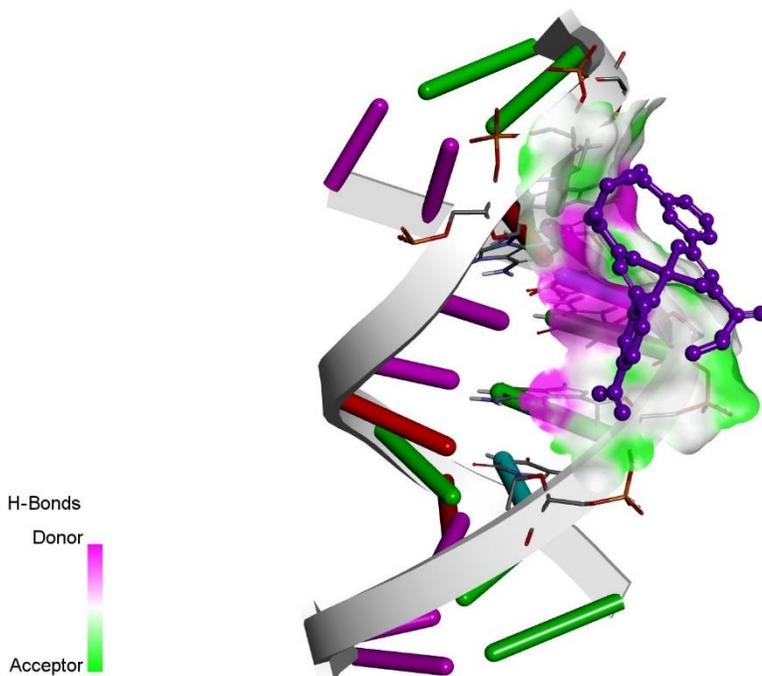
Figure 8. Interaction contributions for the complex **3A** with DNA molecule.

Joksimović, N., et al. (2024). Anticancer potential of novel palladium(II) complexes with acyl pyruvates as ligands: DNA and BSA interactions and molecular docking study. *STED Journal, 6*(1), 1-14.

EXPERIMENTAL

All solvents and substrates were purchased from Sigma. Phosphate buffered saline (PBS) tablets were purchased from Fisher BioReagents. In 10 mM PBS buffer at pH = 7.4 a fresh solution of CT-DNA and EB in doubly distilled water was prepared. The DNA solution gave a ratio of UV absorbance at 260 nm and 280 nm (A_{260}/A_{280}) of ca. 1.8–1.9, indicating that the DNA was sufficiently free of proteins. CT-DNA concentration was measured by the UV absorbance at 260 nm ($\varepsilon = 6600$ M^{-1} cm^{-1}) (Meadows, Liu, Sou, Hudson, & McMillin, 1993).

Synthesis of palladium(II) complexes 3A and 3B and corresponding ligands 2A and 2B

The synthesis of the ligands was performed according to the early published procedure (Andrzejak, et al., 2010). The ligands were characterized using NMR spectroscopy. The synthesis of the novel palladium(II) complexes **3A** and **3B** was performed according to the early published procedure (Joksimovic, et al., 2020). Both new complexes were characterized *via* spectral [UV-Vis, IR, NMR, ESI-MS] and elemental analysis.

2A (ethyl 2-hydroxy-4-(3'-nitrophenyl)-4-oxo-2-butenoate). ^{1}H NMR (CDCl$_3$, 200 MHz) δ (ppm) : 1.40-1.48 (t, J = 7.1 Hz, 3H, CH$_3$), 4.38-4.49 (q, J = 7.1 Hz, 2H, CH$_2$), 7.13 (s, 1H, CH=CO), 7.75-7.79 (m, 1H, CH$_{Ar}$), 8.31-8.36 (m, 1H, CH$_{Ar}$), 8.44-8.50 (m, 1H, CH$_{Ar}$), 8.81-8.83 (m, 1H, CH$_{Ar}$) and 14.66 (br. s., 1H, OH). ^{13}C NMR (CDCl$_3$, 50 MHz) δ (ppm): 14.0, 62.9, 97.8, 122.6, 127.7, 130.1, 133.2, 136.4, 148.6, 161.6, 171.3 and 187.5.

2B (ethyl 2-hydroxy-4-[(*E*)-2-(3'-metoxy-4'-benzyloxyphenylvinyl)]-4-oxo-2-butenoate). ^{1}H NMR (DMSO-d$_6$, 200 MHz) δ (ppm): δ 7.86 – 6.98 (m, 11H, CH$_{Ar}$ + CH=), 6.58 (d, J = 7.7 Hz, 1H, CH=), 5.15 (s, 2H, CH$_2$), 4.28 (q, J = 7.1 Hz, 2H, CH$_2$), 3.83 (s, 3H, CH$_3$), 1.29 (t, J = 7.1 Hz, 3H, CH$_3$).^{13}C NMR (DMSO-d$_6$, 50 MHz) δ (ppm): 14.0, 55.9, 62.2, 70.1, 111.1, 113.4, 121.6, 128.0, 128.2, 128.6, 136.8, 149.6, 150.8, 161.8 and 185.9.

3A [Pd(**2A**)$_2$]. Yellow crystal; yield: 86%; mp = 287 °C; UV-Vis (PBS, λ_{max}/nm, (log(ε/M^{-1} cm^{-1})): 339(4.11); IR (KBr, cm−1): ν 3451, 3084, 2988, 1725, 1587, 1556, 1520, 1441, 1350, 1298, 1078, 1017, 711; ^{1}H NMR (DMSO-d$_6$, 400 MHz) δ : δ 1.16-1.36 (m, 6H, 2×CH$_3$), 4.25-4.36 (m, 4H, 2×CH$_2$), 7.71-7.90 (m, 2H, 2×CH=), 8.14 (s, 2H, 2×CH$_{Ar}$), 8.31-8.70 (m, 6H, 2×CH$_{Ar}$) ppm; ESI-MS (m/z): [M+] = 634; Calcd for C$_{24}$H$_{20}$N$_2$O$_{12}$Pd (%): C 45.41, H 3.18, N 4.41; found: C 45.50, H 3.20, N 4.39.

3B [Pd(**2B**)$_2$]. Orange powder; yield: 83%; mp = 205 °C; UV-Vis (PBS, λ_{max}/nm, (log(ε/M^{-1} cm^{-1})): 310(4.49); IR (KBr, cm−1): ν 3507, 2933, 1725, 1558, 1508, 1417, 1260, 1164, 1137, 1019, 843, 747; ^{1}H NMR (DMSO-d$_6$, 400 MHz) δ 1.15-1.31 (m, 6H, 2×CH$_3$), 3.74-3.85 (m, 6H, 2×OCH$_3$), 4.19-4.32 (m, 4H, 2×CH$_2$), 5.11-5.16 (m, 4H, 2×OCH$_2$), 7.03-7.76 (m, 22H, CH= + CH$_{Ar}$) ppm; ESI-MS (m/z): [M+] = 870; Calcd for C$_{44}$H$_{42}$O$_{12}$Pd (%): C 60.80, H 4.87; found: C 60.88, H 4.88.

Cell lines

Human cervix adenocarcinoma cells (HeLa), breast tumor cell line (MDA-MB 231) and human fetal lung fibroblasts (MRC-5) were obtained from the American Type Culture Collection (ATCC). Cells were maintained in DMEM (Dulbecco's modified Eagle's medium) medium suppemented with 10% heath-inactivated FBS (Fetal Bovine Serum), L-glutamine (2mM), non-essencial amino acids (0,1mM), penicillin (100 IU/mL) and streptomycin (100 µg/mL)(Sigma, Germany). Cells were cultivated at 37°C in an 5% CO$_2$ atmosphere, and absolute humidity.

MTT assay

Cytotoxicity of palladium(II) complexes **3A** and **3B** against human cell lines was performed by tetrazolium colorimetric MTT assay (Sigma, Germany). The assay is based on the transformation of the tetrazolium salt 3-(4, 5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT), to formazan by mitochondrial dehydrogenase in viable cells. Briefly, cells were harvested and plated in 96-well microtiter plates (Thermo Fisher Scientific, United States) at an optimal seeding density of 5×10^3 cells per well and incubated overnight for adherence. After overnight incubation, the medium was replaced with medium containing a range concentration of tested compounds (100, 30, 10, 3, 1 and 0.3µM) or with fresh medium as a control. Cisplatin was used as reference compound.

Cells were incubated at 37°C in a 5% CO_2 atmosphere and absolute humidity for 24 and 48 hours. After incubation, media was removed and 100μL of MTT (0.5 mg/mL PBS) was added to each well. After 4h incubation under culture conditions MTT solution was removed and 150μL of DMSO was added to dissolve the formazan crystals. Absorbance was measured at 550 nm with a multiplate reader (Zenith 3100, Anthos Labtec Instruments GmbH, Austria). Experiments were performed in triplicates and repeated in three independent series. Cytotoxicity was calculated according to the formula: $[(A_{CONTROL}-A_{TEST})/A_{CONTROL}]x100$. The IC_{50} value (50% inhibitory concentration) was calculated using ED50plus v1.0 software.

Docking studies

The X-ray crystal structureS of B-DNA (PDB ID: 1BNA) and BSA (PDB ID: 4F5S) were acquired from the Protein Data Bank (PDB) ([RCSB PDB: Homepage](#)). Docking processes were carried out using Autodock 4.2 (Frisch, et al., 2013) software equipped with the graphical user interface (GUI) Auto-DockTools (ADT 1.5.6rc3) (Morris, et al., 2009). Then the polar hydrogen atoms were added, and ADT was used to remove crystal water, Geisteiger charges were added to each atom, and merge non-polar hydrogen atoms to the DNA structure. The structures were then saved in PDBQT file format, for further studies in ADT. For the visualization of the docking results, a free version of the Discovery Studio Visualizer 3.5.0 Accelrys Software Inc. (Ju, Ding, Sun, & Chen, 2015) software has been used (Sanner, 1999).

CONCLUSION

In order to investigate the anticancer potential, two novel palladium(II) complexes with acyl pyruvates as ligand were tested on MDA-MB-231 and HeLa cancer cell lines. Complex **3A** showed excellent cytotoxic activity, while complex **3B** showed moderate activity on the tested tumor cell lines. In addition, IC_{50} values for complex **3A** were similar to the IC_{50} values of cisplatin. To determine the selectivity, the cytotoxic effects of complex **3A** were examined on human fetal lung fibroblasts (MRC-5), showing that all IC_{50}

values were higher than 100 μM, indicating good selectivity which is crucial since good selectivity is one of the main factors for a new antitumor drug candidate. Investigations of mechanism of anticancer activity reviled that complex **3A** induced apoptotic type of cell death in both HeLa and MDA-MB 231 cell lines. The results of cell cycle analysis showed that **3A** induced cell cycle arrest in G0/G1 phase. In addition, the investigations of interactions with cisplatin revealed that **3A** can be useful as adjuvants in cancer therapy by reducing the dose of cisplatin and in this manner its' side effects. Further investigations of interactions with biomacromolecules such as DNA and a transport protein were performed. Calculated K_{sv} values for the interactions of complex **3A** with DNA implied that our compound interacts with the DNA molecule through intercalation. By examining the binding mode of complex **3A** to a transport protein, we calculated the binding constant K_a, indicating that is able to be transported and distributed to cells in an adequate manner. A molecular docking study was performed to investigate in more detail the mode of binding to DNA and serum albumin molecules. Finally, all results indicate the great potential for future application of novel palladium(II) complex **3A** in clinical practice in the future.

DECLARATION OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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ANALYSIS OF ECONOMIC AND BUSINESS INDICATORS OF ENTREPRENEURSHIP IN REPUBLIC OF SRPSKA

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ABSTRACT

The article examines the role of small, medium and large enterprises in the economy of Republic of Srpska for the period from 2014 to 2022 year. The authors analyzed the economic indicators, according to company size (profitability rate, labor costs per employee, added value per employed person - productivity, employees - annual average and average wages paid per employed person), and also annual business indicators by company size (number of entrepreneurs, number of employees, number of companies and turnover). The aim of the paper is to analyze the operations of SMEs in order to give recommendations for future business improvement and to indicate the main obstacles and weaknesses as well as recommendations. The method of description and classification of data and the method of analysis and synthesis were used in order to achieve the objectives of the research.

Keywords: economic indicators, business indicators, entrepreneurship, Republic of Srpska, SME.

INTRODACTION

With economic and economic development and growth, the wealth of both societies and individuals should be increased, as well as technological progress should be intensified, which will significantly change the living and working conditions of people, especially in the most developed parts of the world. Republic of Srpska should also strive for this goal.

The largest number of companies in Republic of Srpska belong to the SME category, that is, the largest number of them are organized in the form of a limited liability company, and most often with the minimum prescribed share capital. It is a fact that the economic sector and its entities face numerous difficulties and obstacles in their functioning. Due to the stated reason, this article will concentrate on these categories. Entrepreneurs in Republic of Srpska are exposed to numerous fiscal and parafiscal burdens. An unfavorable business environment is characterized by high business costs caused by high taxes and contributions, numerous fiscal and parafiscal levies, various taxes, bureaucracy, unfavorable loans, slow debt collection, smuggling and illegal work. The burden on entrepreneurs greatly affects the creation of an unfavorable environment and non-competitiveness of the domestic economy. Large parafiscal burdens have a negative effect on attracting foreign investments.

Bosnia and Herzegovina, and therefore Republic of Srpska (as part of it), is going

through a phase of intensive legislative reform in the field of economy. The goal of the reform is to create a favorable environment for starting and developing businesses. The role of entrepreneurship in the economic development of Bosnia and Herzegovina (BiH) is becoming particularly relevant. The pace of reform in the sector of small and medium-sized enterprises is limited by the problems of complex administration, incoherent regulations at various levels of government and relatively weak coordination. The SME sector stimulates the transformation of social and state into private ownership, since small and medium-sized enterprises in private ownership are more flexible and can adapt more quickly to oscillatory changes in the market. They generate employment, help the diversification of economic activity and influence the development and increase of export activity and trade. Also, SMEs occupy a significant place in the field of innovation, as well as high-tech jobs. Thanks to their flexibility and innovation, many of them become large enterprises. In this process, emphasis should be placed on creating a friendly business environment in which the transformation of society towards a market economy should take its place (Dušanić-Gačić, 2022). Also, it is very important to point that job satisfaction and employee engagement are key drivers of retention, performance, low turnover rates, organizational citizenship behavior and customer-oriented behavior which leads to customer loyalty (Milovanović, Mamula Nikolić, & Perić, 2022). The goal of the research is to identify the decrease or increase of registered entities in Republic of Srpska (RS). Entrepreneurship develops creativity, improves the birth of ideas and enriches human needs.

THEORETICAL BACKGROUND

Entrepreneurship develops creativity, improves the birth of ideas and enriches human needs. It is neither science nor art, but a practice based on knowledge, which rests on the need for constant changes, during the realization of economic activities. Drucker (1996) believes that it is not enough just to combine resources in entrepreneurship in a new way, but also to create them, which leads to new companies. An interesting conclusion

was also reached by a group of authors which states the highest level of innovation culture is present in micro, then in small and the lowest is in medium size enterprises (Pavlović, Rašković-Depalov, & Milovanović, 2023). This leads to the conclusion that micro-enterprises see their biggest potential in innovations they deliver and this is why they put efforts in the development of innovation culture from the very beginning.

There is no universally accepted definition of entrepreneurship. For many authors, it is synonymous with innovation. Entrepreneurship is taking risks or starting, owning and managing your own business (Dušanić-Gačić, Novaković, & Mirosavljević, 2022). An entrepreneur finds, evaluates and develops a chance, against the forces that prevent the creation of something new. Entrepreneurship is management that implies constant concern for opportunities and challenges, regardless of whether it is about developing the business of an already established organization or about creating a new business and a new organization. Creative destruction is the process of breaking down the existing structure in order to increase its quality and efficiency. In order to create something new, we have to "destroy" what already exists. According to Schumpeter's vision of capitalism, the innovative efforts of entrepreneurs are the main driver of long-term economic growth, despite the fact that in this process the value of existing companies that enjoyed a certain degree of monopoly is destroyed (Schumpeter, 1962). Ludwig von Mises (1966) one of the most significant representatives of the Austrian economic school, believed that in the imaginary construction of the equilibrium system, no one is an entrepreneur. However, in dynamic reality, every participant is an entrepreneur. According to Mises, all economic decisions involve making decisions in accordance with future uncertainty. He defines an entrepreneur as a decision maker whose behavior is influenced by the future itself and his vision of the future. Izrael Kirzner (1973), a representative of the Austrian school of economics and a student of Ludwig von Mises, believed that the essence of entrepreneurship is to quickly respond to profit opportunities that appear on the market.

Mark Casson (1982) one of the most respected contemporary British economists, believes that an entrepreneur is someone who specializes in making "right" decisions. Jeffrey Timmons (1989) professor of entrepreneurship at Babson College and Harvard Business School, sees entrepreneurship as the ability to create something and practically make it "out of nothing". William Bygrave (2003), one of the leading contemporary authorities in the field of entrepreneurship and a professor at Babson College, believes that an entrepreneur is any person who starts a new business. His opinion is that an entrepreneur can be revolutionary only in rare situations. Raajpoot, & Sharma (2021) suggest that managers should understand their central role in setting innovation culture which is important for success of new services. In the absence of innovation culture, understanding customer.

METHODOLOGY AND RESULTS

In order to be able to evaluate the development of the SME sector in countries in transition, UNECE introduced the SME Development Index, which is a complex of economic indicators that incorporate the share of the SME sector in the overall performance of the national economy, based on three economic indicators. These are: share of private property, share of SMEs in GDP, the share of the workforce in the SME sector in relation to the workforce of the entire country. In the first group of countries, the SME Development Index ranges from 500 to 2,200 USD per inhabitant, in countries of the middle level of transition it is less than 500 USD, and in countries with the slowest growth it is less than 100 USD per inhabitant. In our research, we used data available on the web portal of Republic of Srpska Institute of Statistics. In order to achieve the goals of the research in accordance with the defined research subject, the following methods were used: method of description and classification of data, method of analysis and synthesis.

The authors also analyzed the following economic indicators: Profitability rate (in %); Labor costs per employee (in BAM); Added value per employed person - Productivity (in BAM); Employees - annual average; Average wages paid per employed person (in BAM) (Table 1, Table 2, Fig 1).

As table 1 shows, the profitability rate (%) in small businesses has a constant growth throughout all 9 observed years except in 2017, when it was 12.9%. In the case of medium-sized enterprises, the continuity of growth is interrupted in 2018 (9.1%) and in 2022 (12.2%). With large enterprises, there is no continuous growth, but there is variability.

The profitability rate, expressed as a percentage, typically indicates the level of profitability of a company or industry. It measures the efficiency of a company in generating profit relative to its revenue or investment. A higher profitability rate suggests that a company is more efficient in converting revenue into profit, which is generally a positive sign for investors and stakeholders. The profitability rate can be calculated using various metrics, such as net profit margin (net income divided by revenue), return on investment (ROI), return on equity (ROE), or earnings before interest, taxes, depreciation, and amortization (EBITDA) margin. These metrics help assess the financial health and performance of a business and are crucial for decision-making processes, such as investment analysis, strategic planning, and performance evaluation.

The constant growth of Labor costs per employee (in BAM) recorded an interruption in 2016 for small and 2017 for medium-sized enterprises. Also with this indicator, there are oscillations when it comes to large enterprises. Labor costs per employee encompass various expenses related to employing workers, including wages, salaries, bonuses, benefits, social security contributions, and other related expenses such as training costs. It's a crucial metric for businesses as it directly impacts their financial performance and competitiveness.

Next indicator "Added value per employed person - Productivity" typically represents the amount of value added to goods and services by each employed person in a given economy or within a specific industry. It is a measure of labor productivity, indicating how efficiently workers are contributing to the production process. When it comes to this indicator, a similar situation is recorded as with the previous indicator (Labor cost per employee), for all three business sizes.

Also, table 2, which shows Average wages paid per employed person (in BAM) shows an irregularity in growth in 2017, with net salary and gross pay. As for Employees - annual average, continuous growth in the number of employees can be observed for Employees in business entities, but analyzing "Entrepreneurs and employees of entrepreneurs" there is a noticeable break in the growth of the number of employees in 2020.

Table 1. Economic indicators according to company size in Republic of Srpska (from 2014 to 2022 year): Profitability rate (in %); Labor costs per employee (in BAM); Added value per employed person - Productivity (in BAM)

Indicator	Business size	small (0-49 employees)	medium (50-249 employees)	large (250 and over employees)
Profitability rate (in %)	2014.	13,2	5,8	16,7
	2015.	13,3	7,8	19,4
	2016.	14,5	10	18,2
	2017.	12,9	10,2	18,6
	2018.	14,2	9,1	19,4
	2019.	15,5	10,5	17,3
	2020.	15,9	11,7	16,9
	2021.	17,2	14,4	18,5
	2022.	17,3	12,2	17,4
Labor costs per employee (in BAM)	2014.	10839	12845	18771
	2015.	10967	12998	18537
	2016.	10672	13383	17892
	2017.	10973	13229	17393
	2018.	11554	13652	17896
	2019.	11966	14480	18453
	2020.	13075	15007	18926
	2021.	14028	16178	20279
	2022.	16465	18707	22343
Added value per employed person - Productivity (in BAM)	2014.	22936	20772	32580
	2015.	23564	23531	34713
	2016.	23849	26814	34018
	2017.	23029	25962	35162
	2018.	26030	25187	37394
	2019.	28191	27171	35186
	2020.	28987	28619	34987
	2021.	34314	35309	42168
	2022.	40068	38248	47287

Table 2. Economic indicators in Republic of Srpska (from 2014 to 2022 year): Employees - annual average; Average wages paid per employed person (in BAM).

Indicator	year	net salary	gross pay	Indicator	year	Employees in business entities	Entrepreneurs and employees of entrepreneurs	Total
Average wages paid per employed person (in BAM)	2014.	825	1334	Employees – annual average	2014.	204714	36830	241544
	2015.	831	1340		2015.	207709	38266	245975
	2016.	836	1344		2016.	213844	39461	253305
	2017.	831	1331		2017.	219899	40709	260608
	2018.	857	1358		2018.	225342	40967	266309
	2019.	906	1407		2019.	230538	41828	272366
	2020.	956	1485		2020.	232546	41681	274227
	2021.	1004	1546		2021.	236254	42776	279030
	2022.	1144	1730		2022.	243115	43564	286679
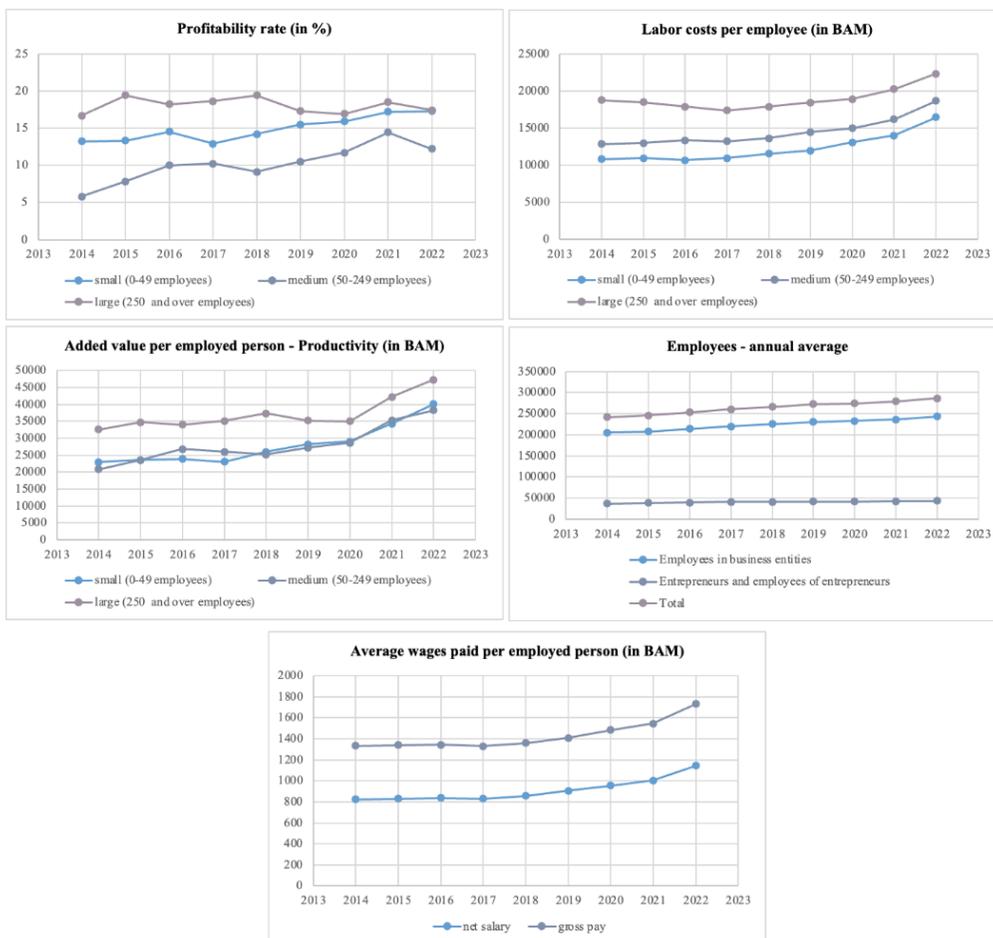
Fig. 1. Economic indicators according to company size in Republic of Srpska (from 2014 to 2022 year): Profitability rate (in %); Labor costs per employee (in BAM); Added value per employed person - Productivity (in BAM); Employees - annual average; Average wages paid per employed person (in BAM) (Authors according the Republic of Srpska Institute of Statistics)

Milovanović, M., & Dušanić-Gačić, S. (2024). Analysis of economic and business indicators of entrepreneurship in Republic of Srpska. *STED Journal, 6*(1), 15-23.

The authors analyzed "Annual business indicators by company size in Republic of Srpska" (from 2014 to 2022 year): Number of entrepreneurs; Number of employees; Number of companies; Turnover (0000 in BAM). The analyzed period is 9 years (from 2014 to 2022) (Table 3, Fig 2).

Table 3. Annual business indicators by company size in Republic of Srpska (from 2014 to 2022 year): Number of entrepreneurs; Number of employees; Number of companies; Turnover (0000 in BAM)

Indicator	Business size	small (0-49 employees)	medium (50-249 employees)	large (250 and over employees)
Number of entrepreneurs	2014.	18576	7	0
	2015.	18834	9	0
	2016.	18657	9	2
	2017.	18033	12	3
	2018.	17801	11	3
	2019.	17907	15	3
	2020.	17629	16	2
	2021.	18743	17	2
	2022.	19370	16	2
Number of companies	2014.	7074	381	58
	2015.	7023	356	63
	2016.	6900	371	70
	2017.	7539	417	78
	2018.	7495	418	87
	2019.	7556	435	88
	2020.	7265	429	95
	2021.	7840	427	94
	2022.	8322	440	97
Number of employees	2014.	86252	39287	38895
	2015.	89374	37659	41700
	2016.	90050	38074	43951
	2017.	88805	42781	49011
	2018.	90776	42738	53371
	2019.	93992	44977	55329
	2020.	91087	43272	56242
	2021.	93675	43661	56244
	2022.	95724	44486	58257
Turnover (000 in BAM)	2014.	9471853	5376298	3222574
	2015.	10088261	5102289	3469023
	2016.	9586490	5098286	3898609
	2017.	9847602	5328347	4673038
	2018.	10702495	5442864	5353766
	2019.	11248247	5464171	5338391
	2020.	10589231	5038512	5354051
	2021.	12587102	5818958	6637779
	2022.	14942143	7114550	8337125

Many economists argue that these metrics are fundamental for assessing the scale, growth, and economic contribution of businesses within an industry or economy. They provide insights into the entrepreneurial ecosystem, business dynamics, employment trends, and revenue generation, helping stakeholders understand the business landscape and make strategic decisions.

It is known in the literature that "Number of Entrepreneurs" refers to the count of individuals who have started or are involved in establishing and managing a business venture.

Entrepreneurs are individuals who take on the risks associated with starting and operating a business with the aim of making a profit. These metrics show that there is a decline from 2017 to 2020, and that the number of entrepreneurs was decreasing. In 2021 year the number would approximately return to the number from 2017.

As for medium entrepreneurs, the continuous increase in the number of such entrepreneurs was interrupted in 2018, but continued the following year. For large entrepreneurs, the number has been the same for the last three years.
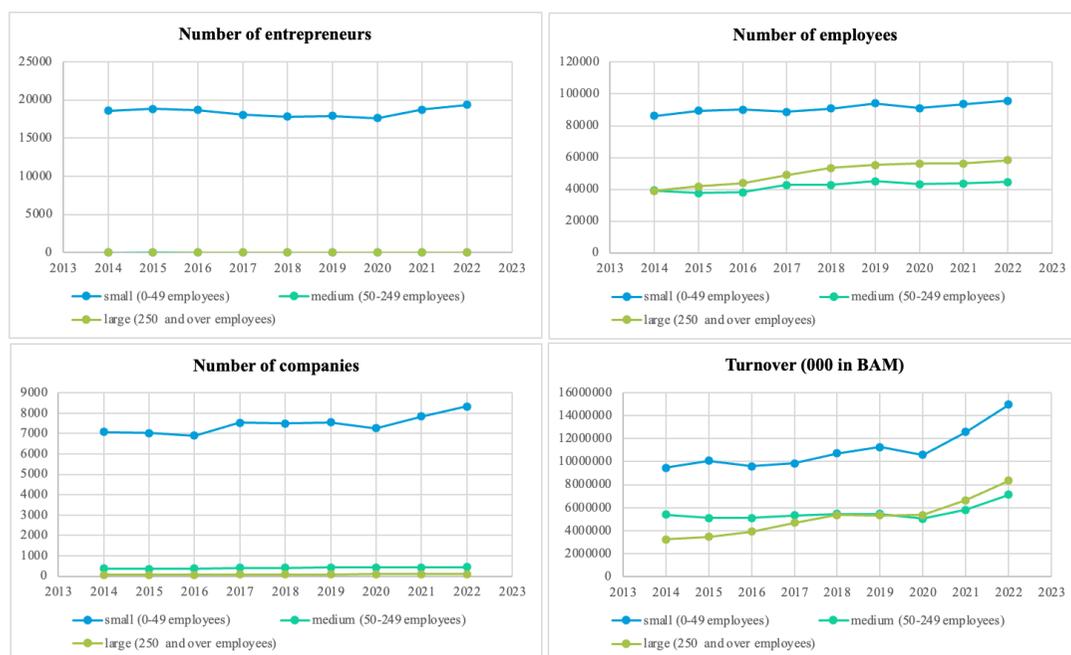
Fig. 2. Annual business indicators by company size in Republic of Srpska (from 2014 to 2022 year): Number of entrepreneurs; Number of employees; Number of companies; Turnover (0000 in BAM) (Authors according the Republic of Srpska Institute of Statistics).

"Number of Companies" represents the total count of registered or active businesses within a particular jurisdiction or industry. It provides an indication of the level of business activity and competition in a given market or economy. Only large companies see the continuity of the growth of the number of companies. Analyzing the numbers of small and medium-sized companies, variability is noticeable from year to year.

As table 3 and Fig. 2 show "Number of Employees" metric indicates the total count of individuals who are employed by a company or organization. It includes full-time, part-time, and temporary workers. The number of employees is a crucial measure of workforce size and organizational capacity. Looking at the data of the mentioned indicator, the situation is noticeable, as with the previous indicator and business sizes.

Turnover, also known as revenue or sales, refers to the total income generated by a company from its primary business activities, such as selling goods or services, over a specific period, usually a fiscal year or quarter. It represents the top-line financial performance

of a business before deducting expenses. Also with this indicator, the situation is similar, as with the previous two, with the fact that there is a noticeable increase in turnover in 2022 compared to the previous year for all three business sizes.

DISCUSSION

In most countries in transition, including in RS, there is underdevelopment of one or more levels or non-cooperation and inconsistency, so the situation is often encountered that, although the government has set the goal of developing the SME sector, support for it is still weak even in the initial phase. Until now, the lack of comprehensive legislation related to the development of entrepreneurship and SMEs in countries in transition has mostly hindered their development. The key condition for success is the creation and adoption of a coherent and transparent SME development program, assistance and promotion, so that the legal, technical and financial conditions are applied comprehensively and in a complementary manner (Dušanić-Gačić, 2022).

The main weaknesses of the institutional framework for the development of the SME sector and entrepreneurship are:

1. The complexity of the institutional arrangement due to the existence of 14 governments throughout BiH, within which is RS, on their territorial entities, and each of them has its own characteristics of creating and implementing policies;
2. Lack of coordination and cooperation between institutions dealing with SME policies at the state and entity level;
3. Limited capacity of these institutions;
4. High dependence on initiatives and programs financed by donors.

However, entrepreneurs have the possibility of incentives that are not unified at the level of BiH, nor in RS. However, we can single out that financial support programs are available that are intended for those who plan to start their own business or are entrepreneurs in the initial phase of development. The programs that have been continuously implemented in recent years are:

➢ The Start-up program is a combination of loans and grants through which beginners can acquire new or used equipment necessary for starting a business, finance ongoing maintenance of business or production premises, as well as cover operational costs.

➢ The early development program is intended for young companies that develop a technological innovation for which there is a need on the market. The program is designed with the intention of supporting the survival of the company during the critical phase of research and development and enabling the development of business capacities with which to place their innovations on the market.

➢ The subsidy for self-employment is intended for the unemployed who are registered with the National Employment Service and have completed training to start their own business.

CONCLUSIONS

Despite slight progress, SME culture is still at an initial, initial level in countries in transition. It is necessary to develop coherent national educational programs in which individual initiative and creativity are promoted from the very beginning and are later monitored in the subsequent professional education of entrepreneurs. Basic obstacles to faster development of the SME sector are classified into six main areas: financial obstacles, institutional obstacles (including regulatory framework and taxation regime), competitive market barriers, barriers related to internal organization and resources, social barriers (including support from government agencies) and the degree of trust between businesses. The basic views of what is considered a key obstacle in the development of the SME sector are classified into two approaches: the "money first" approach (unfavorable conditions under which the bank provides financial support to SMEs) and the "institutional" approach (non-financial obstacles represent a key barrier to growth).

The authors conclude that the main weaknesses for the development of the SME sector and entrepreneurship are the complexity of the institutional and political structure of BiH, the lack of coordination and cooperation between institutions at the entity and state level, high dependence on donor funding. The opportunities

Milovanović, M., & Dušanić-Gačić, S. (2024). Analysis of economic and business indicators of entrepreneurship in Republic of Srpska. *STED Journal, 6*(1), 15-23.

that have been provided are available financial support programs for starting your own business, which have been continuously implemented in recent years for entrepreneurs in the initial phase of development, which were previously discussed. The recommendations are focused on better information and education about the mentioned programs, in order to use them more purposefully.

Interest in the role of SMEs in the transition process has grown rapidly in recent years and there is now general agreement that the SME sector can play a key role in the transition process. Blanchard (1997) believes that the essence of the transition is the reallocation of resources from the state to the private sector, combined with the restructuring of enterprises. The establishment of new companies is a key mechanism through which the reallocation process can bring results.

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MARKETING STRATEGIES IN RECRUITING AND TRAINING VOLUNTEERS FOR THE ORGANIZATION OF SPORTS COMPETITIONS

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ABSTRACT

The study paper's focus is on establishing the connection between marketing initiatives and the strategy used by numerous volunteers to plan sporting events. The manager of the volunteer sector is responsible for assembling a project team and overseeing the recruiting, selection, training, deployment, supervision, and coordination of volunteers while they work as volunteers at major sporting events. The greatest candidates for this position are coordinators for the volunteer sector who have experience as volunteers, as they can inspire others to perform selfless volunteer work. Research has shown that in order to effectively oversee 800 unpaid employees, someone must first build a direct relationship with them— something that can only be done in the event that there are a significant number of trained coordinators. Additionally, it is essential to heavily publicize the volunteer contest and emphasize the advantages that volunteers obtain by taking part in order to attract a big number of participants. In addition to the aforementioned, well-planned, organized, intricate, and gradual preparation that begins several months prior to the competition is required to prepare a big number of volunteers for high-quality and committed involvement at a sporting event. After receiving top-notch training, volunteers can serve in any area of the competition. Additionally, volunteers who have previously taken part in a well-run sporting event typically return to sports volunteering multiple times. Ultimately, the paper's set hypothesis—which related to the contention that there is a positive connection between marketing initiatives, sports event organization, and the approach of volunteers.

Keywords: sports competitions, sports volunteerism, volunteers, marketing.

INTRODUCTION

History has revealed how important sporting events are, talking about the role they played in the development of society and many communities on our planet. Sporting events are different from non-sporting events and competitions. There is a difference in the sense that some form of competition involving physical strength is involved. Moreover, the emotional component makes sports events unique, and indeed, this characteristic becomes essential for the commercial and marketing purposes of the events themselves, which has significant economic implications and other impacts. The growing popularity of sporting

events is a global phenomenon, resulting in larger and larger events being established around the world to capitalize on the associated economic potential. Sports events are characterized by their complexity and time constraints: sports events involve many stakeholders and cannot be easily changed, especially due to the athletes' competition calendar. However, in recent times, in the face of the crisis caused by the coronavirus (COVID-19), mega events such as the 2020 Tokyo Olympics have been postponed, adding a new challenge to the event industry in general and event managers in particular.

The research subject of the paper includes determining the connection between the organization of sports competitions, the approach of volunteers, and the application of marketing activities.

The research aims to determine, based on the available relevant literature, the contribution of marketing activities in the approach of volunteers to sports competitions.

SPORTS EVENTS PLANNING PROCESS

The importance of sporting events in terms of their impact and benefits, especially large international events, is well documented and also well covered in the media, such as television, billboards, newspapers, etc (Allen, O'toole, Harris, & McDonnell, 2012). In general, most attention is paid to economic benefits, mainly because they are easier to quantify. However, other less quantifiable benefits, including regeneration, physical heritage, cultural, social, environmental, tourism, and sports development, may have more significant value in the long term.

Evaluation of the theories of Bowdin, McDonnell, Allen, & O'Toole (2001) and Getz (1997) show that they propose that event planning is a phased process. Others such as Catherwood and Van Kirk (1992), Goldblatt (1997) suggest a less formal approach to event planning. These theories and models generally accept that event organizations need to plan strategically for the long term, including responsibility for the ongoing and long-term management of the financial and physical legacy of major events. Getz (1997) believes that long-term gains and losses should be assessed in the feasibility phase of the planning process. Allen, et al. (2012) and Bowdin, et al. (2001) follow a similar approach. Several

theories also consider closure or shutdown (Allen, et al., 2012; Shone, & Parry, 2001).

The latter (Allen, et al., 2012) acknowledge that some thought should be given to the intended legacies in the formation of goals at the beginning of the planning process. However, the theory offered seems to be more suited to the short-term benefits that events can bring rather than the long-term value that major international events can be strategically planned for. What the models don't cover is where developing strategies for successful long-term legacies should be in the event planning process. There is a need to include specific long-term strategies when planning major international sporting events and strategies that will extend beyond the event itself. Second, it is accepted that the existing theory and models of event planning adequately enable the realization of events, but not particularly for large sporting events. What is needed, therefore, is a more comprehensive process that can encompass the planning needs of sporting events, a process that can accommodate sporting events of all sizes and intentions and thereby enable the event to deliver benefits in the long and short term.

A new approach to the process of event planning

Any potential long-term benefits attributed to an event must be comprehensively covered by strategies that ensure long-term success. First, incorporating cost-benefit forecasting in the feasibility phase of the event planning process would allow organizers to not only forecast the extent of their event's benefits and budget accordingly but through that forecasting, get support for the event at an early stage and appropriate stage.

Second, implementation strategies for the use of new facilities and/or regeneration projects must be embedded to ensure their long-term future. Third, assessing the impact of such an event requires not only an assessment of the short- and medium-term economic and cultural benefits. It also requires a long-term assessment, perhaps as long as 10 years or more, of sustainability and permanence, in other words, the success, regeneration, and legacy created as a result of setting up the event. Fourth, for the goals to be met, there is a reason to include mechanisms in the process that will enable continuous alignment with

short-term, medium-term, and long-term plans. What follows is a new process of event planning that includes both the short-term requirements for implementing the event and the long-term goals that become the legacy of the event (Masterman, 2003a; Masterman, 2003b). The model presented here aims to address the planning process necessary for all scales of events and whilst this text deals with the management of sporting events, it is suggested that this process is universally applicable throughout the event industry.
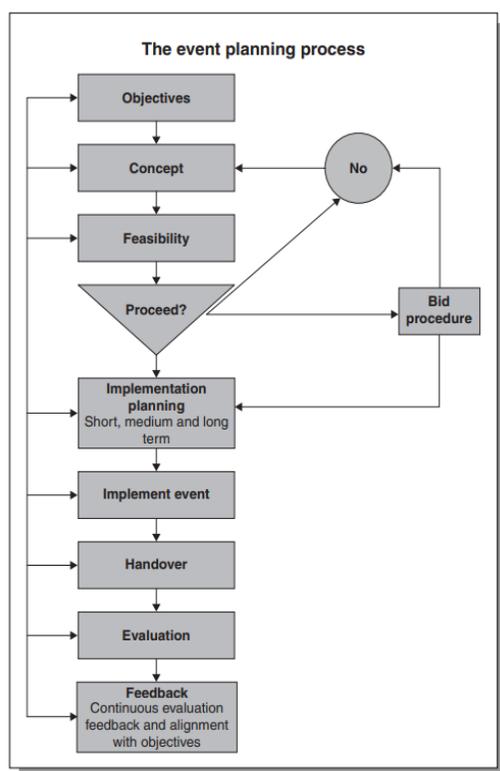

Figure 1. Planning of events and happenings
(Masterman, 2003a; Masterman, 2003b)

A step-by-step process

The model of the event planning process consists of up to 10 different stages. There is justification for a phased process where progression through the planning process is done step by step. Manchester, for example, decided on urban regeneration goals before deciding to bid for both the 2000 Olympics and the 2002 Commonwealth Games (Bernstein, 2002). Next, the feasibility of the latter being able to successfully meet the objectives in the long term was considered. After deciding to

proceed, the city then went to bid for the event. Then there was the development of strategies before the event, to make the event long-term: for example, building the facilities and ensuring their subsequent use before construction. The policy of building permanent facilities only when the subsequent use and users were certain shows that the city not only planned for the long term in the pre-event phase but also was not ready to advance to the next phase in its planning until these conditions were met (Bernstein, 2002). The handover phase followed the implementation of each event, followed by evaluation and feedback in a similar fashion as the final phase. A review of the literature related to the event planning process also supports the phase model (Allen, et al., 2012) with the remainder of the literature showing no arguments against it. The main advantage of the staged process is that it is an effective way to avoid moving forward too quickly and to find that efforts and budgets have been spent unnecessarily. There is also justification for completing each phase before moving on to the next to maintain efficiency in terms of both time and finances. This is also advocated by Allen, et al. (2012), Bowdin, et al. (2001), Getz (1997). A description of each stage of the process follows with the Sydney 2000 Olympic Games, Manchester 2002 Commonwealth Games, and Sheffield 1991 World Student Games serving as examples of key points.

Goals

It is important to identify why the event is going to be organized before deciding what the event will be or what it will look like, so objectives are the first stage in the process. Objectives determine the nature and scope of the event. In the case of major international sporting events, host cities may have regeneration objectives such as the redevelopment of derelict land for new facilities, and residential and business opportunities. The event becomes a catalyst for achieving such goals. Therefore, for this scale of events, it is important to consider how the goals of the event can fit into the wider urban plans. For all scales of events, whether international or local, the objectives refer to what the event itself is intended to achieve. It could be for monetary gain, to develop participation in sports, to determine winners

through competitions, and to engage communities. Whatever the objectives are, they are what the event will be measured against to determine whether or not it was successful.

The use of objectives is not necessarily widespread in the industry. Emery (Emery, 2010), for example, surveyed 400 major sporting event organizers and found that although 64% of respondents claimed to have used goals and objectives, they were generally one general goal and/or lacked detail. There can be several reasons for this. One could be management complacency, but it could also be due to the perception that setting goals is too difficult a task due to the diverse nature of the various actors involved. Setting goals for a long planning process can also be considered too inflexible an approach when so much can change in the interim. Also, since targets are used as a possible benchmark for an event, there may be a reluctance to use them politically. After all, not many people want to be seen to fail. The argument in favor of using event objectives is that they provide direction for planning and execution. Event management texts agree that the use of objectives is essential to the production of a successful event (Allen, et al., 2012; Bowdin, et al., 2001). However, not everyone agrees that they should be ahead of the development of the event concept in the planning process. Some describe a process that begins with a concept and includes an intention to bid for an event where appropriate (Allen, et al, 2012), or an idea and a proposal.

Getz (1997) suggest that scanning the internal and external environment is necessary before setting the vision and goals for the event. Shone, & Parry (2001) at least wrap all of these elements into one initial phase that includes goal setting, and Allen, et al. (2012) and Bowdin, et al. (2001) agree that goals are needed before any situational analysis. Process and Event Management recognizes the need for objectives to be the first stage in the planning process. A concept is a vehicle designed to achieve goals and can only be designed once the goals are set. A lot of it is about having smart goals, that are specific, measurable, achievable, realistic, and timely. To make them achievable and realistic for sporting events, the next stage in the process, feasibility, is key. That they are specific, that they are achieved in a certain time frame, and that they have performance indicators that can be measured helps the penultimate stage of the process, evaluation. To determine the objectives, it is necessary to identify all interested parties and consider their requirements in this first phase so that they can be included in the event planning. This includes considering potential partners and related strategies. Key questions that should be asked at this stage include: why is the event being held, what is to be achieved, who benefits, and how? Although it is not necessary to categorize the goals of sporting events to determine them, in the analysis they can be political, social, cultural, environmental, or economic. Such categorization can help determine who are the people and/or organizations that influence the execution of the event; in other words, its stakeholders.

Stakeholders
- *Buyers:* seat and corporate ticket buyers, athletes or competition participants, advertisers, buyers of corporate packages such as those for franchise space, sponsors, and merchandise buyers.
- *Suppliers:* Organizations used to supply equipment, services, or goods in connection with the event, for example, tournament equipment, legal advice, food and drink, transport, and emergency services.
- *Partners:* Many sporting events are not possible without the sanction of the relevant regional, national, and international governing bodies, and these bodies also run their sports. Other partners may be local, regional, or national governments or their agencies. Separate event management organizations may well combine forces to execute an event. Sponsors are often referred to as partners both in terms of ownership rights and because of the longevity and/or closeness of the relationship, as are those media organizations that purchase event rights.
- *Investors:* Some of the above partners may also be investors as they have a vested interest as a result of providing financial resources either in cash or through services/goods in kind. This interest may result in a monetary return on investment, but not always. Municipal or agency investments may require non-financial returns such as sports, cultural, or social development.

> - *Staff:* Permanent staff, short-term staff, sub-contractors, and volunteers may fall into this category.
> - *External influences:* This includes event publicity that is important to the success of the event and therefore influences any decision-making even if it is not directly related to the event in any of the above conditions. For example, the local community where the event takes place, pressure groups, local and national governments from legislative, economic, health and safety, cultural and social aspects, certain politicians, and the media. At this stage, it is also important to review any reports that have been received for the event.

For example, the competition to win the right to organize an event is increasingly used by event owners. In the corporate world, propaganda is growing against others to run a sporting event on behalf of the event owner. The sports management agency will have to discuss, negotiate, and fulfill the set conditions and objectives of the latter. Even if there is no competition, there will likely be such a brief. In the same light, event owners are increasingly using bidding where host cities compete for the right to host large events. Again, each offer will need to meet different conditions or criteria to be successful (Ilic, & Ostojic, 2023). The planning process must have built-in alignment mechanisms that ensure that objectives are assessed at all stages of the planning process (Ilic, Stojanovic, & Ostojic, 2024). Alignment can be achieved through the identification of performance indicators and targets. For example, in setting goals that include the long-term success of the facilities and the resulting economic gain from organizing the event, the planning process is automatically given performance measures. For all extensive sports events, by setting deadlines for achieving a certain level of income, prescribed levels of media coverage, or signing appropriate contracts, the process gets its integrated indicators. Incorporating mechanisms and operational systems through the planning phase of implementation and thereby allowing further reflection on how the project can be improved will also ensure that in the end, the event achieves what it should achieve.

MATERIALS AND METHODS

The methods used in the paper are descriptive statistics, analysis, and synthesis methods.

The sample

The research included 124 people who were surveyed through a questionnaire, while e-mail addresses were collected by the football club FC "ŽAK" Kikinda. 54% of male respondents and 46% of female respondents participated in the total research sample. The largest percentage of respondents is between 35-40 years old - 42%, while the smallest number of respondents is 55 years old and older - 4%. Most respondents from Kikinda and the surrounding rural communities participated in the research.

Materials

The research instrument is a survey questionnaire that consists of two parts. The first part of the questionnaire aims to determine the socio-demographic characteristics of the sample of respondents, to gain insight into the basic data concerning the gender and age structure. The second part of the questionnaire is made up of closed questions. The answers were mostly formulated according to the Likert scale. The questionnaire was originally compiled by the author of this paper.

The research flow

The research was carried out in November and December 2023, and it included a survey of employees and members of FC ŽAK Kikinda, as well as their mailmen. Questionnaires were sent to individuals in the online form, and on that occasion, all respondents were informed that the research was anonymous and that they could withdraw from participating at any time. Also, the respondents were informed that the obtained data will not be used for any other purposes, except for research for this paper. Once the data were collected, they were analyzed.

The paper started with the hypothesis: „There is a positive connection between marketing activities and the respondents' decision to apply for volunteering".

THE RESULTS

In this part of the paper, the obtained research results are presented graphically.

Primarily, the structure of the sample of respondents was analyzed using descriptive statistics. On that occasion, it was concluded that 51% of men and 49% of women participated in the research (Chart 1).
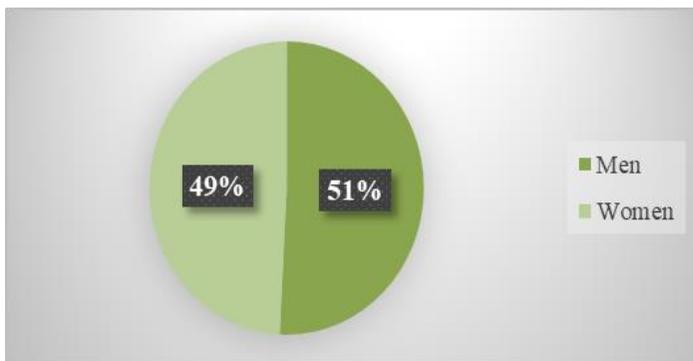
Chart 1. Gender structure

With the next question, an answer was obtained about the employee engagement of the respondents (Chart 2). From Chart 2, it can be seen that 69 respondents (55.64%) are employed, while 55 respondents (44.35%) are unemployed.
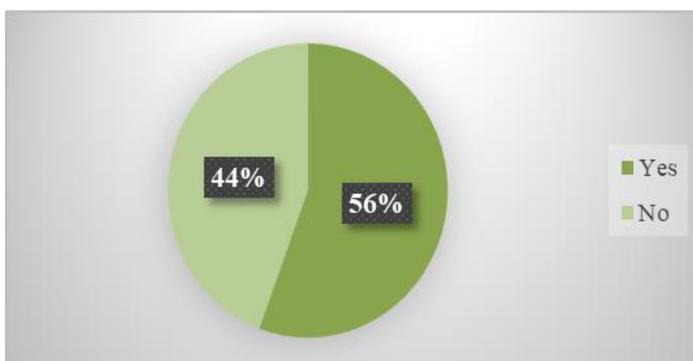
Chart 2. Are you employed?

The next question provides an overview of the respondent's experience in volunteering (Chart 3). According to the research results, it can be concluded that 58 respondents gave a positive answer to the question, that is 47% of the respondents, while 66 of them gave a negative answer to the question, that is 53%.
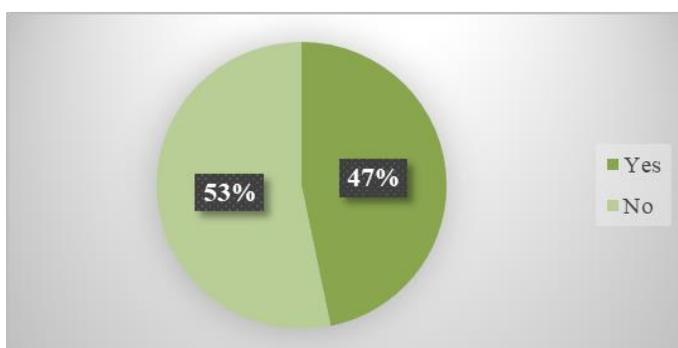
Chart 3. Have you already had experience in volunteering*?*

Latinović, B., et al. (2024). Marketing strategies in recruiting and training volunteers for the organization of sports competitions. *STED Journal, 6*(1), 24-33.

The next question answered how often the respondents follow competitions. According to the answers, the majority of respondents agree or completely agree that they often watch sports competitions, namely 74 (59.66%) respondents, neither agree nor disagree with 15 (12.09%) respondents, while they do not agree, i.e. 35 (28.21%) respondents completely disagree with the stated statement (Chart 4).
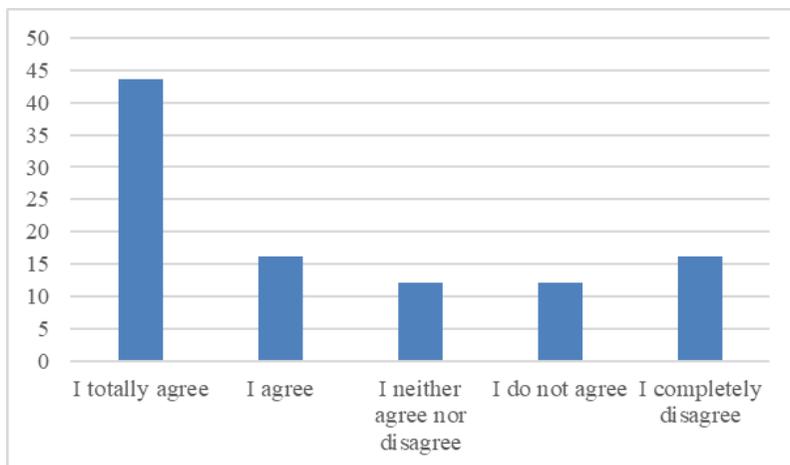

Chart 4. To what extent do you agree with the statement that you follow sports competitions often?

The largest number of respondents agree or completely agree with the statement that the organization's marketing materials influenced their decision to apply for volunteering, i.e. 75 of them (60.47%), neither agree nor disagree, 20 (16.12%) respondents, until they disagree or completely disagree 29 (23,38%) (Chart 5).
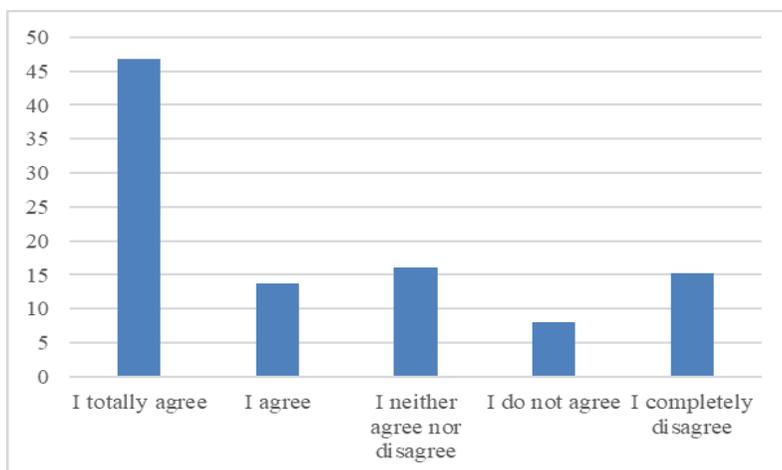
Chart 5. To what extent do you agree that the organization's marketing materials influenced your decision to volunteer?

Based on the answers received from the respondents, it can be seen that the majority agree with the statement that the organization's marketing strategies have influenced recruitment for volunteering in the organization of sports competitions, namely 73 (58.86%), neither agree nor disagree, 22 (17.74 %) respondents, do not agree, that is, 29 (23.38%) respondents completely disagree (Chart 6).
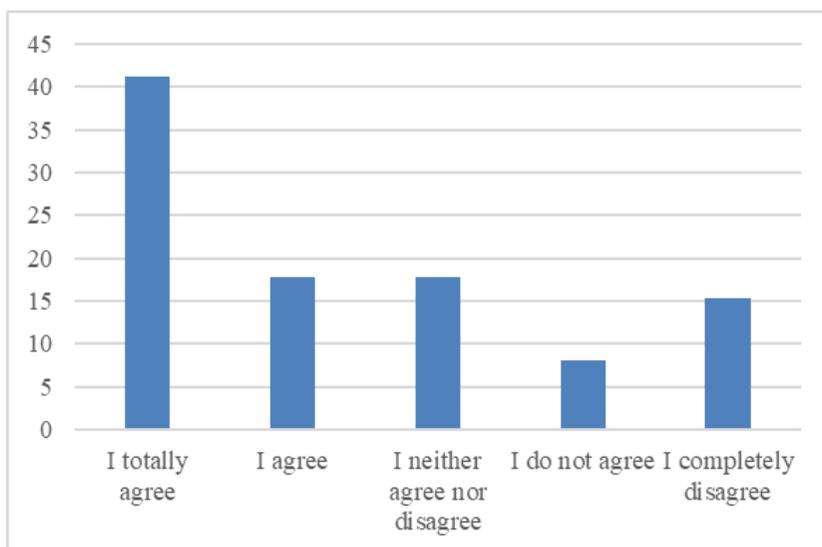
Chart 6. To what extent do you agree with the statement that the marketing strategy of the organization influenced your recruitment for volunteering in the organization of sports events?

Based on the respondents' answers, it can be seen that the majority of respondents agree with the statement that the training of volunteers before sports events is sufficient, i.e. 73 (58.86%) of the respondents, neither agree nor disagree with 26 (20.96%) of the respondents, while do not agree, that is, 25 (20.15) respondents completely disagree with the above statement (Chart 7).
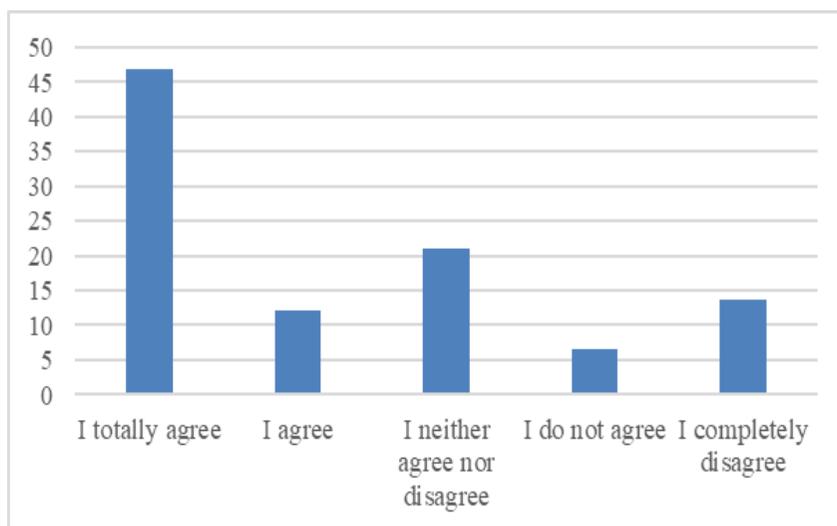
Chart 7. To what extent do you agree with the statement that volunteer training before sporting events is sufficient?

Based on the research results, the majority of respondents agree or completely agree with the statement that improved communication could increase the satisfaction of volunteers who perform volunteer work in the organization of sports competitions, that is, 68 (54.83%) respondents neither agree nor disagree 26 (20.96%) respondents, while 29 (24.19%) respondents do not agree or completely disagree (Chart 8).
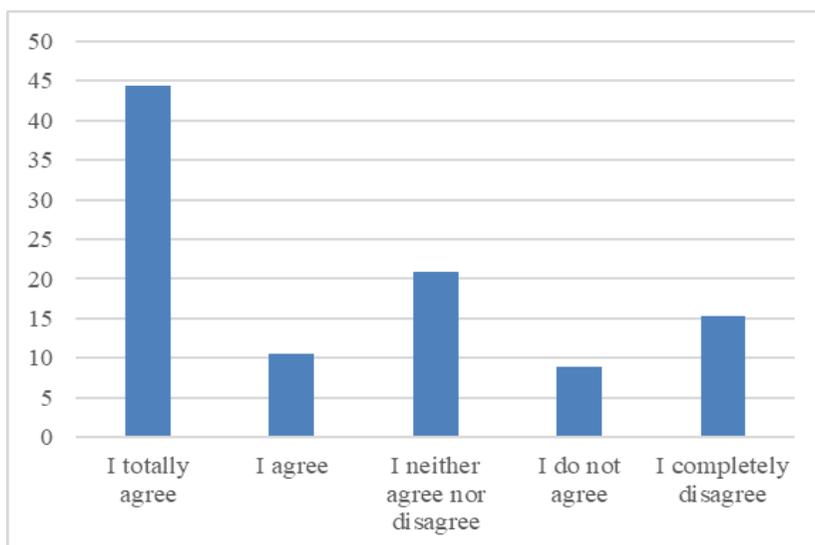
Chart 8. To what extent do you agree with the statement that improved communication could increase the satisfaction of volunteers who do volunteer work in the organization of sports competitions?

Out of the total number of respondents, 45 (36.28%) agree with the statement or completely agree with the statement that additional benefits or rewards can improve the experience of volunteers at sports competitions, while 26 (20.96%) respondents neither agree nor disagree while disagreeing or completely disagreeing respondents are 53 (42,73%) (Chart 9).
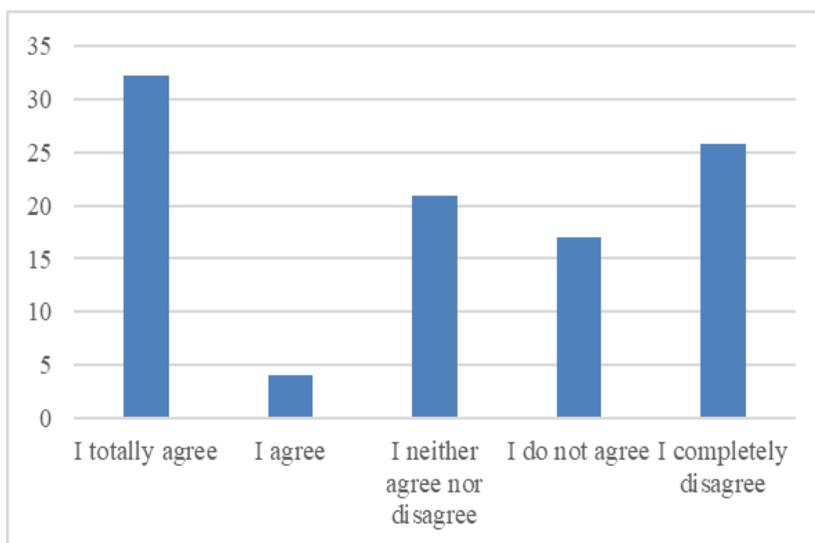
Chart 9. To what extent do you agree with the statement that additional benefits or rewards can improve the experience of volunteers at sports competitions?

CONCLUSIONS

The biggest pleasures of volunteering are improving the environment, lending assistance to those in need, starting changes solely out of moral obligation, and collaborating with others toward a common objective. Apart from fun, volunteering is a great opportunity for young people to learn

something new, meet new people, value their free time, learn to do a different job, and all sorts of other things. This can be very helpful when you are faced with challenges. everyday life brings. For society, volunteering is a value that should be encouraged and nurtured, because only active individuals, united for a common goal, have the power to initiate changes that everyone can do. Every community has to face it. A society without volunteers is a static, backward society because individual enthusiasm is often the main driver of progressive change.

Indeed, many examples confirm this. Serbia, like many similar countries in the Western Balkan, need volunteering, because they must change by modern trends, catch up with what has been missed, and truly become what the citizens expect of them. The Ministry of Youth and Sports has helped a large number of projects that encourage volunteering because it is necessary to consciously accept the fact that effective changes cannot happen if those who want them are not helped.

As can be seen, the hypothesis: "There is a positive association between marketing activities and respondents' decision to apply for volunteering", was confirmed. The majority of the respondents expressed their positive attitude regarding the application of marketing strategy in training and recruiting individuals in the organization of sports competitions. The results of this survey provide a deeper insight into the attitudes and experiences of volunteers about the recruitment, training, and marketing strategies of sports competition organizations. Understanding the respondents' perceptions enables the identification of key areas that require improvement to improve the effectiveness of volunteering and achieve higher levels of volunteer satisfaction. These findings can serve as a basis for the further development of marketing strategies and training programs, contributing to the sustainable engagement of volunteers in sports communities.

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VJEŠTAČKA INTELIGENCIJA: EFEKTI NA DRUŠTVO I EKONOMIJU I NJENO REGULISANJE

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ORIGINALAN NAUČNI RAD

SAŽETAK

Počeci vještačke inteligencije se vezuju za 1956. godinu i Dartmouth konferenciju u organizaciji Stanford univerziteta. Od tih početaka pa do kraja 20. vijeka, njen razvoj je bio relativno spor zbog hardverskih i softverskih ograničenja. Ipak, 21. vijek donosi prekretnicu u svakom smislu.

U 21. vijeku je došlo i do podjele na specijalizovanu, koja se prvenstveno razvijala u 20. vijeku, i opštu vještačku inteligenciju na koju se fokus razvoja stavlja u posljednjim dekadama.

Pozitivni ekonomski efekti usvajanja vještačke inteligencije, shodno provedenom istraživanju, su nedvosmisleni. Efekti na pojedince i čovječanstvo su značajno više podložni diskusiji.

Gotovo polovina ispitanika u provedenom istraživanju nije za prihvatanje vještačke inteligencije u privatne svrhe, a druga polovina je skoro podjednako podijeljena na one koji nemaju mišljenje po ovom pitanju i one koji nisu protiv prihvatanja.

Oko 70% ispitanika smatra da vještačka inteligencija može postati prijetnja za čovječanstvo i mentalno zdravlje pojedinaca. Istovremeno, većina ispitanika ne vidi izazove po svoje zaposlenje.

Kao rješenje ispitanici vide jasnu i striktnu regulacija razvoja i mogućnosti same vještačke inteligencije. Kao odgovorne za ovo regulisanje vide se institucije društva u kojem živimo i kompanije koje razvijaju vještačku inteligenciju.

Pravi korak u ovom smjeru je napravila Evropska unija usvajanjem Akta o vještačkoj inteligenciji u martu 2024. godine. Ono što se očekuje, je da ovaj primjer EU slijede i druge zemlje, čime bi se osigurao ispravan razvoj i upotreba vještačke inteligencije na opštu dobrobit čovječanstva kojem ona treba da služi.

Ključne riječi: vještačka inteligencija, ekonomske koristi, uticaj na društvo, regulacija vještačke inteligencije.

UVOD

U proteklim decenijama, vještačka inteligencija (VI) je postala neizostavan i sveprisutan element našeg društva, transformišući način na koji živimo, radimo i komuniciramo. Od autonomnih vozila do personalizovanih preporuka na društvenim mrežama, VI je prodrla u gotovo svaki aspekt naših života. Heraklitova izjava da je "promjena jedina konstanta" nikada nije bila aktuelnija nego danas, kada VI kontinuirano razvija i mijenja način na koji funkcionišemo kao društvo. Ovaj eksponencijalni rast i široka primjena VI donose brojne mogućnosti, ali i izazove koji sežu od etičkih pitanja do sigurnosnih rizika.

Napredak u oblasti mašinskog učenja, dubokog učenja i drugih grana vještačke inteligencije omogućio je stvaranje sistema koji su sposobni za kompleksne zadatke koji su nekada bili rezervisani samo za ljudski um. Međutim, sa ovim napretkom dolazi i odgovornost da se osigura da ovi sistemi rade u skladu sa našim vrijednostima i ciljevima kao društva. Pitanja o transparentnosti, pravednosti i odgovornosti postaju sve važnija kako VI postaje sve prisutnija.

U ovom članku istražujemo najnovija dostignuća u oblasti vještačke inteligencije, analiziramo njene primjene u različitim sektorima, te razmatramo implikacije njenog daljeg razvoja na društvo i pojedince. Uzimajući u obzir brz tempo napretka u ovoj oblasti, neophodno je dublje razumijevanje kako bi se osiguralo da VI ostvaruje svoj pun potencijal kao alat za unapređenje ljudskog života, uz istovremeno poštovanje etičkih principa i osiguranje bezbjednosti. Ovaj članak poziva na dalje istraživanje, razmišljanje i debatu o ulozi i uticaju vještačke inteligencije u savremenom društvu[1].

POJAM I RAZVOJ VJEŠTAČKE INTELIGENCIJE

Vještačka inteligencija predstavlja granu računarstva koja se bavi stvaranjem sistema koji mogu izvršavati zadatke koji zahtijevaju ljudsku inteligenciju. Ovaj koncept, iako popularan u današnjem svijetu, ima dugu istoriju razvoja koja seže unazad do sredine 20. vijeka.

Pojam vještačke inteligencije prvi put je popularizovan 1956. godine na Dartmouth konferenciji, gdje su istaknuti naučnici poput Džona MekKartija, Marvina Minskija i Kloda Šenona razmatrali mogućnosti stvaranja inteligentnih mašina (McCarthy, Minsky, Rochester, & Shannon, 2006). Od tada, razvoj VI prolazio je kroz različite faze, od optimizma u ranim danima do razdoblja stagnacije i ponovnog buđenja tokom posljednjih decenija.

Druga definicija kaže da se termin vještačka inteligencija koristi za opisivanje funkcija ljudski stvorenih „alata" koji oponašaju kognitivne sposobnosti prirodne inteligencije ljudskih umova (Tai, 2020).

U suštini, razlika između dvije navedene definicije vještačke inteligencije se ogleda i kroz podjelu iste na „slabu" i „jaku" vještačku inteligenciju, o čemu će biti više riječi kasnije u tekstu.

Jedna od ključnih komponenti razvoja VI je algoritamska inovacija. Osnovni algoritmi kao što su pretraga prostora stanja, neuronske mreže i genetski algoritmi evoluirali su i postali sve složeniji i efikasniji. Primjena dubokog učenja, grane mašinskog učenja koja koristi složene neuronske mreže, dovela je do revolucije u oblastima kao što su prepoznavanje slika, obrada prirodnog jezika i autonomno upravljanje.

Razvoj hardvera takođe je igrao ključnu ulogu u napretku vještačke inteligencije. Napredak u procesorskoj snazi, memoriji i paralelnom računarstvu omogućio je brže izvršavanje složenih algoritama, što je doprinijelo ubrzanju razvoja VI. Posebno su grafički procesori postali ključni za ubrzavanje procesa treniranja neuronskih mreža zbog svoje sposobnosti paralelnog izvršavanja.

Pored toga, velika količina podataka postala je dostupna zahvaljujući internetu i digitalizaciji različitih oblasti. Ovi podaci služe kao gorivo za treniranje algoritama mašinskog učenja i omogućavaju stvaranje preciznijih modela.

Uz tehnički napredak, razvoj vještačke inteligencije suočava se i s nizom izazova. Jedan od njih je "problematika uskog uma" (engl. *narrow AI*), gdje su sistemi vrlo specijalizovani za izvršavanje određenih zadataka, ali nemaju sposobnost generalizacije kao ljudski um.

Međutim, izazovi u vezi s privatnošću podataka, etikom i sigurnošću su postali važni aspekti razvoja vještačke inteligencije. Takođe, pitanja povezana s transparentnošću i odgovornošću algoritama postaju sve važnija kako se VI sve više integriše u društvo.

Vještačka inteligencija kakvu danas znamo, prvi put je predstavljena krajem 2022. godine. Od tada, iako tek na samom početku, počeo je da se razvija ogroman broj proizvoda koji manje ili više uključuju vještačku inteligenciju u svoje funkcionisanje. Jedan od pokazatelja koji ovo potvrđuju je i sama brzina prihvatanja vještačke inteligencije od strane ogromnog broja kompanija i pojedinaca iz oblasti informacionih tehnologija, kao i širokog broja običnih korisnika digitalnih tehnologija.

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[1]Uvod je u potpunosti napisan od strane vještačke inteligencije ChatGPT 3.5

Svakako je obećanje da će vještačka inteligencija ostati besplatna i široko dostupna svim zainteresovanim stranama, nešto što će dovesti do ubrzanog prihvatanja i široke upotrebe.

U budućnosti, očekuje se da će vještačka inteligencija igrati ključnu ulogu u različitim sferama ljudskog života, uključujući medicinu, transport, obrazovanje i upravljanje resursima. Stoga, kako bismo iskoristili pun potencijal VI, važno je da razvijamo tehnologije koje su etične, transparentne i odgovorne prema ljudima i društvu.

U cilju razvoja ovakvih tehnologija, izuzetno je značajno pitanje regulative na polju vještačke inteligencije. U tom smjeru je napravljeno nekoliko koraka. Jedan od njih je bio kreiranje Evropske strategije za vještačku inteligenciju 2018. godine od strane Evropske komisije. Zatim je iste godine objavljen Koordinisani plan o vještačkoj inteligenciji (Evropska komisija, 2024). Godine 2020. je ista institucija donijela Bijelu knjigu o vještačkoj inteligenciji gdje je izložena jasna vizija za vještačku inteligenciju u Evropi. Sve ovo je kulminiralo usvajanjem Akta o vještačkoj inteligenciji od strane Evropskog parlamenta u martu 2024. godine (Evropska komisija, 2024).

Ovim Aktom koji je napisan u formi zakona, biće zabranjena i ograničena upotreba vještačke inteligencije za niz praksi koje se smatraju neetičkim ili krše osnovna ljudska prava, kao što su prepoznavanje emocija na radnom mjestu, klasifikacija pojedinaca po etničkoj i vjerskoj pripadnosti, seksualna orijentacija, društveno bodovanje ili prepoznavanje lica. Isto tako je propisano da sadržaj koji je nastao putem vještačke inteligencije mora biti označen kao takav. Uvode se i četiri kategorije rizičnosti upotrebe VI i to: kategorija naprihvatljivog rizika, kategorija visokog rizika, ograničenog rizika i kategorija minimalnog rizika. Shodno ovim kategorijama rizika definišu se i pravila upotrebe VI (Evropska komisija, 2024).

Dakle, vještačka inteligencija predstavlja fascinantan fenomen koji već ima veliki uticaj za ogroman broj sfera ljudskog života. Njen uticaj na društvo i tehnološki napredak sve je značajniji, a budući razvoj će zahtijevati multidisciplinarni pristup koji uključuje tehničke, etičke i društvene aspekte.

EKONOMSKI EFEKTI USVAJANJA VJEŠTAČKE INTELIGENCIJE

Trenutno je široko prisutno vjerovanje da će vještačka inteligencija biti jedan od ključnih faktora budućeg ekonomskog rasta (Lu, 2021). Usvajanje vještačke inteligencije donosi sa sobom brojne ekonomske prednosti i nedostatke koji mogu imati značajan uticaj na privredu i društvo.

Povećanje produktivnosti jedna je od glavnih ekonomskih prednosti. Sistemima vještačke inteligencije omogućeno je da automatizuju rutinske i ponavljajuće zadatke, oslobađajući ljudske resurse za kreativnije i kompleksnije zadatke. To može rezultirati efikasnijim procesima proizvodnje, smanjenjem troškova i povećanjem profitabilnosti za organizacije.

Inovacije i razvoj novih proizvoda dobijaju nove horizonte. Vještačka inteligencija omogućava dublje razumijevanje podataka i identifikaciju uzoraka koje bi bilo teško ili nemoguće primijetiti ljudskim okom. To otvara vrata za inovacije u proizvodima i uslugama, omogućavajući kompanijama da razvijaju personalizovane proizvode, prilagođene potrebama svojih korisnika.

Efikasnije poslovne odluke se, takođe, dovode u korelaciju sa algoritmima vještačke inteligencije, s obzirom na to da mogu analizirati ogromne količine podataka i izvlačiti korisne uvide koji pomažu donosiocima odluka da bolje razumiju tržište, predvide trendove i identifikuju nove poslovne prilike. To omogućava kompanijama da donose brže i bolje informisane odluke, što dovodi do veće konkurentnosti na tržištu.

Personalizacija i poboljšanje korisničkog iskustva je naredna dobrobit, jer VI omogućava personalizaciju proizvoda i usluga na osnovu individualnih preferencija i ponašanja korisnika. To rezultira poboljšanim korisničkim iskustvom i lojalnošću korisnika, što može imati pozitivan uticaj na prihode i profitabilnost kompanija.

Smanjenje troškova i povećanje efikasnosti je, takođe, jedna od dobrobiti. Automatizacija procesa pomoću vještačke inteligencije može dovesti do značajnog smanjenja operativnih troškova za kompanije. Eliminisanje potrebe za ljudskom intervencijom u određenim zadacima može smanjiti troškove rada, greške i vrijeme potrebno za izvršavanje zadataka.

Kako bi ove prednosti oslikali brojkama, može se navesti podatak da je vrijednost tržišta vještačke inteligencije u 2023. godini bila 196,6 milijardi USD globalno. Takođe, predviđa se prosječna godišnja stopa rasta (CAGR) za period 2024–2030. godina na nivou ogromnih 36,6% (Grand View Research Report, 2024). Trenutno u svijetu ne postoji niti jedan drugi faktor sa ovako visokim potencijalom globalnog ekonomskog rasta.

Potencijalni gubitak radnih mjesta jedan je od glavnih ekonomskih nedostataka usvajanja vještačke inteligencije. Automatizacija rutinskih zadataka može rezultirati smanjenjem potrebe za radnom snagom u određenim sektorima, što može dovesti do povećanja nezaposlenosti. Kao primjer se može navesti nova Xiaomi Smart Super Factory fabrika automobila koja sklapa novi automobil SU7 na svakih 76 sekundi, a u njoj radi preko 700 robota i svega 20 radnika (Luchian, 2024). Ako se ovo uporedi sa produktivnosti u Njemačkoj auto-industriji, onda je jasan razlog zabrinutosti njemačkih izvršnih direktora.

Usvajanje vještačke inteligencije može dovesti do neravnoteže na tržištu rada, pri čemu se traže specifične vještine i kompetencije koje nisu dostupne svim radnicima. To može rezultirati neusklađenošću između ponude i potražnje za radnom snagom, što može dovesti do problema kao što su nedostatak kvalifikovanih radnika ili višak nekvalifikovanih radnika.

Uz napredak vještačke inteligencije dolazi i zabrinutost zbog privatnosti i sigurnosti podataka. Velike količine ličnih podataka koji se koriste za treniranje algoritama vještačke inteligencije mogu biti meta zloupotrebe ili neovlašćenog pristupa, što može ugroziti privatnost i povjerenje korisnika (Kak, 2018).

Usvajanje vještačke inteligencije postavlja brojna etička pitanja, uključujući pitanja vezana za pravednost, diskriminaciju i odgovornost algoritama. Postavljanje odgovarajućih etičkih smjernica i regulativa ključno je kako bi se osiguralo odgovorno korištenje ove tehnologije i minimizirali potencijalni negativni uticaji na društvo.

Uz sve ekonomske prednosti, postoji rizik od prevelike zavisnosti od tehnologije vještačke inteligencije. Ova zavisnost može dovesti do ranjivosti sistema i povećane osjetljivosti na tehničke kvarove, hakere ili druge vanjske prijetnje (McClure, 2018).

U cjelini, usvajanje vještačke inteligencije donosi sa sobom brojne ekonomske prednosti, ali i izazove. Ključno je da društvo, poslovni sektor i regulatorna tijela rade zajedno kako bi iskoristili potencijal ove tehnologije dok istovremeno minimiziraju njene negativne uticaje na društvo i ekonomiju.

VJEŠTAČKA INTELIGENCIJA I NJEN UTICAJ NA DRUŠTVO

Ako želimo razumjeti uticaj vještačke inteligencije na privatnu sferu života, prvo moramo napraviti distinkciju između slabe (weak) i jake (strong) vještačke inteligencije (Tai, 2020). Slaba VI se često naziva i uska ili specijalizovana VI, dok se jaka naziva duboka ili opšta vještačka inteligencija (OVI)

Podjela vještačke inteligencije na specijalizovanu i opštu ključni je koncept u razumijevanju različitih nivoa sposobnosti VI. Specijalizovana VI odnosi se na sisteme koji su dizajnirani da izvršavaju specifične zadatke ili funkcije, poput prepoznavanja uzoraka u podacima, prevođenja jezika ili vožnje automobila. Ovi sistemi nemaju svijest ili sposobnost učenja iz iskustva, već samo izvršavaju zadatke za koje su programirani, ali sa mogućnošću da unapređuju tačnost rezultata koji nude ili funkcije koju obavljaju.

S druge strane, opšta vještačka inteligencija predstavlja oblik koji ima sposobnost razumijevanja, učenja, apstraktnog razmišljanja i rješavanja problema na način koji nalikuje ljudskom razmišljanju. Takvi sistemi imaju potencijal da donose odluke, razvijaju svijest o okolini i sebi, te da razvijaju nove strategije i ideje. Opšta VI je još uvijek u razvoju, jer zahtijeva razvoj složenih algoritama i sistema koji su sposobni razumjeti i rješavati širok spektar problema.

Specijalizovana VI se koristi u mnogim aplikacijama kao što su pretraživanje na internetu, preporuke proizvoda, analiza podataka, autonomna vožnja automobila, itd. Vjerovatno bi se mogli složiti da ova VI ima više prednosti za čovječanstvo od njenih negativnih efekata, iz prostog razloga jer je ona ograničena na obavljanje određenog zadatka i ne može se proširiti mimo tih zadatih granica.

Ako uzmemo u razmatranje opštu VI čiji je uticaj na budućnost čovječanstva neuporedivo veći, onda dolazimo do ne tako jednostavnog odgovora. Iz prostog razloga što još gotovo niko ne može imati jasnu sliku o

mogućnostima i upotrebi opšte VI u raznim oblastima ljudskog života.

Trenutno znamo da se opšta VI koristi u medicinskoj dijagnostici, sa značajno boljim rezultatima nego kada isti zadatak obavljaju doktori specijalisti. Medicinske operacije su, takođe jedan od primjera upotrebe VI na opštu dobrobit čovječanstva, a za koje su se hirurzi složili da roboti sa VI to rade bolje nego hirurg specijalista (Tai, 2020). Spoj robotizacije i VI u cilju obavljanja poslova opasnih po ljudsku individuu ili prepuštanje pojedinih poslova VI kako bi se ljudi bavili kreativnijim aktivnostima, je još jedan od primjera ispravne upotrebe VI. Takođe, izbjegavanje grešaka u ljudskom postupanju izazvanih emocijama, zamorom, karakterom ličnosti i slično je naredna prednost. Da skratimo nabrajanja, prednosti upotrebe VI su brojne i značajne.

Međutim, kao i u većini stvari, postoje značajne negativnosti povezane sa upotrebom, prvenstveno opšte VI. Te negativnosti se kreću od pitanja ekologije, privatnosti, etičnosti, racia, pa sve do egzistencijalnih pitanja opstanka ljudske vrste kakvu poznajemo danas.

Pitanje ekologije vezano za VI se najviše povezuje sa ogromnom upotrebom električne energije. Za shvatanje ovog pitanja najbolje je navesti predikciju koju je uradio Aleks de Vris sa univerziteta u Amsterdamu. On je uzeo podatak da samo proizvođač NVIDIA ima projekcije proizvodnje i isporuke od 1,5 miliona servera vještačke inteligencije godišnje. Da bi se pokretalo ovih 1,5 miliona servera potrebno je obezbijediti 85,4 teravat-časa električne energije godišnje. Za poređenje, ovo je više nego što mnoge manje zemlje potroše u toku godine dana (de Vries, 2023).

Osim ovoga, napravljen je i proračun šta bi bilo potrebno kada bi sve Gugl pretrage bile obavljene putem nekog alata VI, umjesto putem Gugl pretraživača. Prvo, u tom slučaju, Gugl bi imao potrošnju električne energije kao što trenutno ima čitava Irska. Zatim, Gugl bi morao investirati oko 100 milijardi USD u hardver da podrži ovakve pretrage. Dalje, ovolika potreba za hardverom od strane samo jedne kompanije bi proizvela značajne poremećaje na tržištu (Leffer, 2023).

Osim ovoga, možemo se zapitati da li je dobro ono što se ističe kao jedna od bitnih prednosti VI, odsustvo emocija u postupanju i donošenju odluka. Ako se prisjetimo da su mnoge velike stvari u ljudskoj istoriji proizašle iz ljudske emocije, onda se možemo zapitati da li je ovo prednost. Sa druge strane, definitivno je naša istorija svjedok i mnogih negativnosti proizašlih iz ljudskog karaktera i emocije.

Kako osigurati potrebnu privatnost i etičnost u postupcima vještačke inteligencije? I pored donošenja zakona u ovoj oblasti, znamo da uvijek postoje pojedinci koji su spremni kršiti zakone. Kao jednu od već prisutnih praksi na ovom polju se može navesti postojanje virusa koji putem VI sam mijenja svoj izvorni kod na svakih 30 sekundi, kako bi onemogućio detektovanje od strane antivirusnih programa. Naravno da je ovo protivzakonito i napravljeno sa zlim namjerama.

Zatim, imamo sve prisutniju VI u vojnoj industriji. Iako su se vojni lobiji postarali da njena upotreba bude zakonski legalna, postavlja se pitanje gdje nas to može odvesti i koje štete može proizvesti. Recimo, kod upotrebe nuklearne energije u vojne svrhe prevladala je svijest da ona mora biti strogo kontrolisana. Da li je to moguće u slučaju VI? Vjerovatno jeste, ali mnogo teže shodno prirodi kreiranja i upotrebe VI. Odnosno, činjenici da je ona dostupna širokim masama, kao i da se nalazi u digitalnom, a ne fizičkom obliku.

Veliki broj autora smatra da će VI redefinisati postojeće prijetnje. Ove prijetnje mogu biti usmjerene prema pojedincima, institucijama, korporacijama, potrošačima, fizičkoj imovini, vladinim tijelima, ali i prema društvu u cjelini. Njihova motivacija može proizaći iz želje za finansijskom dobiti, sticanjem moći ili promjenom nečijeg društvenog položaja (Filipović, Bjelajac, Merodović, Stošić, 2023).

Šta ako se obistine predviđanja da VI u nekom trenutku može preuzeti kontrolu i početi, nezavisno od ljudi, upravljati pojedinim sistemima? Šta ako u takvoj situaciji prosudi da su ljudi suvišni? Pitanja su brojna, ali u ovom trenutku samo hipotetička. Ipak, s obzirom na značaj VI po ljudsku vrstu, potrebno je da se neko ozbiljno pozabavi ovakvim pitanjima.

Akt o vještačkoj inteligenciji donesen od strane Evropskog parlamenta u martu 2024. godine je najbolji primjer proaktivnog promišljanja na ovu temu. Ono što je potrebno jeste da primjer Evropske unije slijede i druge države, pogotovo one razvijene, te da zakonska regulativa bude relativno usaglašena na globalnom nivou. Ovo zadnje je bitno kako se ne bi pojavljivale zemlje u kojima je dozvoljeno

raditi stvari koje nisu dozvoljene u većini drugih zemalja. U ovom slučaju bi onda imali nešto što je slično primjeru „zemalja poreskih rajeva", gdje kompanije koje žele da izbjegnu poreze, osnivaju sjedišta u tim zemljama, a posluju globalno.

ISTRAŽIVANJE
Metod istraživanja

Cilj ovog istraživanja je bio utvrditi stavove opšte populacije o vještačkoj inteligenciji. U istraživanju je učestvovalo 107 ispitanika. Ciljna skupina su bile osobe starosti od 18 do 60 godina, koje redovno koriste digitalne tehnologije, te sa minimalno srednjoškolskim obrazovanjem. Ispitanici su odabrani metodom slučajnog odabira. Struktura uzorka prema polu, godinama starosti, godinama radnog staža i stručnoj spremi predstavljeni su u tabeli 1.

U kategoriji pol neznatno više ispitanika se nalazi u kategoriji muški, i to 52%, dok je 48% u kategoriji ženski, dok se niko nije identifikovao u kategoriju ostali. U kategoriji starost najviše ispitanika se nalazi u kategoriji 31–50 godina i to 49%, zatim 32% u kategoriji 18–30, dok je 20% u kategoriji 51 i više godina. U kategoriji stručna sprema najviše ispitanika je u kategoriji visoka, i to 58%, u kategoriji srednja je 29%, dok je u kategoriji magistar i više 13%. U kategoriji korištenja digitalnih tehnologija 100% posmatranih ispitanika redovno koristi digitalne tehnologije. S obzirom na predstavljenu distribuciju uzorka, smatra se potpuno reprezentativnim.

Upitnik je sadržavao tvrdnje na koje su ispitanici trebalo da daju svoje potvrdne ili odrične odgovore na petostepenoj skali Likertovog tipa (u potpunosti se ne slažem, djelimično se ne slažem, nemam stav, djelimično se slažem, u potpunosti se slažem). Obrada podataka je obavljena u statističkom softveru SPSS 26.0. Za analizu podataka je primijenjena deskriptivna analiza.

Tabela 1. Struktura uzorka prema socio-demografskim faktorima za N=107
Table 1. The structure of sample according to socio-demographic factors for N=107

Socio-demografski faktori		Frekvenca	Procenat
Pol	Muški	56	52%
	Ženski	51	48%
	Ostalo	0	0%
Starost	18–30	34	32%
	31–50	52	49%
	51 i više	21	20%
Stručna sprema	Srednja	31	29%
	Visoka	62	58%
	Magistar i više	14	13%
Redovna upotreba digitalnih tehnologija	Da	107	100%
	Ne	0	0%

Rezultati i diskusija

Prva tvrdnja je glasila „Rado bih prihvatio svakodnevnu upotrebu vještake inteligencije u privatne svrhe i time dopustio pristup mojim privatnim podacima", a na slici 1 su predstavljeni dobijeni odogovori. Odričnih odgovora smo dobili 47,6%, što je, s obzirom na nepoznanice vezane za vještačku inteligenciju upareno sa opšte prisutnim strahovima po privatnost, relativno mali procenat. Međutim, ono što je zanimljivo je da je čak 28% ispitanika reklo da nema stav po ovom pitanju. Druga zanimljivost je da je 24,3% reklo da se djelimično slaže, a niko se nije izjasnio da se apsolutno slaže.
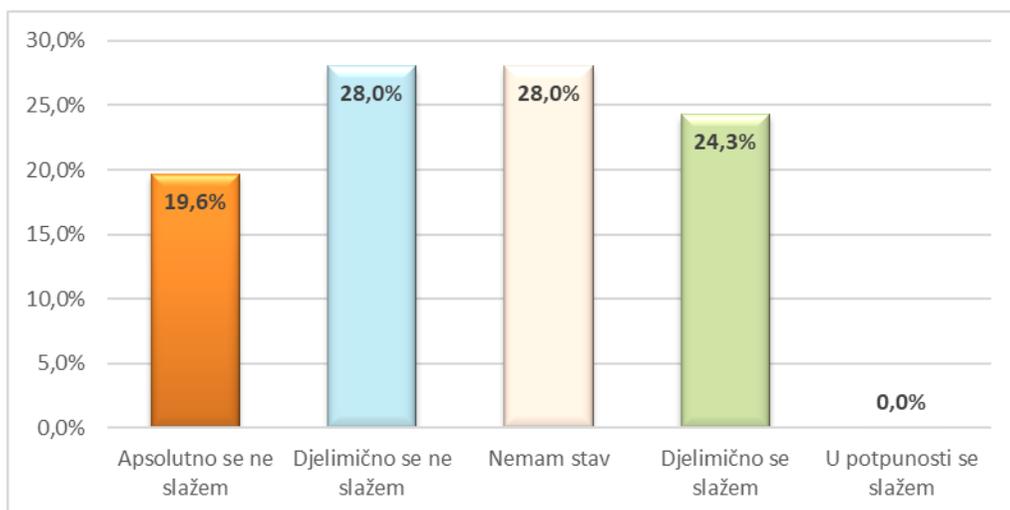
Slika 1. Slaganje/neslaganje sa tvrdnjom „Rado bih prihvatio svakodnevnu upotrebu vještačke inteligencije u privatne svrhe i time dopustio pristup mojim privatnim podacima"

Figure 1. Agreeing/disagreeing with statement "I would gladly accept the daily use of artificial intelligence for private purposes and thereby allow access to my private data"

Druga tvrdnja je glasila „Vještačka inteligencija može značajno ubrzati odvijanje poslovnih procesa i/ili dovesti do smanjenja troškova poslovanja". U dvije grupe koje označavaju slaganje sa navedenom tvrdnjom se nalazi 91,6% odgovora (slika 2). Očito je da ovdje postoji konsenzus da vještačka inteligencija može donijeti ekonomske dobrobiti. Pogotovo zato što niko nije dao odričan odgovor.
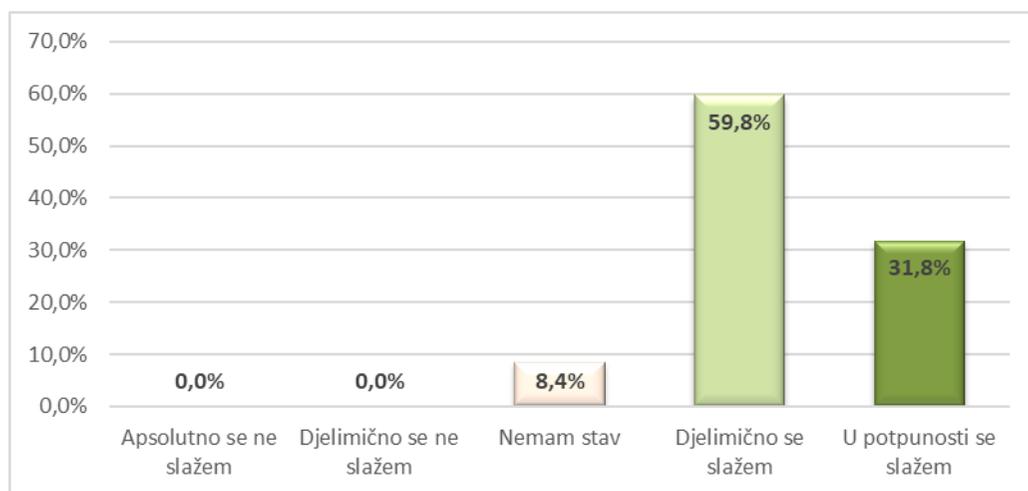
Slika 2. Slaganje/neslaganje sa tvrdnjom „Vještačka inteligencija može značajno ubrzati odvijanje poslovnih procesa i/ili dovesti do smanjenja troškova poslovanja"

Figure 2. Agreeing/disagreeing with statement " Artificial intelligence can significantly speed up business processes and/or lead to a reduction in business costs"

Naredna tvrdnja je glasila „Vještačka inteligencija je prijetnja za moje zaposlenje, jer zbog nje moje radno mjesto može postati suvišno". Ovdje vidimo da je distribucija odgovora takva da se 64,5% ispitanika ne slaže sa ovom tvrdnjom. A od ovih 64,5%, čak 40,2%

se apsolutno ne slaže. Svega 28,0% se djelimično slaže, a samo 3,7% je apsolutno slaže (slika 3). Iz ovoga se vidi da generalna populacija ne vidi izazove za svoje zaposlenje prouzrokovane značajnijim prihvatanjem VI.
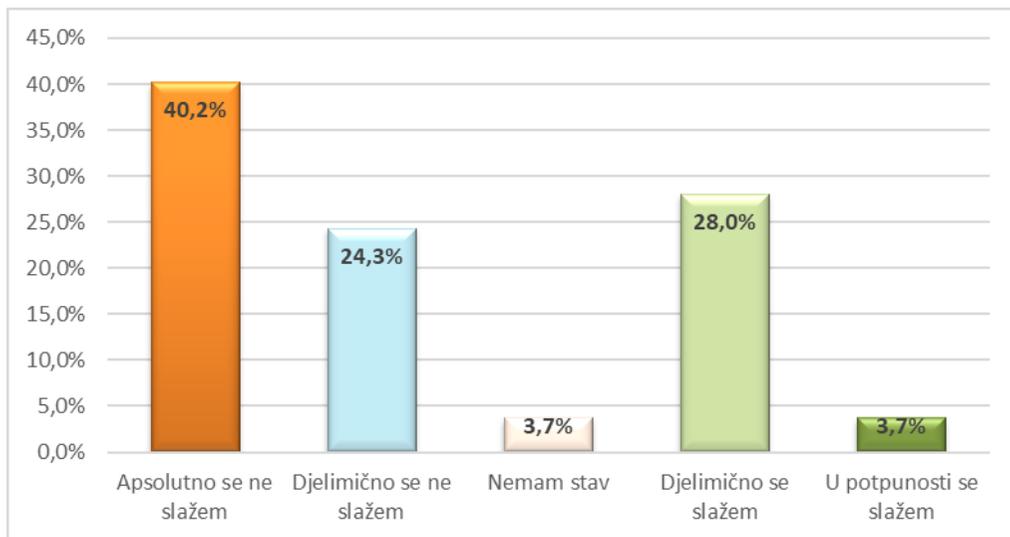
Slika 3. Slaganje/neslaganje sa tvrdnjom „Vještačka inteligencija je prijetnja za moje zaposlenje, jer zbog nje moje radno mjesto može postati suvišno"
Figure 3. Agreeing/disagreeing with statement "Artificial intelligence is a threat to my employment, because it can make my workplace redundant"

Naredno pitanje je glasilo „Smatram da će se šira upotreba vještačke inteligencije odraziti na mentalno zdravlje pojedinaca:". S obzirom na to da je ovo bilo pitanje, a ne tvrdnja, ponuđena su tri moguća odgovora: „pozitivno", „neće imati nikakvog uticaja" i „negativno". Za odgovor negativno se odlučilo 68,2% ispitanika, dok se po 15,9% odlučilo za odgovore pozitivno i da neće imati nikakvog uticaja (slika 4).
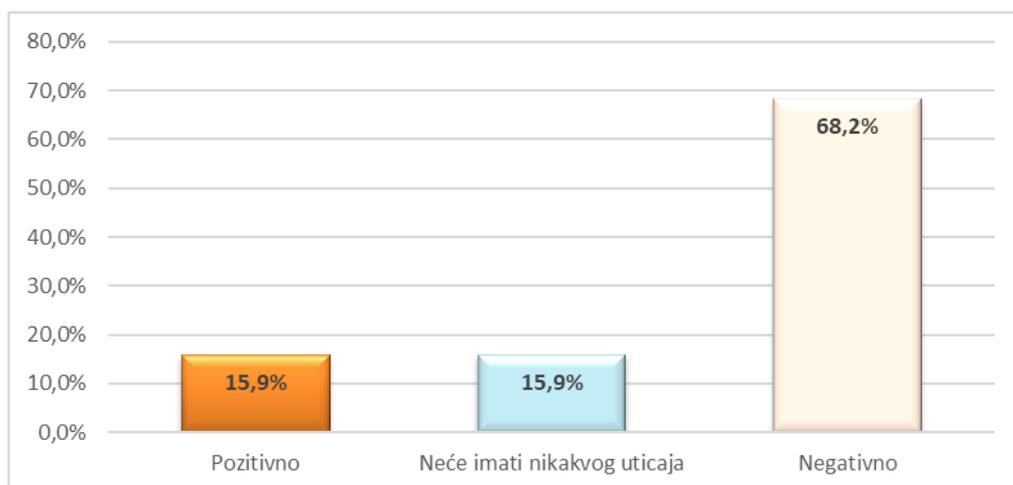
Slika 4. Slaganje/neslaganje sa tvrdnjom „Smatram da će se šira upotreba vještačke inteligencije odraziti na mentalno zdravlje pojedinaca:"
Figure 4. Agreeing/disagreeing with statement "I believe that the wider use of artificial intelligence will affect the mental health of individuals:"

Naredna tvrdnja je glasila „Vještačka inteligencija može postati prijetnja za čovječanstvo", a dobijeni odgovori se vide na slici 5. Tumačenje je jednostavno, s obzirom na to da se čak 71,9% ispitanika izjasnilo da se slaže, s tim da je otprilike polovina u grupi koja se u potpunosti slaže, a polovina u grupi koja se djelimično slaže. Ponovo je iznenađujuće da je relativno veliki procenat (15,9%) onih koji nemaju stav po ovom pitanju. Ukupno 12,1% ispitanika se izjasnilo da se djelimično ne slaže, dok se niko nije izjasnio da se apsolutno ne slaže (slika 5).
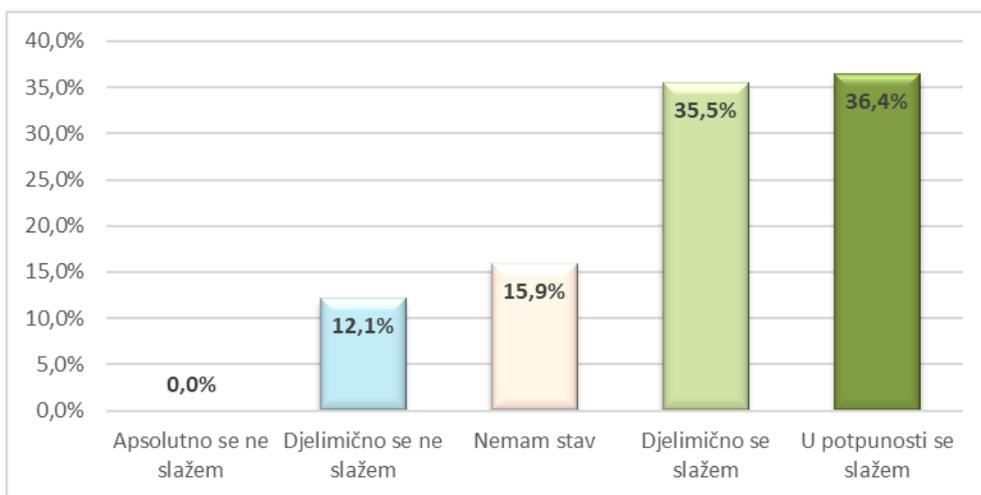

Slika 5. Slaganje/neslaganje sa tvrdnjom „Vještačka inteligencija može postati prijetnja za čovječanstvo"
Figure 5. Agreeing/disagreeing with statement "Artificial intelligence can become a threat to humanity"

Naredna tvrdnja je glasila „Potrebno je striktno regulisati upotrebu i mogućnosti vještačke inteligencije". Gotovo 80% ispitanika se izjasnilo da se u potpunosti slaže, dok je skoro 16% njih bilo za odgovor da se djelimično slaže. Zanimljivo je da niko od ispitanika nije dao odgovor da se ne slaže (slika 6).
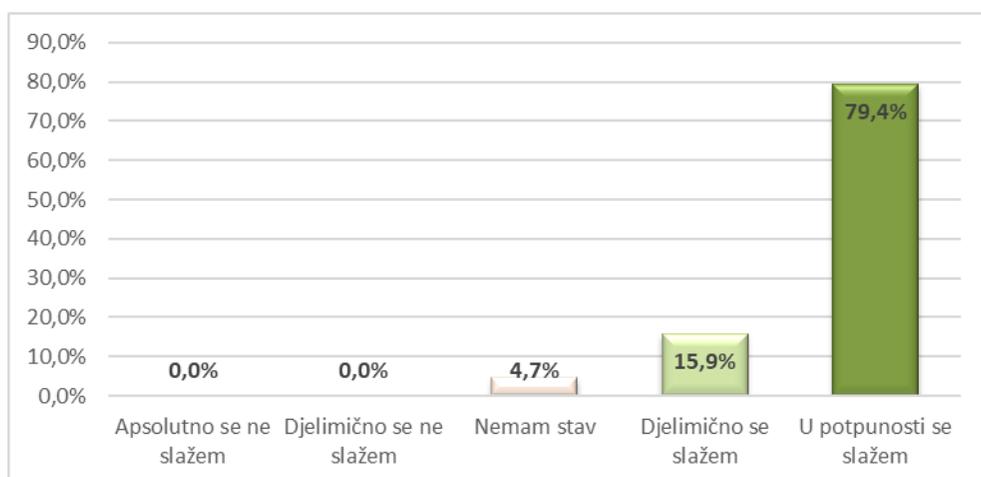
Slika 6. Slaganje/neslaganje sa tvrdnjom „Potrebno je striktno regulisati upotrebu i mogućnosti vještačke inteligencije"
Figure 6. Agreeing/disagreeing with statement "It is necessary to strictly regulate the use and capabilities of artificial intelligence"

I na kraju je bilo pitanje „Najveću odgovornost za regulisanje razvoja i upotrebe vještačke inteligencije imaju:" sa 4 ponuđena odgovora vidljiva na slici 7. Nešto preko 60% odgovora je bio za institucije društva u kojem živimo, a nešto preko 35% za kompanije koje razvijaju VI.
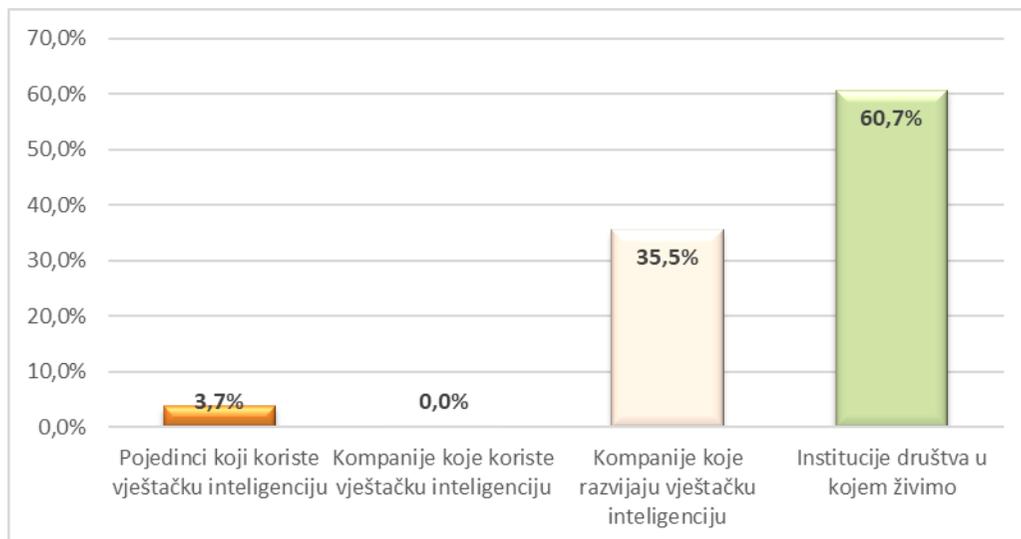
Slika 7. Slaganje/neslaganje sa tvrdnjom „Najveću odgovornost za regulisanje razvoja i upotrebe vještačke inteligencije imaju:"

Figure 7. Agreeing/disagreeing with statement "The greatest responsibility for regulating the development and use of artificial intelligence rests with:"

ZAKLJUČCI

Od početaka vještačke inteligencije 1956. godine pa do danas, njen razvoj je prošao dug put. Ipak, treba imati na umu da je sve do početka 21. vijeka, njen razvoj bio izuzetno limitiran. Ta ograničenja su se odnosila kako na raspoloživi hardver, tako i na softverske mogućnosti. Ipak početkom 21. vijeka ovi limiti nestaju i VI počinje užurbano da se razvija. S obzirom na mogućnosti VI 21. vijeka, dobili smo i podjelu na specijalizovanu (koja je bila u fokusu razvoja u 20. vijeku) i opštu (koja je u fokusu razvoja u 21. vijeku).

Pozitivni ekonomski efekti koje sa sobom nosi značajnije usvajanje VI su nedvojbeni. Njihova lista može biti prilično dugačka, ali povećanje produktivnosti, smanjenje troškova, personalizacija, kvalitetnije poslovne odluke, povećanje efikasnosti i efektivnosti i poboljšanje korisničkog iskustva su samo neke od njih. Od ekonomskih negativnosti mogao bi se navesti potencijalni gubitak radnih mjesta, neravnoteža na tržištu rada, sigurnost podataka, potrošnja energije, neka etička pitanja, itd.

Zaključak je da ekonomske koristi odnose prevagu nad ekonomskim negativnostima koje sa sobom nosi vještačka inteligencija.

Na pitanja uticaja vještačke inteligencije na društvo u kojem živimo, mišljenja su značajnije podijeljena. Zbog toga se pristupilo istraživanju koje je imalo za cilj da ponudi odgovore na ova pitanja.

Iz dobijenih odgovora se iščitava da skoro polovina populacije nije spremna za prihvatanje VI u privatne svrhe i dijeljenje svojih privatnih podataka. Ipak za potpunije razumijevanje ovog stava, potrebno je znati da malo manje od trećine ispitanika nema stav po ovom pitanju. Ovako veliki procenat odgovora da nema stav, upućuje na zaključak da su ispitanici nedovoljno informisani o onome što sa sobom donosi VI. U ovom smjeru vodi i odgovor da gotovo 2/3 ispitanika ne vidi problem za svoje zaposlenje. Ako prihvatimo tezu da ne postoji dovoljna informisanost o VI, onda je apsolutno opravdana svrha pisanja ovog rada. Pogotovo imajući u vidu strukturu uzorka u kojoj preko 70% ispitanika ima fakultetsko ili više

obrazovanje, što znači da bi oni trebalo da budu bolje informisani i osviješteni dio populacije.

Međutim, preko 70% ispitanika smatra da VI može postati prijetnja za čovječanstvo. Isto tako, skoro 70% ispitanika smatra da VI može imati negativne uticaje na mentalno zdravlje pojedinca. Zanimljivo je da ispitanici vide prijetnje po čovječanstvo i po mentalno zdravlje, ali ne vide prijetnje po njihovo zaposlenje. Svi dostupni podaci ukazuju da je manji vremenski horizont u kojem nastupa supstitucija u obavljanju poslova, nego što je horizont u kojem može nastupiti opasnost po čovječanstvo.

Dalje, jasno su se izjasnili da je potrebno striktno regulisati upotrebu i mogućnosti VI sa 95% odgovora u ovom smjeru. Upravo zbog ovoga je izražen stav da institucije društva u kojem živimo i kompanije koje razvijaju VI moraju raditi na razvoju regulatornog okvira na ovom polju.

Pravi značajan korak u tom smjeru su ranije navedeni dokumenti Evropske unije, kao i Akt o vještačkoj inteligenciji donesen do strane Evropskog parlamenta u martu 2024. Ono što je potrebno da ovu prasku EU na polju regulisanja VI slijedi ostatak zemalja, kako bi se minimizovale iskazane zabrinutosti i obezbijedilo da VI služi čovječanstvu, a ne obrnuto.

Opšti zaključak je da čovječanstvo može imati značajne koristi od razvoja vještačke inteligencije, ali pod jednim uslovom – da njen razvoj i vidovi upotrebe budu strogo i harmonizovano regulisani u globalnim okvirima.

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ARTIFICIAL INTELLIGENCE: EFFECTS ON SOCIETY, THE ECONOMY, AND ITS REGULATION

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ORIGINAL SCIENTIFIC PAPER

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ABSTRACT

The beginnings of artificial intelligence are linked to 1956 and the Dartmouth conference organized by Stanford University. From those beginnings until the end of the 20th century, its development was relatively slow due to hardware and software limitations. However, the 21st century brings a turning point in every sense.

In the 21st century, there was also a division into specialized artificial intelligence, which was primarily developed in the 20th century, and general artificial intelligence, on which the focus of development has been placed in recent decades.

The positive economic effects of the adoption of artificial intelligence, according to the conducted research, are unequivocal. The effects on individuals and humanity are significantly more open to discussion.

Almost half of the respondents in the conducted research are not in favor of accepting artificial intelligence for private purposes, and the other half is almost equally divided between those who do not have an opinion on this issue and those who are not against its acceptance.

About 70% of respondents believe that artificial intelligence can become a threat to humanity and the mental health of individuals. At the same time, the majority of respondents do not see challenges in their employment.

As a solution, the respondents see a clear and strict regulation of the development and possibilities of artificial intelligence itself. Institutions of the society we live in and companies that develop artificial intelligence are seen as responsible for this regulation.

A real step in this direction was taken by the European Union with the adoption of the Act on Artificial Intelligence in March 2024. What is expected is that this example of the EU will be followed by other countries, which would ensure the correct development and use of artificial intelligence for the general benefit of humanity, which it should serve.

Keywords: artificial intelligence, economic benefits, impact on society, regulation of artificial intelligence.

BLOCKCHAIN U JAVNOJ UPRAVI BOSNE I HERCEGOVINE

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SAŽETAK

U ovom radu istražujemo potencijal blockchain tehnologije za poboljšanje efikasnosti javne uprave u Bosni i Hercegovini. Suočeni sa izazovima u komunikaciji i pružanju usluga između Vlade i građana, naše istraživanje ispituje kako blockchain može pružiti rješenja. Koristili smo upitnike za prikupljanje mišljenja građana i sproveli komparativnu analizu najboljih praksi iz zemalja koje su uspješno implementirale blockchain u javnim sektorima. Ovaj pristup nam omogućava da identifikujemo specifične oblasti u kojima blockchain, posebno putem pametnih ugovora i hibridnih mreža, može poboljšati efikasnost i rezultate.

Blockchain tehnologija (Nakamoto, 2008), poznata po svojim karakteristikama decentralizacije, transparentnosti i sigurnosti, pokazuje obećanje u nekoliko sektora, uključujući finansije, kriptovalute, podršku poslovanju i pravo, nudeći značajne benefite. Naša analiza sugeriše da, usvajanjem sličnih strategija, Bosna i Hercegovina može riješiti mnoge trenutne probleme koji potkopavaju efikasnost javne uprave.

Naši nalazi, zasnovani na povratnim informacijama građana, ukazuju na to da postojeći sistem ne zadovoljava potrebe efikasnosti, naglašavajući potrebu za inovativnim rješenjima poput blockchaina za poboljšanje pružanja javnih usluga. Svjesni smo potencijalnih izazova u implementaciji, kao što su tehnološka infrastruktura, pravni okviri i socio-ekonomski faktori. Uprkos ovim preprekama, naše istraživanje predstavlja uvjerljiv argument za blockchain tehnologiju kao sredstvo za olakšavanje efikasnije komunikacije i usluga između Vlade i građana.

Zaključujemo sa preporukama za usvajanje blockchain tehnologije u javnoj upravi Bosne i Hercegovine, podržane našom komparativnom analizom i uvidima iz upitnika. Pored toga, predlažemo oblasti za buduća istraživanja kako bismo nastavili da istražujemo transformativni potencijal blockchaina u javnim uslugama.

Ključne riječi: Blockchain tehnologije, smart contracts, javna uprava, decentralizacija.

UVOD

Razvoj informacionih tehnologija kontinuirano oblikuje i unapređuje različite aspekte društva, uključujući javnu upravu. U posljednjih nekoliko godina, blockchain tehnologija se istakla kao jedna od najinovativnijih i najperspektivnijih tehnologija s potencijalom da revolucionizira mnoge sektore. Blockchain, poznat po svojim karakteristikama decentralizacije, transparentnosti i sigurnosti (Swan, 2015), pruža jedinstvene mogućnosti za poboljšanje efikasnosti i efektivnosti javnih usluga.

Javna uprava u Bosni i Hercegovini suočava se s brojnim izazovima, uključujući

kompleksnu birokratsku strukturu, spor proces donošenja odluka, i nedostatak transparentnosti u pružanju usluga građanima. Ovi izazovi često rezultiraju nezadovoljstvom građana i nedostatkom povjerenja u državne institucije. U tom kontekstu, istraživanje potencijala blockchain tehnologije za unapređenje javne uprave postaje izuzetno relevantno i važno.

Cilj ovog rada je da istraži na koji način blockchain tehnologija može unaprijediti efikasnost javne uprave u Bosni i Hercegovini. Fokusiraćemo se na konkretne primjene blockchaina, kao što su digitalna identifikacija, transparentnost transakcija, pametni ugovori i sistemi glasanja. Kroz analizu najboljih praksi iz zemalja koje su već implementirale blockchain u javni sektor, kao i putem prikupljanja mišljenja građana, nastojaćemo identifikovati ključne oblasti u kojima bi primjena ove tehnologije mogla donijeti najveće benefite.

Rad je organizovan na sljedeći način: U prvom dijelu biće objašnjeni osnovni pojmovi i karakteristike blockchain tehnologije. U drugom dijelu razmotrićemo primjene blockchaina u javnoj upravi, s posebnim osvrtom na primjere iz prakse. U trećem dijelu, kroz komparativnu analizu i mišljenja građana, predstavićemo nalaze istraživanja i dati preporuke za usvajanje blockchain tehnologije u javnoj upravi Bosne i Hercegovine.

Zaključujemo s osvrtom na potencijalne izazove i buduće pravce istraživanja, s ciljem da se doprinese daljoj diskusiji o transformativnom potencijalu blockchain tehnologije u javnom sektoru.

BLOCKCHAIN - OSNOVNE DEFINICIJE I PRIMJENE

Blockchain je inovativna tehnologija koja predstavlja distribuiranu digitalnu knjigu ili bazu podataka. Svaki unos u knjigu, poznat kao blok, povezan je sa prethodnim blokom koristeći kriptografski heš, čineći lanac blokova – otuda naziv blockchain. Ova tehnologija donosi nekoliko ključnih karakteristika koje je čine revolucionarnom:

➢ Distribuirana Knjiga (*Ledger*): Blockchain je distribuirana knjiga gdje su sve informacije ili transakcije pohranjene preko mreže računara (čvorova). Nema centralne tačke kontrole, što smanjuje rizik od manipulacije ili korupcije (Mihajlović, & Zubović, 2020);

➢ Konsenzus Mehanizam: Za dodavanje novog bloka u lanac, većina čvorova u mreži mora postići konsenzus. Postoji nekoliko konsenzus algoritama, kao što su *Proof of Work (PoW), Proof of Stake (PoS), i Practical Byzantine Fault Tolerance (PBFT);*

➢ Kriptografska Sigurnost: Svaki blok je kriptografski povezan sa prethodnim blokom pomoću heš funkcije. Heš funkcija uzima ulazne podatke i generiše fiksnu veličinu heš koda. Mala promjena u ulaznim podacima mijenja cijeli heš kod, čineći podatke sigurnim i nepromjenljivim;

➢ Nepromenljivost (*Immutability*): Kada je blok dodan u blockchain, on postaje trajni zapis. Ne može se mijenjati niti brisati bez promjene svih narednih blokova, što je praktično nemoguće bez konsenzusa mreže;

➢ Transparentnost: Sve transakcije su vidljive svim učesnicima mreže. Ova transparentnost povećava povjerenje među učesnicima i omogućava provjerljivost podataka;

➢ Pametni Ugovori (*Smart Contracts*): Ovo su samostalni ugovori sa uslovima ugrađenim direktno u kod. Izvršavaju se automatski kada su ispunjeni određeni uslovi, bez potrebe za posrednicima.

Proof of Work (PoW).

Proof of Work (PoW) je jedan od prvih i najpoznatijih konsenzus algoritama, najčešće korišten u blockchain mrežama kao što su Bitcoin i Ethereum (prije prelaska na PoS). Osnovna ideja PoW je da mreža rješava kompleksne matematičke probleme kako bi verifikovala transakcije i dodavala nove blokove u blockchain:

➢ Rudarenje: Čvorovi u mreži, poznati kao rudari, takmiče se u rješavanju kriptografskih problema. Ovi problemi zahtijevaju značajnu računarsku snagu za rješavanje.

➢ Rješenje problema: Prvi rudar koji riješi problem dobija pravo da doda novi blok transakcija u blockchain i nagrađen je s određenim brojem kriptovaluta (npr. Bitcoin).

➢ Validacija: Ostali čvorovi u mreži provjeravaju da li je rješenje tačno. Ako

většina mreže potvrdi validnost rješenja, blok se dodaje u blockchain.

➢ Sigurnost: PoW obezbjeđuje sigurnost tako što je rješavanje problema izuzetno teško i zahtijeva puno resursa, dok je verifikacija rješenja relativno jednostavna. Ovo otežava napadačima da preuzmu kontrolu nad mrežom.

Proof of Stake (PoS)

Proof of Stake (PoS) je alternativni konsenzus algoritam koji se koristi za verifikaciju transakcija i dodavanje novih blokova u blockchain. Umjesto rudarenja, PoS koristi postojeće količine kriptovalute koje korisnici drže kao "ulog" za validaciju blokova. Evo kako funkcioniše:

➢ Ulog: Korisnici mreže deponuju (stake) određeni iznos svoje kriptovalute kao ulog. Što je veći ulog, veća je vjerovatnoća da će korisnik biti izabran za validaciju sledećeg bloka;

➢ Validatori: Čvorovi koji drže ulog poznati su kao validatori. Validator sa najvećim ulogom ili najdužim stažom (ili kombinacijom ovih faktora) ima veće šanse da bude izabran za dodavanje novog bloka;

➢ Verifikacija: Kada je validator izabran, on verifikuje transakcije i dodaje novi blok u blockchain. Kao nagradu, validator dobija transakcione naknade i/ili dodatne kriptovalute;

➢ Sigurnost: PoS obezbjeđuje sigurnost tako što validatori imaju ekonomski ulog u mreži. Ako pokušaju da prevarom dodaju neispravan blok, gube svoj ulog.

Practical Byzantine Fault Tolerance (PBFT)

Practical Byzantine Fault Tolerance (PBFT) (Castro, & Liskov, 1999) je konsenzus algoritam dizajniran za omogućavanje distribuiranim sistemima da postignu dogovor (konsenzus) čak i u prisustvu zlonamjernih čvorova ili kvarova u sistemu. PBFT je efikasna metoda za postizanje konsenzusa u okruženju gdje neki čvorovi mogu djelovati neispravno ili zlonamjerno, što je poznato kao problem bizantinskih grešaka.

Ključne Karakteristike PBFT-a:

Otpornost na Greške: PBFT može tolerisati do 1/3 zlonamjernih ili neispravnih čvorova u mreži. Ako mreža ima n čvorova,

PBFT može funkcionisati ispravno sve dok manje od n/3 čvorova djeluje zlonamjerno ili ima kvar.

Deterministički Konsenzus: PBFT koristi deterministički pristup za postizanje konsenzusa. To znači da će mreža, pod istim ulaznim uslovima, uvijek doći do istog izlaza.

Brzina i Efikasnost: PBFT je dizajniran da bude brz i efikasan u mrežama sa relativno malim brojem čvorova. Međutim, može postati neefikasan u veoma velikim mrežama zbog povećane količine komunikacije potrebne za postizanje konsenzusa.

Kako PBFT Funkcioniše?

1. Replike: Mreža se sastoji od n čvorova, gdje je jedan čvor označen kao primarni (glavni) čvor, a ostali su backup (rezervni) čvorovi;

2. Poruke i Faze: Konsenzus se postiže kroz razmjenu poruka tokom tri glavne faze:
   ➢ Pre-preparation: Primarni čvor predlaže novi blok transakcija i šalje poruku sa prijedlogom svim backup čvorovima;
   ➢ Preparation: Backup čvorovi provjeravaju validnost prijedloga i šalju poruku drugim čvorovima potvrđujući da su primili validan prijedlog;
   ➢ Commit: Kada backup čvorovi prime dovoljno (n - 1) poruka od drugih čvorova koje potvrđuju validnost prijedloga, šalju završne poruke koje potvrđuju da su spremni da dodaju novi blok u blockchain.

3. Konsenzus: Konsenzus se postiže kada backup čvorovi prime dovoljan broj commit poruka (obično 2/3+1). Tada se blok transakcija dodaje u blockchain.

Pametni Ugovor (Smart Contract)

Pametni ugovor je samostalni program koji se izvršava na blockchain mreži i automatski sprovodi, kontroliše ili dokumentuje događaje i radnje prema uslovima ugovora ili sporazuma. Ovi ugovori su napisani u obliku kodiranih instrukcija koje su pohranjene, verifikovane i izvršene na blockchainu, što omogućava sigurnu i transparentnu automatizaciju transakcija bez potrebe za posrednicima.

Ključne karakteristike pametnih ugovora:

➢ Automatizacija: Pametni ugovori automatski izvršavaju zadate radnje kada su ispunjeni unaprijed definisani uslovi. Ovo eliminiše potrebu za manuelnim intervencijama ili posrednicima;

➢ Transparentnost: Svi učesnici u mreži mogu vidjeti i verifikovati pametni ugovor i njegove uslove, što povećava povjerenje i smanjuje rizik od prevara (Liu, Lu, Zhu, Paik, & Staples, 2023);

➢ Sigurnost: Pametni ugovori koriste kriptografske metode za osiguranje podataka i verifikaciju transakcija, čime se osigurava integritet i nepovredivost ugovora;

➢ Nezavisnost: Nakon što se pametni ugovor postavi na blockchain, on se izvršava nezavisno i nepovratno, bez potrebe za daljom kontrolom ili modifikacijom.

BLOKCHAIN U JAVNOJ UPRAVI

Upotreba blockchain tehnologije u javnoj upravi može donijeti mnoge prednosti koje nisu direktno povezane sa pametnim ugovorima (Kassen, 2024). Evo nekoliko načina na koje blockchain može biti koristan:

➢ Registrovanje vlasništva: Blockchain može biti korišćen za vođenje registara nepokretnosti, zemljišta, vozila, i drugih oblika vlasništva. Ovo omogućava tačne, nepromjenljive i lako provjerljive evidencije, čime se smanjuje rizik od prevara i sporova oko vlasništva;

➢ Evidencija građanskih stanja: Blockchain može poboljšati upravljanje matičnim knjigama rođenih, vjenčanih i umrlih, čime se osigurava sigurnost i tačnost ovih podataka. Decentralizovana priroda blockchaina omogućava brzi pristup i verifikaciju podataka;

➢ Sistemi glasanja: Pored pametnih ugovora, blockchain tehnologija sama po sebi može omogućiti sigurniji i transparentniji proces glasanja, smanjujući mogućnost izborne prevare i omogućavajući verifikaciju glasova u realnom vremenu;

➢ Transparentnost budžeta: Blockchain može omogućiti javno praćenje budžetskih transakcija, što omogućava građanima i revizorima da prate kako se troše javna sredstva. Ovo povećava

odgovornost i smanjuje mogućnost korupcije;

➢ Distribucija pomoći: Blockchain može pomoći u transparentnom i efikasnom distribuiranju pomoći u vanrednim situacijama, kao što su prirodne katastrofe ili pandemije. Pomoć može biti direktno dostavljena onima kojima je potrebna bez posrednika;

➢ Zdravstveni kartoni: Blockchain može omogućiti sigurno i decentralizovano vođenje medicinskih kartona, čime se olakšava razmena informacija između različitih zdravstvenih ustanova i osigurava privatnost pacijenata;

➢ Sistemi identifikacije: Blockchain može poboljšati sisteme za upravljanje identitetima građana, omogućavajući jedinstveni digitalni identitet koji može biti korišćen za pristup različitim uslugama, kako u javnom, tako i u privatnom sektoru;

➢ Praćenje lanca snabdijevanja: Blockchain može biti korišćen za praćenje lanca snabdijevanja u javnim projektima, osiguravajući transparentnost i odgovornost u svakoj fazi, od nabavke materijala do finalne isporuke;

➢ Sudska evidencija: Blockchain može poboljšati upravljanje sudskim zapisima i dokazima, osiguravajući njihovu nepovredivost i olakšavajući pristup relevantnim informacijama za sve strane u sudskim procesima.

Pametni ugovori imaju veliki potencijal za poboljšanje efikasnosti i transparentnosti u javnoj upravi (Balcerzak, et al., 2023). Evo nekoliko načina na koje bi se mogli koristiti:

➢ Upravljanje javnim sredstvima: Pametni ugovori mogu automatski izvršavati isplate i nadgledati trošenje javnih sredstava, čime se smanjuje mogućnost korupcije i malverzacija. Na primjer, sredstva dodijeljena za javne projekte mogu biti oslobođena samo kada se ispune određeni uslovi i faze projekta (Abdullah, & Jusoh, 2023);

➢ Glasanje: Implementacija pametnih ugovora u izborni proces može povećati sigurnost i transparentnost glasanja. Ovi ugovori mogu omogućiti automatizovanu provjeru identiteta birača, bilježenje glasova i objavljivanje rezultata bez

mogućnosti manipulacije (Benabdallah, Audras, Coudert, El Madhoun, & Badra, 2023);

➢ Ugovori i javne nabavke: Pametni ugovori mogu osigurati da su procesi javnih nabavki pošteni i transparentni. Ugovori bi se automatski izvršavali nakon ispunjavanja ugovornih obaveza, kao što su isporuka roba ili usluga, što smanjuje rizik od korupcije;

➢ Upravljanje identitetima: Pametni ugovori mogu poboljšati upravljanje ličnim podacima građana, omogućavajući sigurnu i transparentnu verifikaciju identiteta. To može olakšati pristup javnim uslugama i smanjiti birokratske prepreke;

➢ Socijalna davanja: Automatizacija isplate socijalnih davanja kroz pametne ugovore može osigurati da sredstva stignu do korisnika na vreme i bez grešaka. Ugovori mogu biti programirani tako da provjeravaju ispunjenost uslova za primanje pomoći prije svake isplate (Cagigas, Clifton, Diaz-Fuentes, Fernández-Gutiérrez, & Harpes, 2023);

➢ Zdravstveni sistemi: Pametni ugovori mogu poboljšati praćenje i upravljanje zdravstvenim podacima, omogućavajući sigurnu razmjenu informacija između različitih zdravstvenih ustanova i osiguravajući tačnost i sigurnost medicinskih evidencija.

Korišćenjem blockchain tehnologije, javna uprava može postići veću efikasnost, sigurnost i transparentnost, što na kraju vodi ka boljem pružanju usluga građanima i većem povjerenju u javne institucije.

Primjeri iz drugih država

Estonija je pionir u korišćenju blockchain tehnologije u javnoj upravi kroz svoj X-Road sistem. Ovaj sistem omogućava sigurnu razmjenu podataka između različitih državnih institucija. Građani mogu pristupiti svojim zdravstvenim, pravnim i administrativnim podacima putem interneta, što je omogućeno decentralizovanim i kriptografski zaštićenim sistemom (e-Estonia, n.d.).

Gruzija je implementirala blockchain tehnologiju za upravljanje registrom zemljišta. Ovaj sistem omogućava transparentnu i sigurnu evidenciju vlasništva nad zemljištem. Svaka promjena u vlasništvu se zapisuje na blockchain, što smanjuje mogućnost prevara i sporova oko vlasništva. Gruzija je takođe smanjila vrijeme potrebno za registraciju zemljišta i poboljšala povjerenje građana u sistem (The World Bank, 2016).

Honduras je započeo pilot projekat korišćenja blockchain tehnologije za upravljanje registrom zemljišta u saradnji sa tehnološkim partnerima. Cilj je borba protiv korupcije i poboljšanje sigurnosti vlasničkih prava. Blockchain osigurava transparentnost i provjerljivost svih promjena u vlasništvu (Reuters, 2015).

Švedska istražuje upotrebu blockchain tehnologije za digitalizaciju registra nekretnina. Cilj je smanjenje vremena potrebnog za kupoprodaju nekretnina sa nekoliko mjeseci na nekoliko dana. Blockchain osigurava sigurnu i transparentnu evidenciju svih transakcija, od inicijalne ponude do finalne prodaje, uključujući provjeru identiteta učesnika i verifikaciju dokumenata (Government Offices of Sweden, 2017).

Ovi primjeri pokazuju kako različite zemlje koriste blockchain tehnologiju za unapređenje javne uprave i mogu poslužiti kao vodič za implementaciju sličnih rješenja u Bosni i Hercegovini.

REZULTATI ISTRAŽIVANJA

Na početku 2024. godine, autori su sproveli istraživanje o primjeni novih tehnologija u javnoj upravi u Bosni i Hercegovini. Cilj istraživanja bio je da se utvrdi stanje javne uprave u Bosni i Hercegovini i koliko su korisnici usluga spremni da prihvate nove tehnologije u javnoj upravi. Od 1267 odgovora od 3000 pripremljenih upitnika sa 4 pitanja, najveću grupu predstavljaju oni između 16 i 29 godina, sa 588 predstavnika, pa oni od 30 do 49 godina sa 414 (graf 2), 604 odgovora je došlo od osoba ženskog pola, 663 od osoba muškog pola (graf 1).
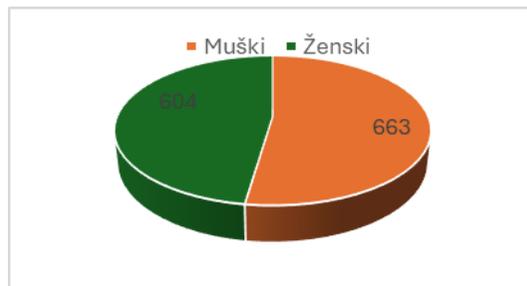
Graf 1. Pol ispitanika
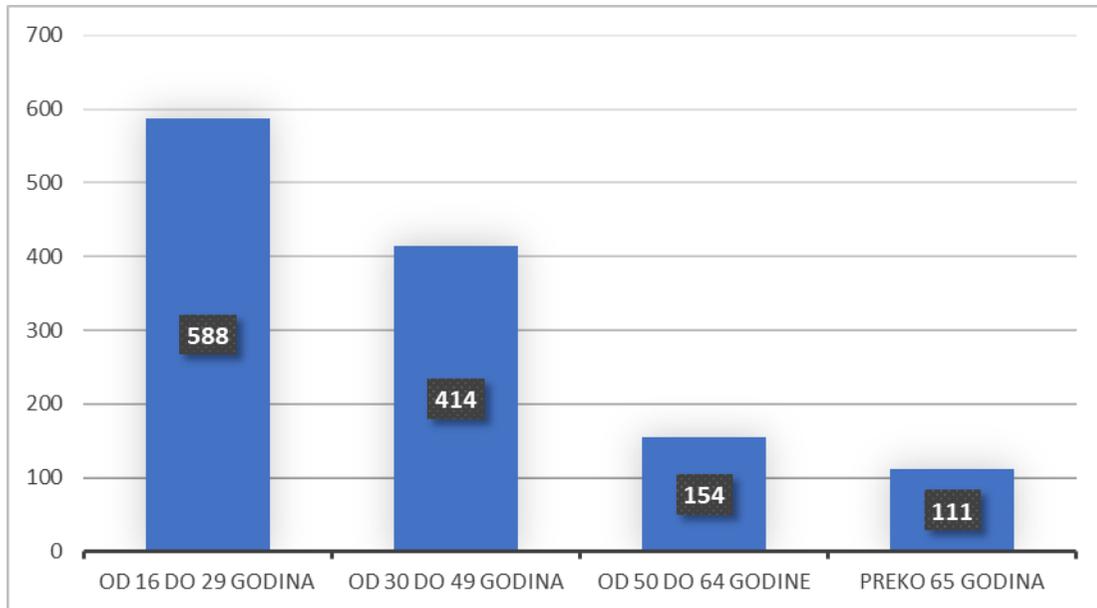
Graf 2. Starosna struktura ispitanika

Kao što je i očekivano, najveći broj korisnika javne uprave nije zadovoljan brzinom usluga, sa 455 odgovora vrlo nezadovoljan, i 421 odgovorom uglavnom nezadovoljan, dok je samo 23 korisnika odgovorilo da je vrlo zadovoljno brzinom usluge (graf 3). Najveći broj korisnika na uslugu čeka od 11 minuta do jednog sata, njih 376, i od 1 do 60 dana njih 302 (graf 4).
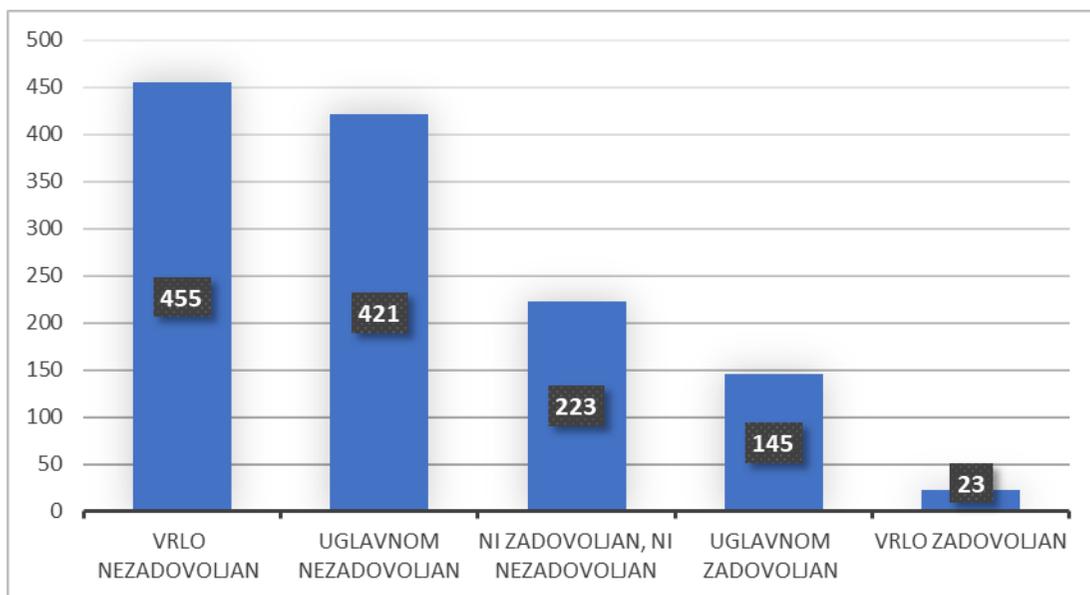
Graf 3. Zadovoljstvo korisnika brzinom usluga koje pruža javna uprava
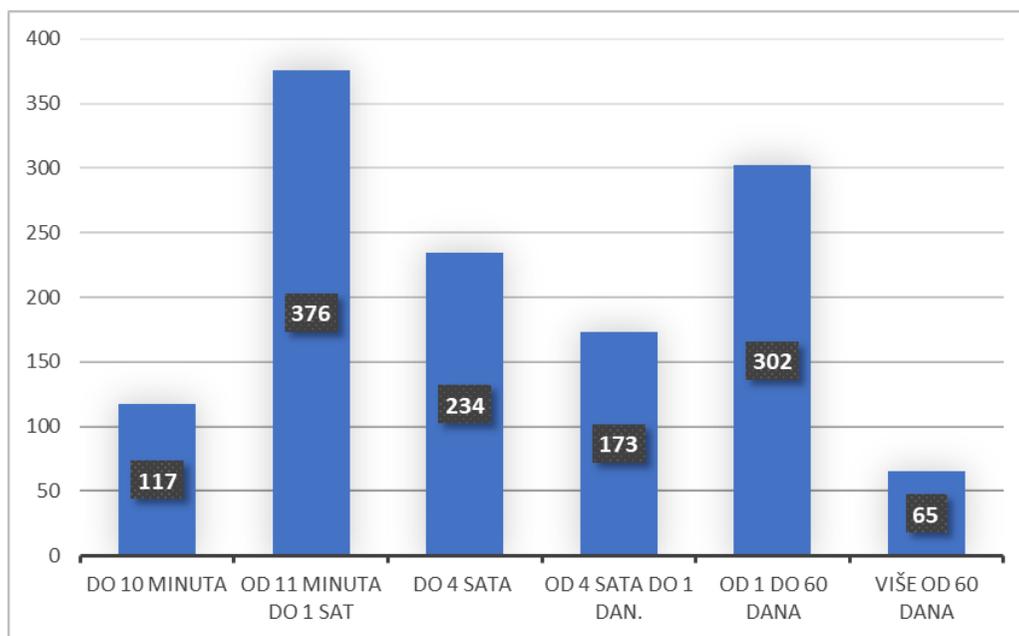
Graf 4. Vrijeme potrebno da dobijete uslugu

Javna uprava u Bosni i Hercegovini opterećena je arhaičnim regulativama i internim pravilnicima koji usporavaju njeno funkcionisanje. U dobu u kojem živimo, autori smatraju da ne postoji nijedan razlog zašto bi korisnik trebao da čeka na uslugu duže od nekoliko sekundi. Ovi rezultati ukazuju na značajnu potrebu za unapređenjem efikasnosti i brzine usluga koje pruža javna uprava u Bosni i Hercegovini. Implementacija novih tehnologija, kao što je blockchain, može biti ključni faktor u poboljšanju ovih aspekata, omogućavajući brže i transparentnije usluge za građane.

BLOCKHAIN U JAVNOJ UPRAVI BOSNE I HERCEGOVINE

Implementacija pametnih ugovora i blockchain tehnologije može donijeti značajne promjene i poboljšanja u javnoj upravi Bosne i Hercegovine na nekoliko ključnih područja. Primjena blockchaina za stvaranje sigurnih i nepromjenljivih digitalnih identiteta građana omogućila bi automatsku verifikaciju identiteta prilikom prijave za različite usluge, čime bi se smanjila mogućnost prevara i povećala efikasnost procesa. To bi olakšalo građanima pristup uslugama, smanjilo birokratske prepreke i ubrzalo procese, čineći javnu upravu efikasnijom i pristupačnijom.

Vođenje zemljišnih knjiga pomoću blockchain tehnologije osiguralo bi transparentnost i sigurnost podataka o vlasništvu nekretnina. Automatsko ažuriranje zapisa prilikom promjene vlasništva putem pametnih ugovora smanjilo bi birokratske procese i rizik od korupcije. Građani bi imali povjerenje u nepromjenljivost i tačnost zapisa, a time bi se smanjile pravne nesigurnosti i sporovi vezani za vlasništvo nekretnina.

Korištenje blockchaina za praćenje i transparentno objavljivanje svih transakcija u okviru javnog budžeta omogućilo bi građanima uvid u trošenje javnih sredstava. Pametni ugovori bi osigurali automatsko izvršavanje i praćenje plaćanja, čime bi se povećala transparentnost javnih finansija. Ovo bi omogućilo bolju kontrolu i nadzor nad javnim sredstvima, smanjujući mogućnost zloupotreba i korupcije. Građani bi imali veće povjerenje u način na koji se troši njihov novac, što bi doprinijelo jačanju povjerenja u državne institucije.

Implementacija blockchain tehnologije za elektronsko glasanje osigurala bi integritet i sigurnost glasova, a pametni ugovori bi verifikovali identitet glasača i automatski bilježili glasove na nepromjenljivu i transparentnu knjigu, smanjujući mogućnost izbornih prevara. Elektronsko glasanje bi učinilo izborni proces bržim, sigurnijim i pristupačnijim, omogućujući građanima da glasaju iz bilo kojeg mjesta, što bi moglo

povećati izlaznost na izborima i poboljšati demokratski proces.

Primjena pametnih ugovora u provođenju javnih tendera osigurala bi transparentnost i poštenje u procesu dodjele ugovora. Sve ponude i uslovi bili bi zapisani na blockchainu, a pametni ugovori bi automatski birali najpovoljniju ponudu prema unaprijed definisanim kriterijumima. Ovaj pristup bi eliminisao mogućnost namještanja tendera i korupcije, te osigurao da javni poslovi budu dodijeljeni najkvalitetnijim i najpovoljnijim ponuđačima, što bi rezultiralo boljim uslugama i projektima za građane (Nguyen, & Nguyen, 2023).

Praćenje isplate socijalnih beneficija putem blockchain tehnologije osiguralo bi da pomoć stigne do pravih korisnika bez kašnjenja. Automatska provjera uslova za isplatu i izvršenje transakcija putem pametnih ugovora smanjila bi mogućnost zloupotrebe. Ovaj sistem bi osigurao da socijalna pomoć bude distribuirana efikasno i pravedno, bez administrativnih grešaka i zloupotreba, što bi povećalo povjerenje korisnika u socijalne programe i poboljšalo životne uslove najugroženijih grupa.

U suštini, primjena blockchain tehnologije i pametnih ugovora u javnoj upravi Bosne i Hercegovine može značajno unaprijediti efikasnost, transparentnost i sigurnost u pružanju usluga građanima. Ova tehnologija nudi rješenja za mnoge izazove s kojima se suočava javna uprava, uključujući birokratske prepreke, korupciju i nedostatak transparentnosti, te može doprinijeti jačanju povjerenja građana u državne institucije.

ZAKLJUČCI

Na osnovu sprovedenog istraživanja, jasno je da blockchain tehnologija ima značajan potencijal za poboljšanje efikasnosti, transparentnosti i sigurnosti javne uprave u Bosni i Hercegovini. Implementacija blockchaina može pomoći u rješavanju brojnih izazova s kojima se suočava javna uprava, kao što su kompleksna birokratska struktura, spor proces donošenja odluka i nedostatak transparentnosti u pružanju usluga građanima.

Analizom najboljih praksi iz drugih zemalja koje su već implementirale blockchain u javni sektor, kao i putem povratnih informacija građana, identifikovane su ključne oblasti gdje bi primjena blockchain tehnologije

mogla donijeti najveće benefite. Preporuke uključuju razvoj strategije i pravnog okvira, pilot projekte, edukaciju i obuku, modernizaciju tehnološke infrastrukture, povećanje transparentnosti, saradnju s privatnim sektorom, kontinuirano praćenje i evaluaciju, kao i međunarodnu saradnju.

Konkretni primjeri iz Estonije, Gruzije, Švedske i Hondurasa pokazuju kako blockchain može biti efikasno korišten za vođenje registara, digitalnu identifikaciju, sisteme glasanja, transparentnost budžeta i druge oblasti javne uprave. Ovi primjeri služe kao inspiracija za Bosnu i Hercegovinu da usvoji slične strategije.

Istraživanje je pokazalo da postoji značajna potreba za unapređenjem efikasnosti i brzine usluga koje pruža javna uprava u Bosni i Hercegovini. Implementacija blockchain tehnologije može biti ključni faktor u ostvarivanju ovih ciljeva, omogućavajući brže, sigurnije i transparentnije usluge za građane, što na kraju vodi ka većem povjerenju u državne institucije.

Uprkos izazovima kao što su tehnološka infrastruktura, pravni okviri i socio-ekonomski faktori, prednosti koje blockchain tehnologija donosi su jasne i značajne. Nastavak istraživanja i pilot projekata će biti ključan za dalju evaluaciju i prilagođavanje strategija za uspješnu implementaciju blockchain tehnologije u javnu upravu Bosne i Hercegovine.

Ovim radom smo postavili temelje za dalje istraživanje i implementaciju blockchain tehnologije, i nadamo se da će naše preporuke i nalazi biti od koristi državnim institucijama, stručnjacima i građanima u njihovim naporima da unaprijede javnu upravu.

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BLOCKCHAIN IN PUBLIC ADMINISTRATION IN BOSNIA AND HERZEGOVINA

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SHORT SCIENTIFIC PAPER

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ABSTRACT

In this paper, we explore the potential of blockchain technology to enhance public administration efficiency in Bosnia and Herzegovina. Facing challenges in communication and service delivery between the government and its citizens, our research investigates how blockchain can provide solutions. We employed questionnaires to gather citizens' opinions and conducted a comparative analysis of best practices from countries that have successfully implemented blockchain in public sectors. This approach allows us to identify specific areas where blockchain, particularly through smart contracts and hybrid networks, can improve efficiencies and outcomes.

Blockchain technology, known for its decentralization, transparency, and security features, shows promise in several sectors, including finance, cryptocurrency, business support, and law, offering substantial benefits. Our analysis suggests that by adopting similar strategies, Bosnia and Herzegovina can address many current issues undermining public administration effectiveness.

Our findings, based on citizens' feedback and international case studies, indicate that the existing system falls short in efficiency, underscoring the need for innovative solutions like blockchain to enhance public service delivery. We acknowledge potential challenges in implementation, such as technological infrastructure, legal frameworks, and socio-economic considerations. Despite these hurdles, our research presents a compelling case for blockchain technology as a means to facilitate more effective communication and services between the government and its citizens.

We conclude with recommendations for adopting blockchain technology in Bosnia and Herzegovina's public administration, supported by our comparative analysis and questionnaire insights. Additionally, we suggest areas for future research to continue exploring the transformative potential of blockchain in public services.

Keywords: bockchain, smart contracts, public administration, decentralization.

STAVOVI KORISNIKA DIGITALNIH TEHNOLOGIJA O NJIHOVOM UTICAJU NA SVAKODNEVNI ŽIVOT, POSAO I MENTALNO ZDRAVLJE

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KRATKI NAUČNI RAD

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SAŽETAK
Digitalna tehnološka revolucija je počela u drugoj polovini prošlog vijeka. Njen razvoj u prvim dekadama nakon otkrivanja tranzistora je bio prilično spor. Ubrzanje i šira svijest o mogućnostima digitalne tehnologije počeli su se širiti nakon uvođenja interneta. Posljednje dvije dekade donijele su brz razvoj digitalnih tehnologija i opštu prihvaćenost u privatnom i poslovnom životu.
Koristi za pojedince, kompanije, institucije i društvo u cjelini su ogromne i nesumnjive. Ipak, imajući u vidu provedene studije o stepenu digitalizacije pojedinih oblasti društva i pojedinih država, smatra se da je budući potencijal ogroman, a tek se očekuju značajni prodori potpomognuti vještačkom inteligencijom.
Međutim, pored nesumnjivih koristi, postoje i određeni negativni aspekti koji nisu dovoljno rasvijetljeni niti jasno predstavljeni korisnicima. Zbog toga je ovaj rad imao za cilj utvrditi stavove samih korisnika prema digitalnim tehnologijama, te je u empirijskom dijelu ispitivao i njihove stavove o negativnim uticajima na mentalno zdravlje korisnika.
Rezultati su očekivani u dijelu ispitivanja koristi koje proizilaze upotrebom digitalnih tehnologija. Iznenađenje nije ni postojanje negativnih uticaja na zdravlje korisnika, dok je stepen negativnog uticaja i nepreduzimanje korektivnih akcija od strane korisnika iznenađujući. Istraživanje je pokazalo da su korisnici svjesni negativnih aspekata koje proizilaze iz, prvenstveno prekomjerne upotrebe digitalnih tehnologija, ali i dalje ne preduzimaju gotovo ništa da umanje te negativne posljedice.
Ključne riječi: digitalne tehnologije, digitalni uređaji, softverske aplikacije, mentalno zdravlje.

UVOD

Način života se značajno mijenjao kroz istoriju, što je, uglavnom, bio zamajac napretka i razvoja civilizacije. Uopšteno govoreći, kada se osvrnemo i pogledamo unazad, vjerovatno bismo se složili da su ta promjena i sposobnost ljudskog bića da se prilagodi tim promjenama, fundamenti našeg postojanja danas, ali isto tako i nivoa životnog standarda koji uživamo.

I pored apsolutno pozitivnog stava prema promjenama, definitivno nisu sve promjene u ljudskoj istoriji bile pozitivne. Mnoge su imale negativne konotacije u vremenu u kojem su se dešavale, a neke su zadržale isti epitet uprkos protoku vremena.

Međutim, ono što je definitivno drugačije u promjenama koje se dešavaju u našim životima u odnosu na promjene koje su bile na snazi kroz bilo koji period istorije, je uvećanje brzine i intenziteta tih promjena. Ovo je pogotovo izraženo zadnjih 30-ak godina, sa značajnim širenjem digitalne tehnološke revolucije.

U današnje vrijeme gotovo je nezamisliv život bez savremenih digitalnih tehnologija kao što su računari, internet, pametni telefoni, društvene mreže, razne aplikacije za komunikaciju, online vijesti, itd. I dok su pozitivni efekti uvođenja ovih tehnologija u svakodnevni život i posao nesumnjivi, postavlja se pitanje da li postoje i kakvi su negativni efekti istih. S obzirom na činjenicu da još uvijek ne postoje nedvosmislena saznanja o negativnim posljedicama opšte prisutne digitalne tehnologije u životima pojedinaca, zadatak ovog rada bio je da unese dodatna razjašnjenja u ovu oblast i ponudi neke nove nalaze.

Počevši od ove pretpostavke, postavljene su hipoteze ovog rada:

1. digitalne tehnologije značajno pomažu u odvijanju svakodnevnog života i poslovanja;
2. digitalne tehnologije imaju negativan uticaj na mentalno zdravlje pojedinaca koji koriste te tehnologije.

POJAM I RAZVOJ DIGITALNE TEHNOLOŠKE REVOLUCIJE

Digitalna revolucija ilustruje unapređenje tehnologije od mehaničkih uređaja, analogne i elektronske tehnologije do digitalne tehnologije za obradu i čuvanje informacija koja je dostupna danas (Sharma, & Shanmugaboopathi, 2022).

Druga definicija koja svrsishodno opisuje digitalizaciju navodi da je to fenomen koji se odnosi na transformaciju analognih podataka u digitalni jezik koji unapređuje odnose između klijenata donoseći dodatnu vrijednost za ekonomiju i društvo u cjelini (Reis, Amorim, Melao, Cohen, & Rodrigues, 2020).

Još jedna od svrsishodnih i jednostavnih definicija kaže da je digitalizacija stepen usvajanja i integracije digitalnih tehnologija u razne aspekte društvenog života (Hilbert, 2020).

Počeci digitalne revolucije se vezuju za 1974. godinu i pojavu prvih tranzistora koji su omogućili razvoj digitalizovanih kompjutera. Naredni značajan korak se desio s javnom dostupnošću interneta koja se vezuje za 1991. godinu. Korak koji je integrisao postojeće tehnološke revolucije je pojava pametnih telefona koja se vezuje za 2007. godinu (ako se izuzmu prve verzije pametnih telefona koje su imali značajne limitacije po pitanju funkcionalnosti).

Značajan datum je i 2002. godina, kada je čovječanstvo bilo prvi put u situaciji da čuva više podataka u digitalnom nego u bilo kom drugom formatu. Zanimljiv podatak koji oslikava brzinu razvoja digitalnih tehnologija, govori da čovječanstvo svakih 2,5 do 3,0 godine uduplava količinu pohranjenih podataka, odnosno da čuva više podataka nego čitava civilizacija do tada. Takođe, značajno je naglasiti da se kasnih 80-ih godina prošlog vijeka ispod 1% podataka čuvalo u digitalnom obliku, dok se 2012. godine preko 99% podataka čuvalo u digitalnom obliku (Hilbert, 2020).

Iako se ovo što je do sada viđeno na polju tehnološkog napretka, već naziva četvrta tehnološka revolucija, neki praktičari kao što je Klaus Švab (Schwab, 2023), mišljenja su da će se tek otvoriti novi horizonti napretka sa širim uvođenjem vještačke inteligencije. Vještačka inteligencija kakvu danas znamo, prvi put je predstavljena krajem 2022. godine. Od tada, iako tek na samom početku, počeo je da se razvija ogroman broj proizvoda koji manje ili više uključuju vještačku inteligenciju u svoje funkcionisanje. Jedan od indikatora koji ovo potvrđuju je i sama brzina prihvatanja vještačke inteligencije od strane ogromnog broja kompanija i pojedinaca iz oblasti informacionih tehnologija, kao i širokog broja običnih korisnika digitalnih tehnologija. Svakako je obećanje da će vještačka inteligencija ostati besplatna i široko dostupna svim zainteresovanim stranama, nešto što će dovesti do njenog ubrzanog prihvatanja i široke upotrebe.

EKONOMSKI EFEKTI DIGITALNE TEHNOLOŠKE REVOLUCIJE

Digitalna revolucija je dovela i do ogromnih ekonomskih unapređenja. Jedna od prostih ilustracija koja se često koristi za prikazivanje ekonomskih promjena je slika na kojoj su sučeljeni pisaća mašina i računar. Pri tom pisaća mašina predstavlja način obavljanja

poslova koji je nestao sa pojavom digitalnih tehnologija, dok računar predstavlja novi, jednostavniji i brži način obavljanja poslovnih zadatka, te možda ono što je najvažnije, predstavlja i nevjerovatno prošireni obim mogućnosti upotrebe digitalnih tehnologija.

Digitalizacija u kompanije uvedena je relativno sporo. Prvenstveno iz razloga što su komponente bile skupe i što su zahtijevale obučeno osoblje, koje u tom periodu nije postojalo u dovoljnom broju. Protokom vremena, oba razloga su minimizirana, cijena komponenti je drastično smanjena, a broj obučenog osoblja je bivao sve veći. Tako da danas, gotovo da i ne postoje kompanije koje nisu, u manjoj ili većoj mjeri, digitalizovale svoje poslovanje.

Trenutno se smatra da su najveći izvori rasta na polju digitalnih tehnologija dalje usvajanje u kompanijama koje su nisko digitalizovane, kao i dalje digitalizovanje državne uprave kao servisa privrede i stanovništva. Ovo zadnje nosi značajne potencijale, s obzirom na činjenicu da za stanovništvo i privredu može značiti ogromne uštede. Te uštede se u prvom redu ogledaju u uštedi vremena za stanovništvo i kompanije, a koje će oni investirati u neke druge aktivnosti koje im donose novu vrijednost. Takođe, značajan izvor ušteda i unapređenja produktivnosti se odnosi na same institucije državne uprave. Ako se one digitalizuju na ispravan način i u dovoljnoj mjeri, one će obavljati svoje zadatke značajno brže i uz značajno manje troškove. To će značiti ogromne uštede u samom državnom budžetu svake pojedine države koja ovo napravi.

Unapređenja koja su se desila, najočitije se mogu vidjeti kroz unapređenje produktivnosti kompanija. Istraživanje na ovu temu za područje Evropske unije u periodu 2014–2019 je pokazalo da se 97–98% povećanja produktivnosti može objasniti usvajanjem digitalnih tehnologija (Chenic, et al., 2023).

Drugo istraživanje za područje Australije navodi da se 5,8% rasta BDP per capita pripisuje širokom usvajanju digitalizacije u poslovne operacije (Qu, Simes, & O`Mahony, 2017).

S druge strane, vrlo često postavljano pitanje je ono koje se odnosi na obim usvojenosti digitalnih tehnologija u nekoj kompaniji ili nekom društvu. Jedna od studija koja se bavi ovom temom navodi da je Kina imala udio digitalne ekonomije u ukupnom BDP-u 14,2% u 2005. godini, a da se on popeo na 38,6% u 2020. godini (Zhang, Zhao, Wan, & Yao, 2021). Ako je ovaj procenat ovako mali u drugoj najvećoj ekonomiji planete, onda je definitivno prostor za dalja unapređenja izuzetno veliki. Treba samo znati da se navedena studija bavila razmatranjima na trenutnom nivou tehnološkog razvoja. S obzirom na to da će se ovaj razvoj ubrzano dešavati u narednim godinama, postaje jasnija slika mogućih unapređenja.

Kao potvrda ovih navoda može se pogledati i tržišna kapitalizacije svih kompanija prisutnih na berzama. Trenutno, među 5 najvrijednijih svjetskih kompanija nalaze se 4 kompanije koje se bave isključivo digitalnim tehnologijama (CompaniesMarketcap, 2024). Ovo je zapanjujući rezultat imajući u vidu da su neke od njih stare svega 20-ak godina. Kako tržišna kapitalizacija u velikom obimu, kroz cijenu akcija, odražava očekivanja budućeg poslovanja, očito je da su procjene budućnosti za ove kompanije veoma optimistične.

## UTICAJ DIGITALNE TEHNOLOŠKE REVOLUCIJE NA POJEDINCA

Ipak, svi ovi nesumnjivo pozitivni efekti mogu se sagledavati i kroz uticaj na čovjeka kao jedinku koja se prilagođava digitalnom dobu, prvenstveno na njegovo mentalno zdravlje. Prema definiciji Svjetske zdravstvene organizacije, mentalno zdravlje je stanje mentalnog blagostanja koje ljudima omogućuje da se nose sa životnim stresovima, realizuju svoje sposobnosti, dobro uče i dobro rade te doprinose svojoj zajednici (WHO, 2022). U nastavku ovog rada, pažnja će biti usmjerena na prvi dio definicije: „da se nose sa životnim stresovima, realizuju svoje sposobnosti, dobro uče i dobro rade“.

U 2023. godini postojalo je 5,3 milijardi internet korisnika, koji u prosjeku provedu online 6,4 sata u toku svakog dana (Statista, 2023). Ako se od 24 časa dnevno, aproksimira vrijeme spavanja na 8 časova, dolazi se do procjene da se tačno 40% vremena, tokom kojeg je populacija budna, provede online. Znajući da je ovaj procenat prije 30 godina bio gotovo nula, postavlja se pitanje od čega je populacija uzela vrijeme i dodijelila ga svom online prisustvu?

Vrlo zanimljivo je pogledati na šta tačno odlazi ovih 6,4 časova svakog dana. Na slici niže vidi se da preko 50% populacije alocira ovo vrijeme na pronalazak informacija, održavanje kontakta sa prijateljima i porodicom, čitanje vijesti, te na gledanje različitih video sadržaja.
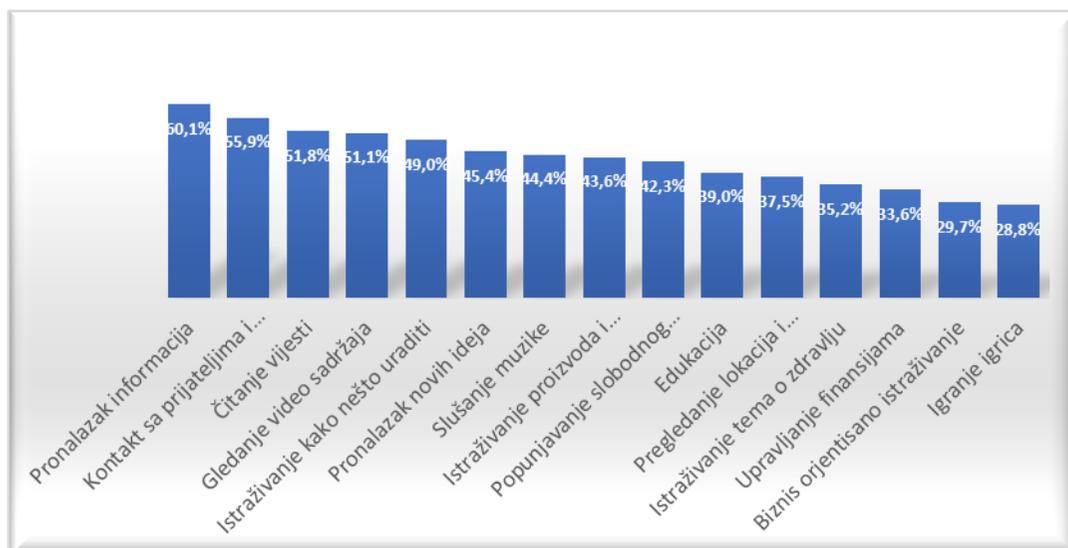
Slika 1. Upotreba interneta shodno razlozima korišćenja
Figure 1. Use of the Internet according to the reasons for use

Ono što je takođe zanimljivo, je da preko 42% populacije koristi internet kako bi popunilo slobodno vrijeme, bez nekog specifičnog razloga za korišćenje. Ovo je upravo u korelaciji sa nalazima studije koju je proveo Microsoft i koja kaže da 77% populacije 18-24 godine kada nema šta da radi, poseže za mobilnim telefonom kako bi prekratilo vrijeme (razlika u procentima dolazi iz različitog dobnog dijeljenja ispitanika). Ovaj procenat za populaciju preko 65 godina starosti je svega 10% (Microsoft attention spans, 2015; Mac, 2023; Mcspadden, 2015).

Još jedna značajna negativnost uočena upravo pomenutom studijom je pad pažnje, odnosno koncentracije. Od 2000. godine (otprilike kada je digitalizacija počela značajnije da ulazi u živote pojedinaca) prosječna pažnja smanjena je sa 12 na 8 sekundi. S druge strane povećala se mogućnost obavljanja više različitih stvari u isto vrijeme (*multitasking*). Ovo je upravo ono što se primjećuje kod djece koja su u stanju da istovremeno vode konverzaciju, slušaju podkast i pregledaju sadržaj na društvenim mrežama. Oni su u stanju da rade više stvari istovremeno,

ali se nisu u mogućnosti koncentrisati na jednu stvar u dužem vremenskom periodu. Ovo definitivno nije dobro za veliki broj oblasti u životu gdje je potrebno uložiti ozbiljniji umni napor kako bi se vidjeli rezultati, kao što je recimo školovanje, naučno-istraživački rad ili ogroman broj profesionalnih zanimanja.

Osim što nije dobro sa društvenog stanovišta, u smislu smanjenja populacije koja je sposobna za dublji umni napor, ovo nije dobro ni za samog pojedinca. Od gotovo svake individue se često očekuje ozbiljan umni napor, a veliki dio mlađe populacije gubi sposobnost kroz način života. Time se dolazi do paradoksa da okruženje u kom obitava navedeni pojedinac, očekuje od njega da je sveprisutan i brzo responzivan u digitalnom svijetu, što je osnovni zahtjev multitaskinga, a što mu umanjuje koncentraciju. Sa druge strane, istovremeno se očekuje od pojedinca da bude sposoban i uloži ozbiljan umni napor u smislu vremena i koncentracije u rješavanje različitih zadataka. Ova kontradiktornost može unijeti konfuziju u svijest pojedinaca koja se reperkutuje na njihovo mentalno zdravlje.

Kao potvrda navedenoga, na predstavljenom grafikonu, koji se tiče Sjedinjenih Američkih Država, može se vidjeti izuzetno veliki skok pojavljivanja snažnih depresivnih stanja. U slučaju muškaraca, u 2004. godini procenat je 5%, da bi u 2022. godini skočio na 11,5%. Kod žena je zabilježen skok sa 13,1% u 2004. godini na čak 28% u 2022. godini (Vankar, 2024).
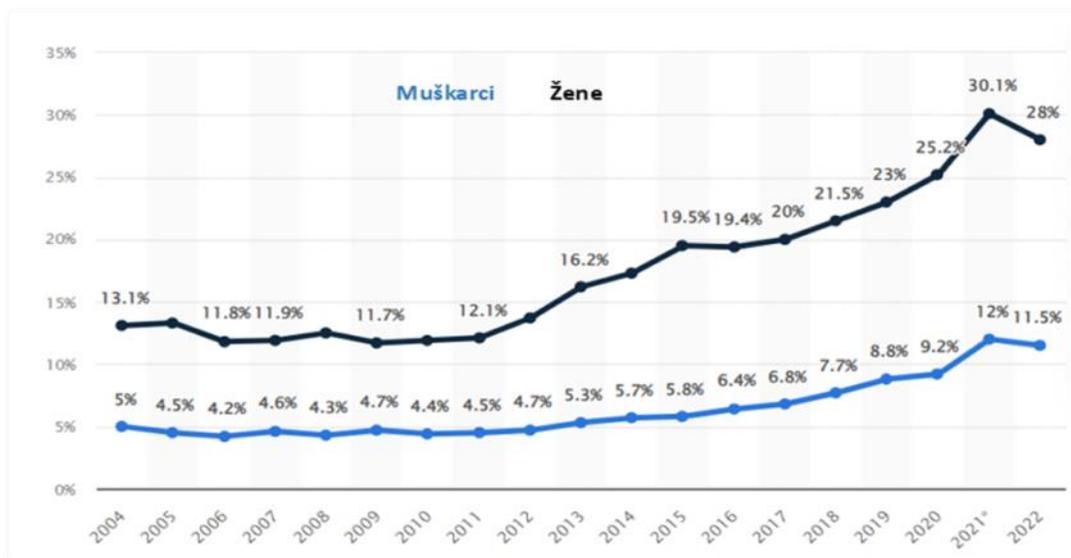
Slika 2. Pojava snažnih depresivnih stanja u zadnjih 12 mjeseci, 2004–2022
Figure 2. Occurrence of strong depressive states in the last 12 months, 2004–2022

Shodno navedenom, postoji ozbiljna zabrinutost da obrazac života uspostavljen u digitalnom dobu nosi sa sobom značajne negativne posljedice po pojedince, prvenstveno mentalne prirode (iako zabrinutosti za fizičko zdravlje nikako ne treba zanemariti). Upravo ovo se nastojalo potvrditi ili opovrgnuti empirijskim istraživanjem koje je predstavljeno u narednim redovima.

ISTRAŽIVANJE
Metod istraživanja

Imajući u vidu da je cilj ovog rada da se utvrdi da li digitalne tehnologije značajno pomažu u odvijanju svakodnevnog života i poslovanja, te da li digitalne tehnologije imaju negativan uticaj na ljudsku individu koja koristi te tehnologije i njeno opšte zdravstveno stanje, u prvom redu mentalno zdravlje, pristupilo se istraživanju.

Ispitanicima je pojašnjenje pojma digitalne tehnologije predstavljeno na sledeći način: „Pod pojmom digitalne tehnologije u ovom istraživanju se podrazumijevaju uređaji kao što su pametni telefoni, tableti, računari, pametni televizori, konzole za igrice, itd, ali i softverske aplikacije poput društvenih mreža Instagram, Facebook, X, itd, aplikacije za komunikaciju poput Viber, Whats up, SMS, itd, aplikacije za gledanje video sadržaja You tube, Netflix, itd, portala sa vijestima, raznih igara u digitalnom obliku, kao i svih drugih softvera koji se koriste na digitalnim uređajima".

U istraživanju je učestvovalo 107 ispitanika, iz Slovenija, Hrvatske, Srbije i Bosne i Hercegovine. Ciljna skupina su bile osobe starosti od 18 do 60 godina, koje redovno koriste digitalne tehnologije, te sa minimalno srednjoškolskim obrazovanjem. Ispitanici su odabrani metodom slučajnog odabira. Struktura uzorka prema polu, godinama starosti, godinama radnog staža i stručnoj spremi predstavljeni su u tabeli 1.

U kategoriji pol neznatno više ispitanika se nalazi u kategoriji muški, i to 52%, dok je 48% u kategoriji ženski, dok se niko nije identifikovao u kategoriju ostali. U kategoriji starost najviše ispitanika se nalazi u kategoriji 31–50 godina, i to 49%, zatim 32% u kategoriji 18–30, dok je 20% kategoriji 51 i više godina. U kategoriji stručna sprema najviše ispitanika je u kategoriji visoka, i to 58%, u kategoriji

srednja je 29%, dok je u kategoriji magistar i više 13%. U kategoriji korištenja digitalnih tehnologija 100% posmatranih ispitanika redovno koristi digitalne tehnologije. S obzirom na predstavljenu distribuciju uzorka, smatra se potpuno reprezentativnim.

U istraživanju je korišten servej metod. Kao instrument je korišten upitnik podijeljen na četiri dijela. Prvi se odnosio na socio-demografske faktore predstavljene u Tabeli 1. Drugi se odnosio na sferu privatnog života i sadržavao je tvrdnje na koje su ispitanici trebalo da daju svoje potvrdne ili odrične odgovore na petostepenoj skali Likertovog tipa (u potpunosti se ne slažem, djelimično se ne slažem, nemam stav, djelimično se slažem, u potpunosti se slažem). Treći se odnosio na sferu poslovnog života, a u četvrtom su se tražili odgovori na pitanje kako digitalne tehnologije utiču na zdravlje pojedinaca. Obrada podataka je obavljena u statističkom softveru SPSS 26.0. Za analizu podataka je primijenjena deskriptivna analiza.

Tabela1. Struktura uzorka prema socio-demografskim faktorima za N=107
Table 1. The structure of sample according to socio-demographic factors for N=107

| Socio-demografski faktori		Frekvenca	Procenat
Pol	Muški	56	52%
	Ženski	51	48%
	Ostalo	0	0%
Starost	18–30	34	32%
	31–50	52	49%
	51 i više	21	20%
Stručna sprema	Srednja	31	29%
	Visoka	62	58%
	Magistar i više	14	13%
Redovna upotreba digitalnih tehnologija	Da	107	100%
	Ne	0	0%

Rezultati i diskusija

Rezultati deskriptivne analize zajedno sa tumačenjem dobijenih rezultata biće predstavljeni odvojeno po hipotezama koje su predstavljene na početku rada. Na narednih 6 slika biće predstavljeni dobijeni rezultati koji se odnose na prvu hipotezu da digitalne tehnologije značajno pomažu u odvijanju svakodnevnog života i poslovanja.

Na slici 3 je jasno i ogromnom većinom od 92,5% potvrđena tvrdnja da digitalne tehnologije olakšavaju svakodnevno obavljanje obaveza u privatnom životu. Procenat odgovora od 3,7% koji se apsolutno ne slažu i 3,7% onih koji se djelimično ne slažu je statistički insignifikantan. Ovim je jasno da su digitalne tehnologije unijele dodatni komfor u živote ispitanika, oslobađajući vrijeme koje su ranije trošili, a koje sada mogu preusmjeriti na druge aktivnosti u svojim životima. Međutim, na šta su ispitanici preusmjerili ovo vrijeme, vidjećemo u nastavku.

Slika 4 pokazuje da 73,2% ispitanika je voljno da usvoji nove tehnologije koje se pojavljuju na tržištu, a koje služe u privatne svrhe. Ovo je izuzetno značajan pokazatelj, prvenstveno za tržišno orijentisane subjekte, s obzirom na to da ovako visoka stopa prihvatanja je odličan pokazatelj da ako ponude kvalitetne proizvode, velika je vjerovatnoća usvajanja od strane korisnika. Takođe, ovaj podatak je značajan iz razloga što znamo da su pojedinci nešto oportuniji u prihvatanju digitalnih

tehnologija u privatnom životu, s obzirom na to da to vrlo često znači ugrožavanje privatnosti pojedinca.
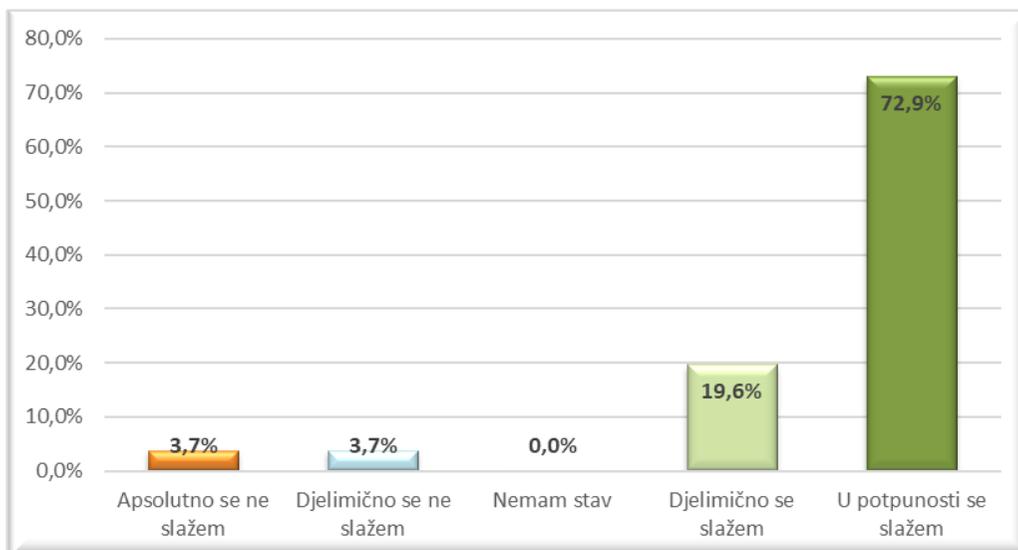
Slika 3. Slaganje/neslaganje sa tvrdnjom „Digitalne tehnologije olakšavaju svakodnevno obavljanje raznih privatnih obaveza“
Figure 3. Agreeing/disagreeing with statement " Digital technologies facilitate the daily performance of various private duties"
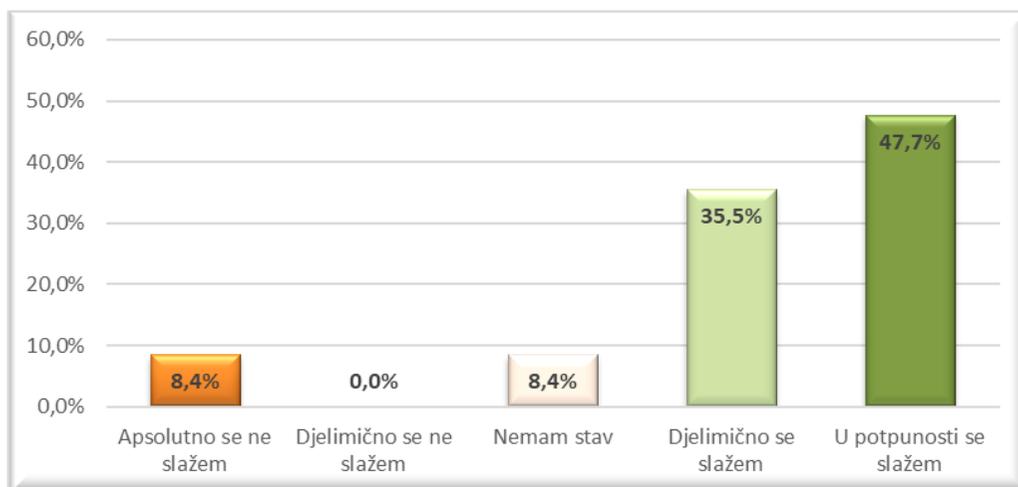
Slika 4. Slaganje/neslaganje sa tvrdnjom „Rado prihvatam nove digitalne tehnologije koje se koriste u privatne svrhe“
Figure 4. Agreeing/disagreeing with statement "I welcome new digital technologies that are used for private purposes"

Slika 5 je jednim dijelom potvrda prethodno iznesenog stava da ljudi rado prihvataju nove tehnologije u svoje privatne živote. Vidljivo je da 92,5% ispitanika slobodno vrijeme često provodi koristeći digitalne tehnologije. Ovo se može i treba povezati sa prvim pitanjem, čiji odgovori upućuju na to da su ljudi uvođenjem digitalnih tehnologija u njihove živote, dobili više slobodnog vremena. Međutim, veoma je zanimljivo vidjeti da su to slobodno vrijeme oni alocirali na korištenje digitalnih tehnologija. Ako ukrstimo podatak da

92,5% populacije koristi digitalne tehnologije u svoje slobodno vrijeme, sa podatkom da se digitalne tehnologije koriste 6,4 časa u toku dana, onda se postavlja očigledno pitanje da li je ovo dobar obrazac ponašanja. Odgovor na ovo pitanje ostavljamo za malo kasnije.

Slika 5. Slaganje/neslaganje sa tvrdnjom „Slobodno vrijeme često provodim koristeći digitalne tehnologije"
Figure 5. Agreeing/disagreeing with statement "I often spend my free time using digital technologies"

Slika 6 govori o stavu prema digitalnim tehnologijama u poslovnom životu. Svih 100% ispitanika je pozitivnog stava. Ovo je i razumljivo imajući u vidu da su svi zainteresovani da brže i bolje obave postavljene zadatke. Ovde takođe ne postoji zabrinutost za privatnost svog života. Još jedna značajna informacija je da je vjerovatno svih 100% ispitanika svjesno da konkurentnost kompanija i institucija u kojima rade ne bi mogla opstajati bez dovoljne usvojenosti digitalnih tehnologija.
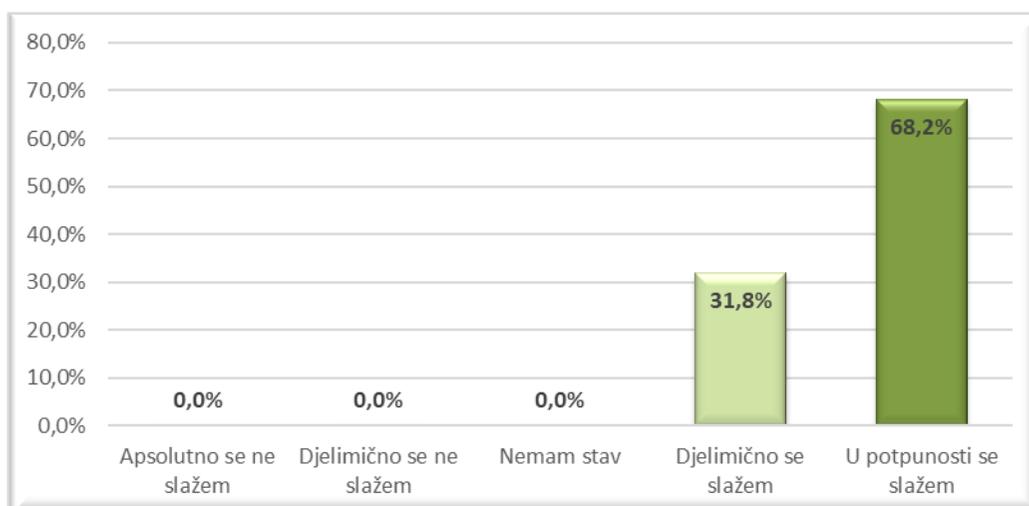
Slika 6. Slaganje/neslaganje sa tvrdnjom „Digitalne tehnologije su dobrodošle u poslovnom okruženju jer olakšavaju obavljanje poslovnih zadataka"
Figure 6. Agreeing/disagreeing with statement "Digital technologies are welcomed in the business environment as they facilitate the performance of business tasks"

Slika 7 nam pokazuje ogromnu većinu od 96,3% ispitanika koji smatraju da digitalne tehnologije povećavaju produktivnost kompanija i institucija oličenu kroz ubrzanje poslovnih procesa ili smanjenje troškova. Ako se prethodno pitanje odnosilo lično na ispitanike, onda se ovo pitanje odnosi više na institucije i kompanije u kojima rade. I ogromna većina njih smatra da digitalne tehnologije unose kvalitet u poslovanje istih.
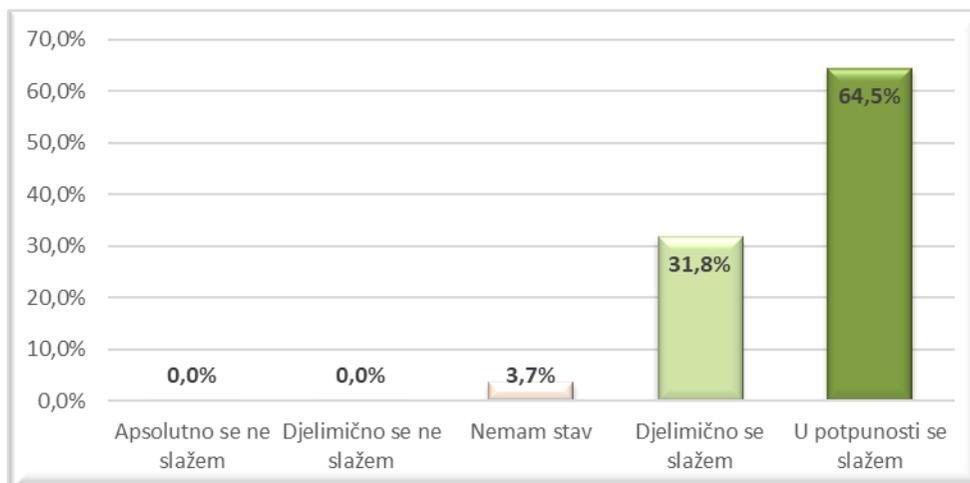
Slika 7. Slaganje/neslaganje sa tvrdnjom „Digitalne tehnologije ubrzavaju odvijanje poslovnih procesa i/ili dovode do smanjenja troškova poslovanja“
Figure 7. Agreeing/disagreeing with statement "Digital technologies speed up business processes and/or lead to a reduction in business costs"

Slika 8 upućuje na stepen prihvatanja digitalnih tehnologija u poslovne svrhe. Iznosi vrlo visokih 96,3% i veći je nego spremnost prihvatanja ovih tehnologija u privatne svrhe. Ovo je i logično imajući u vidu da zabrinutost oko privatnosti postoji u privatnom životu, dok u poslovnom gotovo da ne postoji. Kao i da je primarni interes pojedinca u poslovnoj sferi da brže i lakše obavi posao za koji je plaćen, a što omogućavaju digitalne tehnologije.
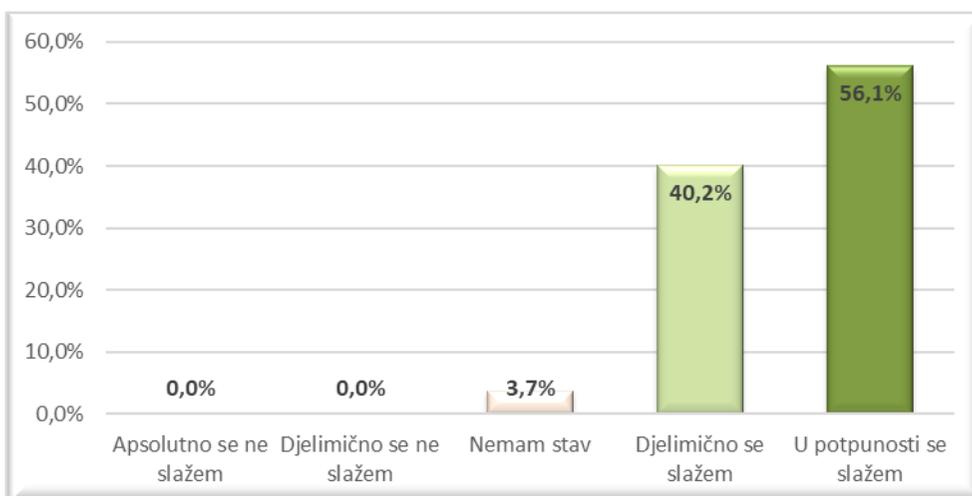
Slika 8. Slaganje/neslaganje sa tvrdnjom „Rado prihvatam nove digitalne tehnologije koje se koriste u poslovne svrhe"

Figure 8. Agreeing/disagreeing with statement "I welcome new digital technologies used for business purposes"

Na narednih 6 slika su predstavljeni dobijeni rezultati koji se odnose na drugu hipotezu da digitalne tehnologije imaju negativan uticaj na ljudsku individuu koja koristi te tehnologije i njeno zdravstveno stanje, u prvom redu mentalno zdravlje.

Slika 9 ukazuje da kod 96,3% populacije sve više zastupljen multitasking (obavljanje dva ili više zadataka istovremeno ili u kraćem vremenskom periodu). Ovo samo po sebi nije loša stvar, nego pozitivna, s obzirom na to da

unapređuje efektivnost pojedinca. Ono što je negativno je da se multitasking povezuje sa negativnim obrascima kao što su smanjenje koncentracije, smanjenje strpljenja, smanjenje pažnje, manji fokus na detalje, itd. Veza multitaskinga i navedenih negativnih obrazaca je naučno dokazana i predstavljena ranije u ovom radu. Multitasking kao pojavu su predominantno inicirale i omogućile digitalne tehnologije.
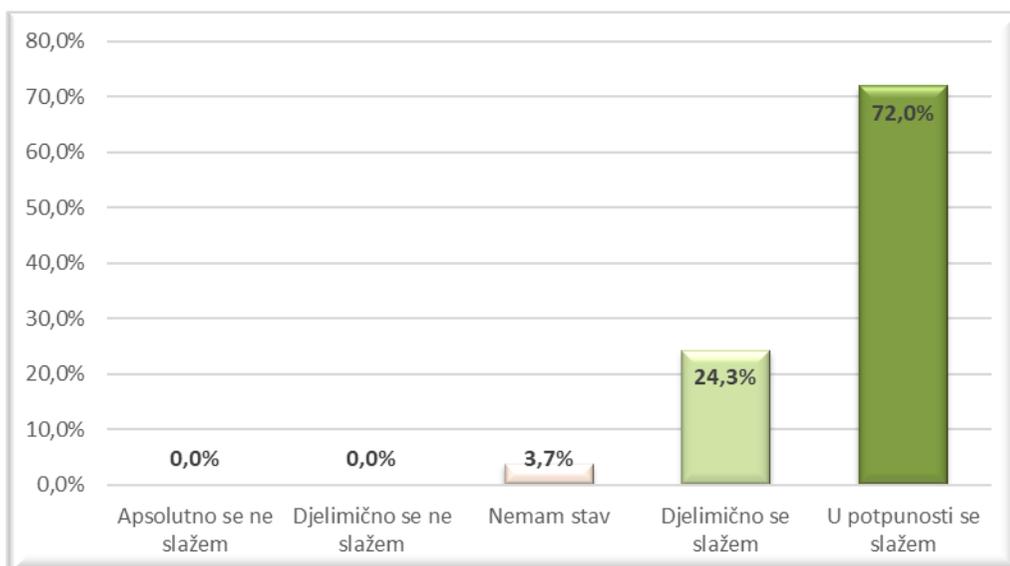
Slika 9. Slaganje/neslaganje sa tvrdnjom „Fenomen multitaskinga je kod mene sve više zastupljen u zadnjih 10 godina"

Figure 9. Agreeing/disagreeing with statement "The phenomenon of multitasking has become more and more common for me in the last 10 years"

Slika 10 je u direktnoj korelaciji sa rezultatima prethodnog pitanja. Smanjenje pažnje usmjerene na detalje je direktan proizvod novih obrazaca življenja koje su donijele digitalne tehnologije. Samo jedan od njih je multitasking. Sa smanjenjem pažnje se slaže 75,7% ispitanika.

Slika 11 pokazuje slaganje sa tvrdnjom da poslije duže upotrebe digitalnih tehnologija, ispitanici imaju osjećaj izgubljenog vremena. Ovo slaganje iznosi 87,9%. Ipak ono što je zanimljivo je da je distribucija unutar ovog procenta 63,6% u korist odgovora „djelimično se slažem", a manji procenat od 24,3%

ispitanika je izjavio da se apsolutno slaže. Ovo ukazuje da su ispitanici svjesni da im prekomjerna upotreba digitalnih tehnologija ne koristi, ali ipak nisu toliko rezolutni u svom stavu. Zanimljivo je, takođe, da niko nije odgovorio da se apsolutno ne slaže, a samo 9 ispitanika se djelimično ne slaže, što dodatno govori o zastupljenosti navedene pojave. Što se tiče uticaja osjećaja izgubljenog vremena, jasno je da ono ima izrazito negativne uticaje na opšte psihičko zdravlje pojedinca. Prvenstveno jer se iznova ponavlja. Živjeti sa osjećajem izgubljenog vremena, a da je pri tom to

(polu)svjesno napravio, je devastirajuće po mentalno zdravlje pojedinca.
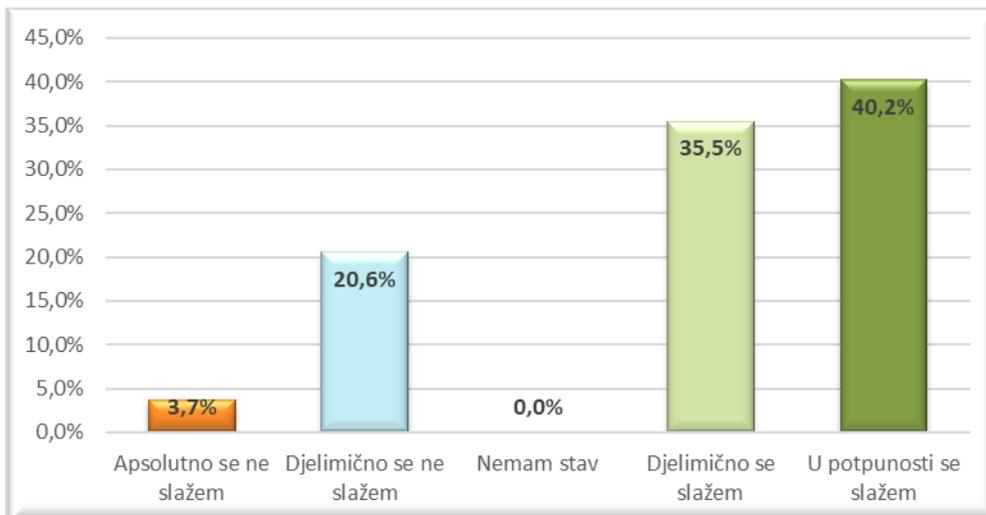
Slika 10. Slaganje/neslaganje sa tvrdnjom „Manje vremena i pažnje posvećujem detaljima kada nešto čitam ili gledam online nego što je to bio slučaj ranije"
Figure 10. Agreeing/disagreeing with statement "I spend less time and attention to detail when reading or watching something online than I used to"
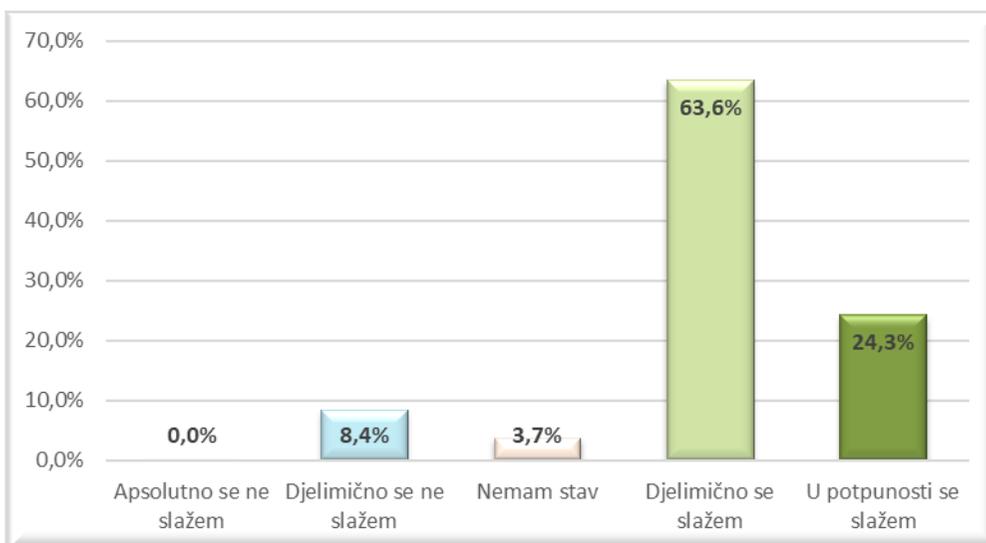
Slika 11. Slaganje/neslaganje sa tvrdnjom „Često nakon duže upotrebe digitalnih tehnologija imam osjećaj izgubljenog vremena"
Figure 11. Agreeing/disagreeing with statement "Often after using digital technologies for a long time I have a feeling of wasted time"

Slika 12 ukazuje da je preko pola ispitanika ili njih 56,0% osjetilo nervozu, promjenu raspoloženja ili neku drugu nelagodu nakon previše vremena potrošenog na korištenje digitalnih tehnologija. Kako bi se ustanovilo koliko populacije previše koristi digitalne tehnologije, postavljeno je naredno pitanje.

Slika 13 govori da 80,4% ispitanika smatra da previše koristi digitalne tehnologije. Ako ovaj procenat pomnožimo sa 56% koliko je izjavilo da nakon previše korištenja osjeća

neki oblik nervoze, neraspoloženja ili neku drugu vrstu nelagode, dolazimo do podatka da 45% ima neki od navedenih negativnih pojavnih oblika. Ovo je zapanjujuće visok procenat zastupljenosti pojave koja se dešava regularno, a koja sa sobom nosi značajne negativne posljedice. S obzirom na to da je ovo

pitanje zadiralo u privatnost ispitanika, iako je istraživanje bilo anonimno, za očekivati je da su ispitanici bili skloni „uljepšavanju" odgovora. Zbog toga je postavljeno naredno pitanje koje se nije ticalo života ispitanika, nego trećih osoba.
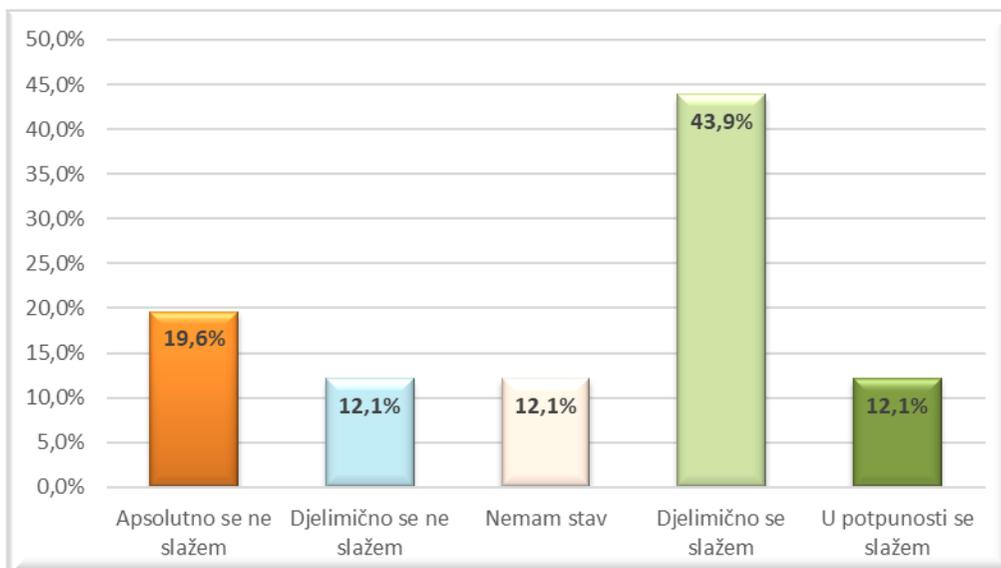
Slika 12. Slaganje/neslaganje sa tvrdnjom „Osjetio sam nervozu, promjene raspoloženja ili neku drugu vrstu nelagode kada previše vremena provodim koristeći digitalne tehnologije"
Figure 12. Agreeing/disagreeing with statement "I have experienced nervousness, mood swings, or some other type of discomfort when I spend too much time using digital technologies"
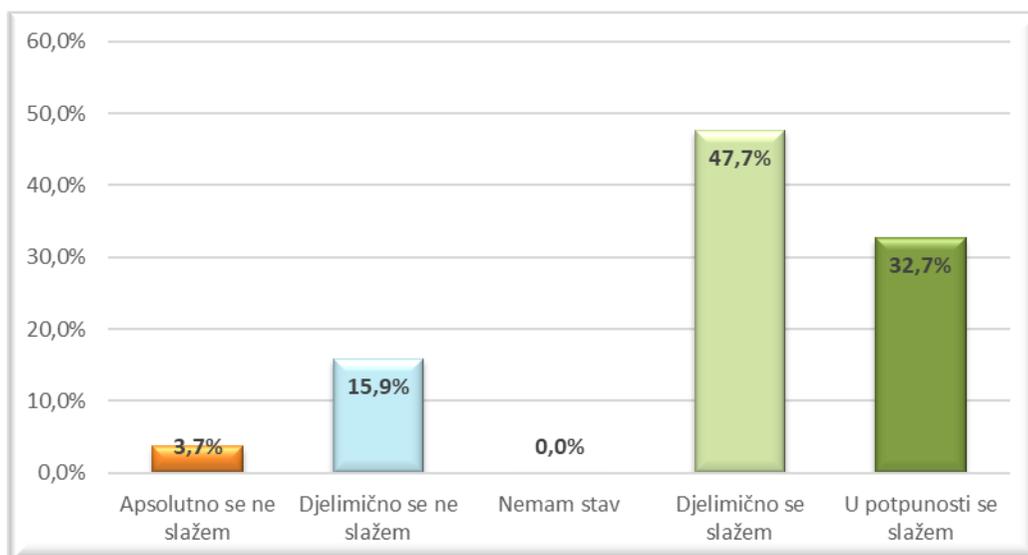
Slika 13. Slaganje/neslaganje sa tvrdnjom „Provodim previše vremena u toku dana koristeći digitalne tehnologije"
Figure 13. Agreeing/disagreeing with statement "I spend too much time during the day using digital technologies"

Slika 14 ukazuje da su procenti koji govore u suštini istu stvar kao i prethodna dva pitanja, značajno veći kada se pitanje ne odnosi direktno na ispitanika. Rezultat je ogromnih 96,2% ispitanika koji su stava da digitalne tehnologije imaju negativne uticaje na mentalno zdravlje, prvenstveno mlađih osoba.
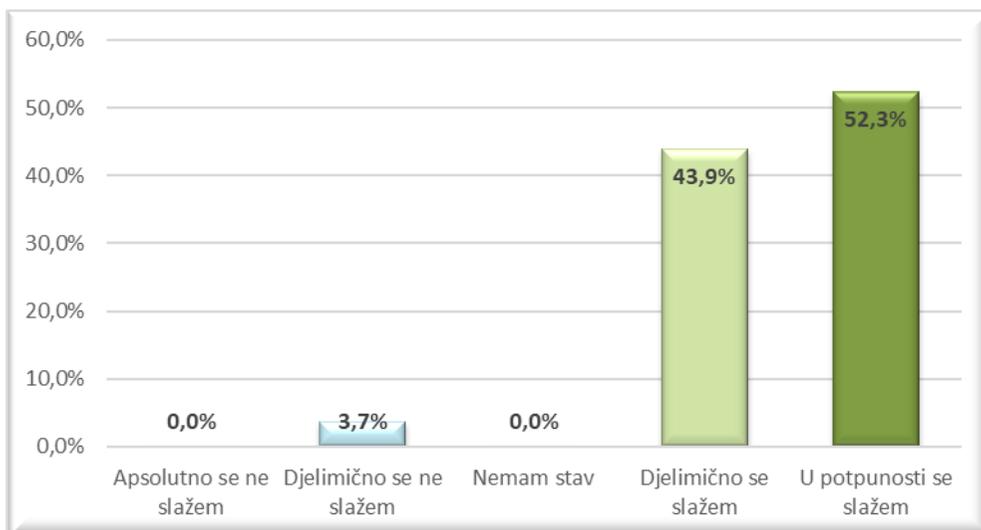
Slika 14. Slaganje/neslaganje sa tvrdnjom „Smatram da digitalne tehnologije imaju negativne uticaje na mentalno zdravlje, prvenstveno mlađih osoba"

Figure 14. Agreeing/disagreeing with statement "I believe that digital technologies have a negative impact on mental health, primarily of younger people"

Na naredne dvije slike će biti predstavljeno nešto što nije u direktnoj funkciji dokazivanja postavljenih hipoteza, ali ima praktičnu upotrebljivost i usko je povezano sa samom temom istraživanja. Naime, želja je bila da se ispitaju stavovi ispitanika o tome koji digitalni uređaji i koje digitalne aplikacije imaju najveći negativni efekat na mentalno zdravlje. Rezultati slijede u nastavku.

Slika 15 pokazuje da 63,6% ispitanika smatra da je pametni telefon najveći uzročnik nervoze ili nekog drugog vida nelagode.

Slika 16 prikazuje upotrebu ostalih digitalnih tehnologija. Na grafikonu se vidi da se ističu dvije stavke, a to su na prvom mjestu društvene mreže sa 44,9% i video igre sa 15,9%.
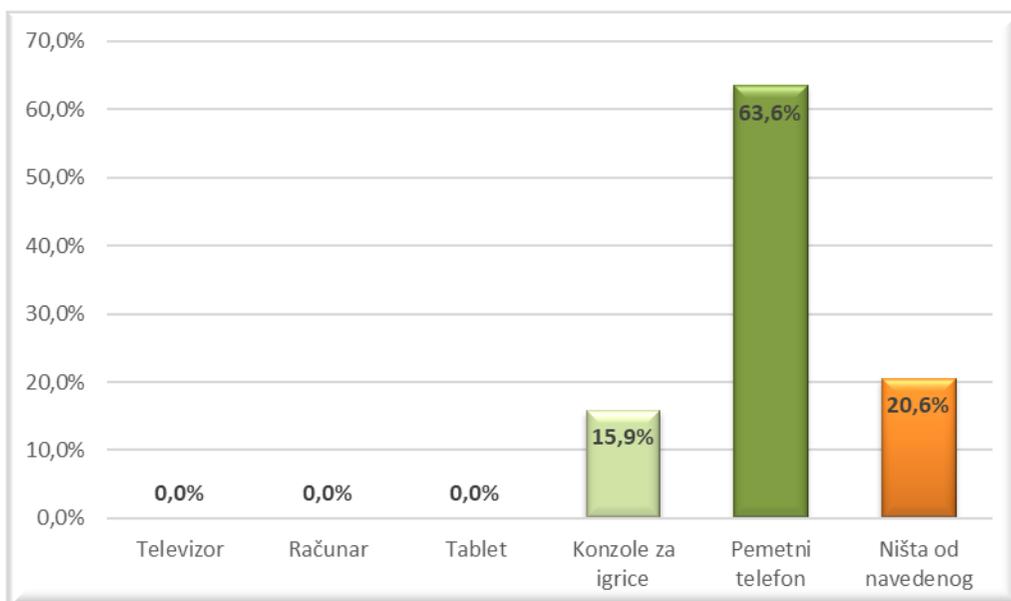
Slika 15. Odgovori na pitanje „Digitalni uređaj koji mi najviše unosi nervozu ili neki drugi vid nelagode prilikom pretjeranog korištenja"
Figure 15. Agreeing/disagreeing with statement "The digital device that causes me the most nervousness or some other form of discomfort when overused"
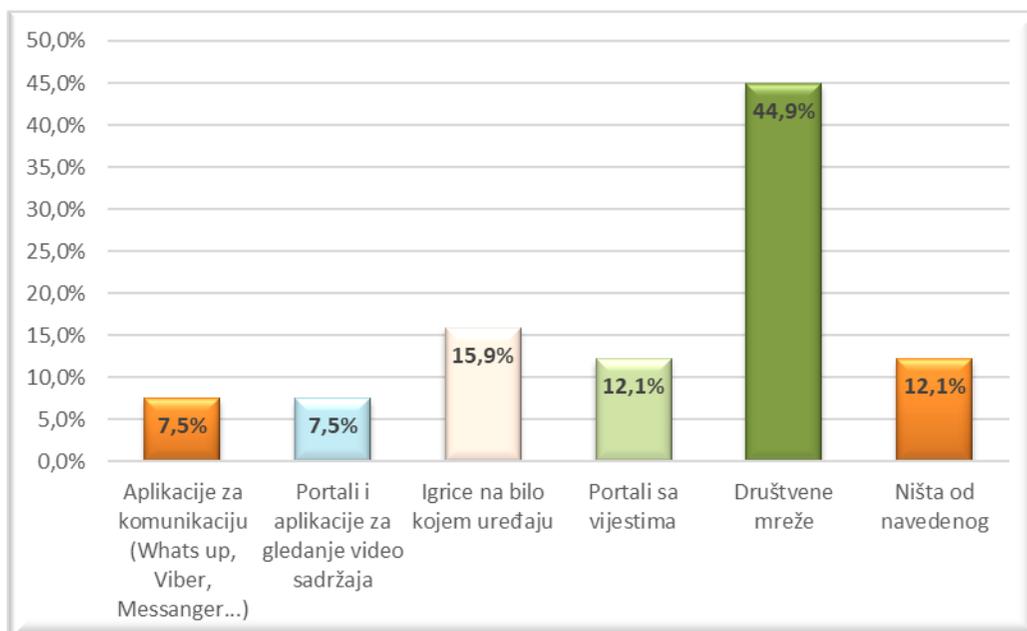
Slika 16. Odgovori na pitanje „Softverske aplikacije koje mi najviše unose nervozu ili neki drugi vid nelagode prilikom pretjeranog korištenja"
Figure 16. Agreeing/disagreeing with statement "The software applications that cause me the most nervousness or some other kind of discomfort during excessive use"

ZAKLJUČCI

Cilj ovog istraživanja je bio ispitati stavove pojedinaca po pitanju prihvaćenosti i uticaja digitalnih tehnologija na privatni i poslovni život, te uticaja na mentalno zdravlje pojedinaca. U tu svrhu su postavljene dvije hipoteze. Prvom se istraživalo da ispitanici smatraju da digitalne tehnologije značajno pomažu u odvijanju njihovog svakodnevnog života i poslovanja, a drugom da li digitalne tehnologije imaju negativan uticaj na opšte zdravstveno stanje korisnika, u prvom redu na mentalno zdravlje. Obje postavljene hipoteze su potvrđene.

Iz predstavljenih rezultata istraživanja jasno je da su digitalne tehnologije opšte prihvaćene u privatnom i poslovnom životu i da ne postoji otpor prihvatanju novih digitalnih tehnologija ni u jednoj od ove dvije oblasti. Digitalne tehnologije obje oblasti se posmatraju kao sredstvo komfora, unapređenje produktivnosti, uštedu vremena i olakšavanje završavanja raznih obaveza.

Uvođenjem digitalnih tehnologija u privatni i poslovni život, populacija je dobila više slobodnog vremena, ali je paradoks što su to slobodno vrijeme posvetili intenziviranju upotrebe samih digitalnih tehnologija. Populacija provodi više vremena uz digitalne uređaje, nego što je oslobodila vremena usvajanjem tih uređaja. Vrijeme koje populacija troši koristeći te uređaje nije adekvatno potrošeno, imajući u vidu da se najviše vremena troši u neproduktivne svrhe, koje dovode do narušavanja zdravlja pojedinaca.

Iz posljednjeg dijela istraživanja jasno je da korisnici smatraju da ove tehnologije imaju negativne uticaje na njihovo mentalno zdravlje, prvenstveno na dio koji uključuje da mogu „da se nose sa životnim stresovima, realizuju svoje sposobnosti, dobro uče i dobro rade" (treba navesti izvor). Samo neke od tih negativnih pojava su prekomjerno trošenje slobodnog vremena na upotrebu digitalnih uređaja, izraženiji multitasking koji ima uticaj na smanjenje pažnje, fokusa i posvećenosti detaljima, kao i osjećaj izgubljenog vremena, osjećaj nervoze, promjene raspoloženja ili neki drugi vid nelagode. Rezultati koji govore da društvene mreže i pametni telefoni unose najviše negativnosti na mentalnom planu ne iznenađuju. S druge strane, ovi podaci su značajni jer pokazuju da su korisnici svjesni negativnih efekata pretjerane upotrebe tehnologije.

Većina pametnih telefona ima funkciju praćenja vremena provedenog u korištenju uređaja, kao i funkciju ograničenja vremena provedenog u korištenju samog uređaja. Kao očigledna korektivna aktivnost nameće se (samo)ograničenje upotrebe pametnog telefona što bi dovelo moglo dovesti do velikih, prvenstveno zdravstvenih benefita, a zatim i mnogih drugih koji dolaze kao rezultat dobrog mentalnog zdravlja.

Isti slučaj je i sa društvenim mrežama i drugim tehnologijama. Znajući da se društvenim mrežama predominantno pristupa putem pametnih telefona, ograničavanjem upotrebe aplikacija društvenih mreža na pametnim telefonima bi imalo dvostruki efekat. Smanjila bi se upotreba društvenih mreža i uređaja, kao glavnih uzročnika negativnosti po mentalno zdravlje pojedinaca

Pitanje koje se nametnulo po dobijanju rezultata istraživanje je zašto veliki dio populacije, koji je svjestan negativnih implikacija korištenja digitalnih tehnologija, nije uveo samokontrolu i samoograničenje upotrebe digitalnih tehnologija, kako bi prevenirao i otklonio ove negativnosti? Da li su oni sposobni to napraviti ili trebaju stručnu pomoć? Da li institucije društva trebaju činiti više na osvjetljavanju ovog problema i propagiranju preventivnih aktivnosti? Šta svi ostali i društvo u cjelini treba učiniti kako bi zaštitili pojedinca, a prvenstveno mlađu populaciju od negativnih efekata prekomjerne upotrebe digitalnih tehnologija u neproduktivne svrhe?

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ATTITUDES OF DIGITAL TECHNOLOGY USERS ON THEIR IMPACT ON DAILY LIFE, WORK, AND MENTAL HEALTH

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SHORT SCIENTIFIC PAPER

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ABSTRACT

The digital technological revolution began in the second half of the last century. Its development in the first decades after the discovery of the transistor was rather slow. Acceleration and a wider awareness of the possibilities began to spread after the introduction of the Internet. And then the last two decades brought rapid development of digital technologies and general acceptance in private and business life.

The benefits for individuals, companies, institutions and society as a whole are enormous and unquestionable. Nevertheless, bearing in mind the conducted studies on the degree of digitization of certain areas of society and certain countries, it is considered that the potential is huge. And significant breakthroughs supported by artificial intelligence are still expected.

However, in addition to the undoubted benefits, there are also certain negatives, which are not sufficiently clarified or which are often obscured. Therefore, this paper aimed to determine the attitudes of the users themselves towards digital technologies, and in its last part, it examined the existence of negative effects on the mental health of users of digital technologies.

The results are expected in the part of the examination of the benefits arising from the use of digital technologies. The existence of negative effects on the health of users is not a surprise either. The surprise is the degree of negative impact and lack of corrective action by the user. In other words, users are aware of the negatives that arise from, primarily, the excessive use of digital technologies, but they still do almost nothing to reduce these negative consequences.

Keywords: digital technologies, digital devices, software applications, mental health.

PROBLEMSKA NASTAVA MATEMATIKE

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SAŽETAK

Posmatrano sa školskog obrazovnog sistema, može se reći da cjelokupna vaspitno-obrazovna djelatnost treba da uvažava potrebe i mogućnosti svakog učenika i maksimalno razvija njegove potencijale. Paralelno sa razvojem potencijala učenika rastu i potrebe učenika za svakodnevnim snalaženjem i rješavanjem problemskih situacija. Savremeni pogledi na učenikovo usvajanje znanja i vještina u nastavi matematike je učenje putem istraživanja i rješavanja problema. U ovom radu ćemo odgovoriti na pitanje da li primjenom problemske nastava nastava matematike učenicima postaje zanimljiva. Ispitaćemo kako razmišljaju učenici, roditelji i nastavnici u kojoj je mjeri primjenom problemskog učenja, poučavanja i rješavanje problema u nastavi matematike nastava matematike zanimljiva učenicima i to iz ugla učenika, roditelja i nastavnika.

Ključne riječi: problemska nastava, matematika, stavovi učenika roditelja i nastavnika

Ja nikad ne podučavam svoje učenike;
ja im samo pokušavam pružiti uslove u kojima oni mogu učiti.
Albert Einstein

UVOD

Sjedinjene Američke Države su kolijevka problemske nastave iz koje se vremenom ovaj oblik podučavanja proširio u sve zemlje svijeta. Obrazovni sistemi su zahtijevali unošenje promjena u nastavu s ciljem povećanja efikasnosti kod učenika tokom usvajanja znanja i na temelju toga nastalo je učenje putem rješavanja problema. Učenici su navođeni da samostalno istražuju i otkrivaju, pri čemu su zastupljeni svi oblici kritičkog mišljenja, promišljanja i misaonih aktivnosti. Prednosti korištenja ovakvog načina rada u vaspitno-obrazovnim institucijama je razvijanje kreativnih, misaonih sposobnosti kod učenika.

Osnovna polazišta problemske nastave matematike su znanja koja su bitna za uspješno uključivanje učenika u rad, ali još više zbog razvijanja logičkog, kritičkog matematičkog mišljenja, promišljanja, snalažljivosti, rješavanja problema i problemskih situacija. Kreativan učenik treba da razmišlja mudro, ali da istovremeno bude fleksibilan i otvoren za različite alternative (Kadum, 2005, str. 10). Samim tim, stvaralački kreativan proces je postupak dolaska do stvaralačkih kreativnih rješenja, koji se u problemskoj nastavi matematike može ostvariti motivisanošću učenika za pronalaženje velikog broja rješenja zadanog problema. Primjenom problemske nastave učenici do rješenja dolaze na stvaralačke, neobične i drugačije načine i postaju kreativniji u nastavnom procesu. To dovodi do razvijanja stvaralačkog, kreativnog mišljenja učenika, nastavni proces postaje

kreativniji, a učenik i sredina u kojoj učenik boravi, odnosno školski ambijent, postaje lagodnije i pozitivnije mjesto za kretivan rad učenika, odnosno učenik kreativno stiče znanje.

PROBLEMSKA NASTAVA NASTAVE MATEMATIKE

Danas je problemska nastava opšteprihvaćena kao najviši oblik učenja, što svjedoči ovaj rad. Stevanović (2023) problemsku nastavu definiše kao vrlo složen mentalni proces u kome učestvuju svi misaoni procesi u različitim kombinacijama te zbog toga učenici znanje stiču na kreativan način.

Po Stevanoviću (2023) problemska nastava podrazumijeva aktivnost u tročlanoj sktrukturi koju čine: problemska situacija, aktivnost učenika i situacija cilja, gdje svaki od njih ima svoje sastavne dijelove koji se međusobno nadovezuju. Inicijalno je potrebno postaviti problemsku situaciju na taj način da učenici imaju dovoljan broj podataka i znanja o datoj temi, odnosno, da budu motivisani da se upuste u prevladavanje prepreke i pronalažanje rješenja problema. Svaki problem treba sagledati sa više strana i vidjeti koja su rješenja već poznata. Ako je problem teži, treba ga raščlaniti na manje probleme i prići mu na neki novi način, sa drugačijeg aspekta tj. rješavati jedan po jedan problem, a zatim iz njih izvoditi zaključke (Andrić, 2007, str. 18). Učenici doživljavaju problem svako sebi na svojstven i na različit način, za neke će biti teži, za neke lakši, pa je zato problem individualni doživljaj. U praksi je produktivnije učenicima zadati teže zadatke koji malo nadmašuju njihove mogućnosti, jer će tada učenik više razmišljati, što je veoma korisno za njihovo napredovanje.

Ovakav pristup od učenika zahtijeva veće angažovanje. Na ovaj način se otkrivaju i razvijaju saznajne i logičke radnje na osnovu kojih donosimo sudove o matematičkim sadržajima koji su predmet saznanja misaone i kritičke sposobnosti učenika (Maričić, 2010, str. 485).

Potrebno je primjenjivati različite metode, oblike, tehnike, ali i nastavna sredstva kako bi učenički potencijali bili što efektivnije i potpunije iskorišćeni. Veoma je važno učenikovo prethodno iskustvo i znanje, jer na temelju tog znanja dolazi do novih ideja, misaonih procesa, zaključivanja, problemskih sitauacija i rješavanja istih. Ovakav vid učenja dovodi do iskustvenih promjena (Banđur i Potkonjak, 1999, str. 29). Kod učenika dolazi do izražaja veća kreativnost u nastavi matematike, veći nivo saradnje, više ideja, propitivanja, stvaranje alternativa, odgovornosti, odlučivanja, kritičkog mišljenja...

Poslednji segment ovog modela nastave je situacija cilja koja podrazumijeva postignuće rješenja problema uz usvajanje novih znanja, izvođenje zaključaka i generalizacije (Tomić i Karačić, 2015, str. 4).

Za uspješnu primjenu problemske nastave važno je pravilno odabiranje njenog nivoa. Ističemo četiri različita nivoa problemske nastave (Prvanović, 1981, str. 87):

➢ Problemski monolog – Ovaj nivo se koristi ukoliko su nastavni sadržaji potpuno novi i ne oslanjaju se na prethodno gradivo. Nastavnik postavlja pitanja i samostalno odgovara na njih. Na taj način informiše učenike o novom gradivu, ali im dozvoljava da samostalno razmišljaju.

➢ Problemski dijalog – Kod ove vrste problemske nastave nastavnik postavlja problem, nudi mogućnosti za njegovo rješavanje, a kroz dijaloge se dolazi do rješenja. Ukoliko se kroz dijalog ne dođe do rješenja, već nastavnik saopšti rješenje, nastava se i dalje smatra problemskom, jer su učenici bili aktivni učesnici nastave.

➢ Samostalno rješavanje problema – Nastavnik postavlja problem, a učenici ga samostalno rješavaju.

➢ Samostalno formulisanje i rješavanje problema – Na ovom nivou problemske nastave od učenika se očekuje da samostalno formulišu i rješavaju problem. Nastavnikov zadatak jeste da postavi problem.

Nastavnik organizuje, realizuje nastavne sadržaje, zadatke, motiviše, formuliše stvarne probleme i osposobljava učenike za aktivno korišćenje različitih informacija, principa, pravila, izvora znanja, navodi na kritičko mišljenje, promišljanje, rješavanje problema. (Anić i Pavlović Babić, 2015, str. 37).

Shodno zahtjevima i mogućnostima problemske nastave u nastavi matematike uloga nastavnika se mijenja, postaje raznolika.

METODOLOGIJA ISTRAŽIVANJA

Cilj ovog rada je odgovoriti na pitanje da li primjenom problemske nastave matematike učenicima nastava postaje zanimljiva, odnosno ispitati kako razmišljaju učenici, roditelji, nastavnici u kojoj je mjeri primjenom problemskog učenja, poučavanja i rješavanje problema u nastavi matematike nastava matematike zanimljiva učenicima i to iz ugla učenika, roditelja i nastavnika.

Problem istaraživanja je ispitati kako razmišljaju učenici, roditelji i nastavnici u kojoj mjeri primjenom problemske nastave matematike matematika učenicima postaje zanimljiva.

Predmet istraživanja su stavovi učenika, nastavnika i roditelja o primjeni problemske nastave u nastavi matematike.

Uzorkom je obuhvaćeno 200 učenika petog razreda, 200 roditelja i 110 nastavnika iz četiri osnovne gradske škole iz Banjaluke.

Metode korištene u ovom istraživanju su metode teorijske analize i sinteze, deskriptivna metode ili servej metoda, statičke kvantitativne metode. U istraživanju se koristila tehnika skaliranja-procjenjivanja.

Pretpostavka je da je primjenom problemske nastave matematike nastava matematike učenicima postaje zanimljiva, učenici do rješenja dolaze na kreativan način kritičkim mišljenjem i promišljanjem.

Primijenjeno je nekoliko statističkih postupaka, svi su se na jedan ili drugi način bavili razmatranjem učenika, ali i roditelja i nastavnika.

Problemsko učenje zahtijeva pored uzajamne interakcije učenik-učenik, učenik-nastavnik i veliku odgovornost za sopstveni rad, međusobnu komunikaciju, interakcijske odnose, istraživanje, kritičko mišljenje, promišljanje uvažavajući svakog člana grupe i podržavanje njihovih ideja i zamisli. Uloga učenika se mijenja rješavanjem problemskih zadataka i situacija, on istražuje, postavlja pitanja, prikuplja nove dokaze, izražava svoje mišljenje koristeći argumente, uzima u obzir druge perspektive, razumije uzroke i posljedice, koristi nezavisno i samousmjereno promišljanje, odnosno dolazi do novih inovativnih ideja, donosi odluke zasnovane na dokazima, zaključuje, rješava problem što i svjedoči ovo istraživanje.

U prvom redu je izvršena analiza mjera deskriptivne statistike da bi se ustanovile tendencije u okviru kojih se kreću dobijeni rezultati. Nakon toga je izvršena provjera odstupanja dobijenih distribucija u odnosu na normalnu. Poslije toga je razmatran stepen slaganja učenika, njihovih roditelja i nastavnika oko procjene kvaliteta nastave matematike primjenom problemske nastave matematike na osnovu svih ovih podataka dat je odgovor.

Tabela 1: Mjere deskriptivne statistike za procjenu stavova učenika, roditelja i nastavnika u kojoj mjeri je nastava matematike primjenom problemske nastave zanimljiva učenicima iz igla učenika, roditelja i nastavnika

	Vrednovanje od strane učenika	Vrednovanje od strane roditelja	Vrednovanje od strane nastavnika
N	200	200	110
M	41,52	41,94	41,35
SEM	0,49	0,42	0,32
SD	7,23	6,15	3,44
W	52,31	37,94	11,85
S_k	−1,027	−0,52	−0,003
Ku	1,40	−0,65	−0,081
Min	11,00	26,00	33,00
Max	50,00	50,00	50,00
χ^2	132,14	59,86	63,000
D_f	28	22	15
P	0,00	0,00	0,00

Legenda: N – uzorak; M – aritmetička sredina; SEM – standardna greška aritmetičke sredine ; SD – standardna devijacija; W – varijansa; S_k – skjunis; Ku – kurtozis; χ^2 – hi kvadrat test; d_f – stepen slobode; p – nivo statističke značajnosti

REZULTATI ISTRAŽIVANJA

Podaci koji se odnose na vrednovanje da primjenom problemske nastave matematike nastava matematike učenicima postaje zanimljiva, pokazuju vrlo visoki rezultati bez obzira na to da li se radi o procjeni samih učenika, nastavnika ili roditelja. Sve tri varijable imaju vrijednosti aritmetičke sredine koje prelaze vrijednost 40. Imajući u vidu da je maksimalna moguća vrijednost za sve tri varijable 50, možemo jasno zaključiti da se radi o vrlo kvalitetnom i frekventnom vrednovanju, odnosno da primjenom problemske nastave u nastavi matematike nastava matematike i rješavanje zadataka ovom metodom učenicima je veoma zanimljiva.

Ukoliko se pogledaju vrijednosti skjunisa kao indikatora horizontalnog pomjeranja distribucije skorova vidimo da su sve tri dobijene vrijednosti negativnog predznaka, što jasno sugeriše da su rezultati svih ispitanika pomjereni ka višim skorovima, odnosno ka pozitivnom maksimumu. S druge strane, kurtozis kao mjera vertikalnog odstupanja za procjenu datu od strane učenika pokazuje da je spljoštena, odnosno da učenici daju značajno različite odgovore u odnosu na nastavnike i roditelje. S druge strane vidimo, da su rezultati nastavnika i roditelja sa negativnim vrijednostima skjunisa, što pokazuje spljošteniju distribuciju od normalne, odnosno manji raspon skorova koje nastavnici i učenici postižu.

Konačno, ukoliko se navedena odstupanja posmatraju u cjelini i ukoliko se dobijene raspodjele procjene primjene problemske nastave uporede sa normalnom distribucijom, onda možemo zaključiti da sve tri procjene vrednovanja značajno odstupaju od normalne raspodjele.

Naime, za sve tri procjene (učenici, nastavnici i roditelji) je statistička vrijednost hi kvadrat testa statistički značajna. Napominjemo da su sve tri dobijene vrijednosti hi kvadrat testa statistički značajne na nivou 0,01.

Drugim riječima, procjene od strane učenika, nastavnika i roditelja su pomjerene ka pozitivnim vrijednostima odnosno na osnovu do sada dobijenih rezultata mogli bismo reći da su odgovori bogati, odnosno ovakvim vidom poučavanja i učenja nastave matematike nastavnik se stalno teorijski i praktično priprema, jer shodno individualnim, mentalnim sposobnosti svojih učenika, treba da utvrdi kakve su razlike među njima u sposobnostima i znanjima, i na osnovu toga osmisliti zadatke. Kod ovakvog načina učenja i poučavanja sadržaja nastave matematike teškoće se najviše javljaju zbog velikog broja učenika u razredu.

Primjenom i izradom zadataka ovakvim načinom rada se postižu dobri rezultati, nastava postaje zanimljivija, učenici kritički misle, promišljaju, procjenjuju i na kreativan i veoma zanimljiv način dolaze do rješenja zadataka (Maričić, 2011, str. 198).

Njihovom primjenom dolazimo do otkrivanja određenih zakonitosti ili novih teorija (Branković i Ilić, 2003, str. 124).

Ovakav vid nastave se mora dobro osmisliti i funkcionalno koristiti sa ostalim vrstama nastave, oblicima i metodama učenja i poučavanja.

ZAKLJUČAK

Primjenom problemske nastave matematike nastava matematike učenicima postaje zanimljiva, posmatrano iz ugla nastavnika, roditelja i samih učenika. Zaključivalo se na jedan poseban, ali objektivan način, te se može zaključiti da i po ocjeni učenika, nastavnika i roditelja primjena problemske nastave u nastavnom procesu, predstavlja važan vaspitni resurs, jer problemskom nastavom matematike veoma je bitno da učenike osamostalimo da rješavaju problem individualno ili unutar grupe. Veoma je bitna motivisanost učenika, njegova angažovanost, vjera učenika u samog sebe i vjera u svoje ideje koje mogu dovesti do rješenja zadataka.

Problemski zadatak od učenika zahtijeva da bude istraživač, da logički razmišlja i usmjeri se na umni rad, gdje je neophodno da bude koncentrisan, istrajan, ali i dosljedan kako bi ga uspješno riješio (Kurnik, 2002, str. 52).

Mogućnost učenika da sami potraže u udžbenicima adekvatan sadržaj koji se odnosi na zadani problem, da svoje vrijeme provedu na kvalitetan način i da se trude da naučeno gradivo kasnije uspješno primjene na nove problemske situacije je glavna odlika pristupa rada u problemskoj nastavi.

Znanje da se riješi matematički zadatak predstavlja najbolju karakteristiku matematičkog mišljenja učenika, kao i nivo njihovog matematičkog obrazovanja (Dejić i Egrlić, 2010, str. 69).

Učenici na ovaj način stiču znanja samostalnim radom, istražujući i tragajući za određenim podacima, rješavajući problemske zadatke.

Učenici praktično stvaraju znanja, služe se raznim tekstualnim i drugim materijalima, a uloga nastavnika je da pripremi odgovarajuće problemske zadatke i situacije, motiviše učenike, podstiče njihovu angažovanost, kritičko mišljenje, promišljanje prilikom rješavanja zadataka i navodi ih da primijene stečeno znanje u daljem učenju.

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PROBLEM TEACHING OF MATHEMATICS

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REVIEW SCIENTIFIC PAPER

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ABSTRACT

Observed from the school education system, it can be said that the entire educational activity should respect the needs and possibilities of each student and develop his potential to the maximum. In parallel with the development of students' potential, the students' needs for everyday coping and solving problem situations also grow. Contemporary views on students' acquisition of knowledge and skills in mathematics teaching is learning through inquiry and problem solving. In this paper, we will answer the question whether the application of problem-based teaching makes the teaching of mathematics interesting for students. We will examine how students, parents and teachers think, to what extent the application of problem-based learning, teaching and problem solving in mathematics classes makes mathematics teaching interesting for students, from the perspective of students, parents and teachers.

Keywords: problem teaching, mathematics, attitudes of students, parents and teachers.

GUIDELINES TO AUTHORS FOR WRITING PAPERS

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ABSTRACT

Guidelines to the authors on the manner of preparation of the article are designed in accordance with the best world publishing practice and the Rulebook on publishing scientific publications (Official Gazette of the Republic of Srpska, No. 77/17). The instruction was created in order to unify the style of publishing articles in all issues and editions of the scientific magazine "STED JOURNAL". The magazine is published semi-annually (May-November) in printed versions, with a circulation of 200 copies, and the electronic version of the issue is published at https://stedj-univerzitetpim.com/. All articles must be formatted in accordance with this Instruction and delivered to the email address of the journal. Each paper undergoes a preliminary elimination review, after which it is rejected or referred to the blind review process by two independent reviewers. Papers that have at least two positive reviews are published in the journal. The list of reviewers is adopted by the Editorial Board of the journal. The identity of the reviewer is not revealed to the authors and vice versa.

Keywords: STED Journal, review, publication, scientific publications

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- ➢ Conclusion;
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The title of the paper should be centred and written in upper case, Times New Roman, 14 pt, bold, Caps Lock;

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Other parts of the paper should be written using the alignment on both sides (Times New Roman, 12 pt), one-sided spacing with one empty row above, between the subheadings and paragraphs, with margins of 2.54 cm (1"). The beginning of the paragraph should be typed at the beginning of the row.

The abstract should have 100-250 words, and it is positioned between the paper heading (consisting of the paper title and information on authors) and key words, which are followed by the text of the paper.

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Tables and charts

Tables should be prepared in the WORD, graphics in the EXCEL, except for some special cases when it is not possible technically. Tables and graphics should be clear, as simple as possible and transparent. The title, heading (text) and subtext in tables and graphics should be written in Times New Roman – normal, Font Size 10 pt. Tables should be placed at a certain place in the text. Tables should not include more than ten columns and more than fifteen rows. If the author assumes that data should be presented in a larger number of columns and rows, it is necessary to split the content of the table into two or more smaller tables or deliver it as a special attachment. They have to be drawn according to the computer template (Insert Table), and not using the spacing, dots and tabs. When citing tables and graphics, we write the title of the table or graphic in the initial capital letter and then we specify its ordinal number (e.g. as it is shown in Table 9 and Figure 6, the lowest value was...).

A table example:

Table 1 The curing data for NR/CSM rubber blend compounds with different content of waste rubber powder

| WRP content (phr)	Curing characteristics					
	M_l, dNm	M_h, dNm	$\Box M$, dNm	t_{s2}, min	t_{c90}, min	*CRI*
0	4	40	36	6	15	11.0
20	5	42	37	8	16	12.5
40	5	45	40	9	16	14.3
60	7	46	39	9	17	12.5
80	7	47	40	10	17	14.3
100	7	47	40	10	17	14.3

A chart example:
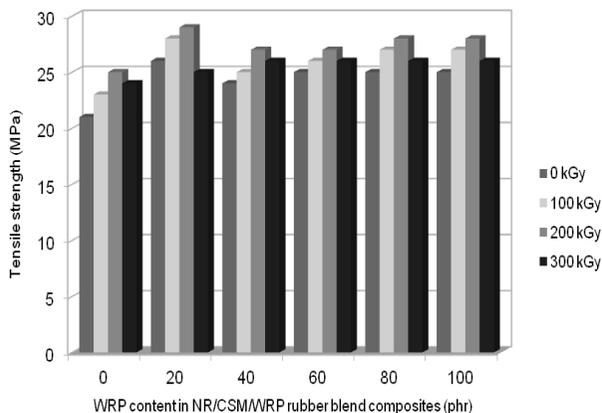
Figure 1 The effect of waste rubber powder content on tensile strength for the NR/CSM/WRP composites irradiated with different doses.

Equation

Equations should be written in the graphic editor for equations, specifically in the Microsoft Equation and they should be placed at the beginning of the text. On the right edge of the text in the row in which the equation is written one should indicate its number in parentheses beginning with number 1.

$$m_r = m_s \left(1 - e^{k_s t_{maks}}\right) - m_d \left(1 - e^{-k_d (t - t_{maks})}\right) za \quad t > t_{maks} \tag{1}$$

Figures

Figures have to be prepared for black-and-white printing, that is, if the original figure is in colors which cannot be distinguished in black-and-white printing, the colors have to be replaced by "raster", that is, different graphic signs which need to be explained in the legend. We insert in figures only the most essential text necessary for understanding, such as measure variables with their dimensions, short explanation on curves and similar. The rest is stated in the legend under the figure (Figure 2). The maximum size of a figure is 13 cm x 17 cm.

Figure 2 The SEM micrograph of NR/CSM/WRP composites filled with 20 phr waste rubber powder at 7500X magnification.

Kojic, D., Žiravac Mladenović, M. & Pavlicevic, J. (2024). Guidelines authors for writing papers. *STED Journal, 6*(1), 79-85

Other notes

In order to include successfully the papers published in one of the official languages of Bosnia and Herzegovina into international information flows, parts of the manuscript should be written both in the author's language and in English, including: text in tables, figures, diagrams and drawings, their titles and symbols.

About authors

When sending the paper one should give their full official address, telephone number and e-mail of all authors and emphasize the author with who the Editorial Board shall cooperate. These notifications should be submitted on a separate sheet.

Experimental technique, symbols and units

Experimental techniques and devices are described in detail only if they deviate significantly from the descriptions already published in the literature. If techniques and devices are familiar, only the source of necessary notifications is stated.

Symbols of the physical quantities should be written in Italic (Times New Roman, 12 pt. – italic), and units of measurement in upright letters, e.g. *V, m, p, t, T*, but m^3, kg, Pa, °C, K. Quantities and units of measurement have to be used pursuant to the International System of Units (SI).

LITERATURE

The reference list at the end of the article has to include only the sources which the author referred to in the article text. The used literature items are listed in alphabetical order. Left 0", Right 0", Hanging 0.3", Before 0", After 0", Single. Primarily use journal references (minimum 50%, preferably more than 80%).

Examples of citing

An example of citing a scientific journal

The general form for citing papers from the journal is as follows: author's surname [comma], initial of first name(s) [dot], [open small bracket] year of publication [closed small bracket] [dot] title of the paper [dot], journal title - italic [comma] volume number - italic [open parenthesis] issue number [closed parenthesis] [comma] start page [dash] end page [dot].

In the text:

When the author(s) are mentioned in the sentence and his/her words are stated, then after the author's name the year of publication of the cited work and the page number in brackets are stated:
- one author: (Avramović, 2011);
- two authors: (Žiravac-Mladenović i Đurica, 2018);
- three to five authors: first citing in text: (Mitić, Nikolić, Cakić, Nikolić, & Ilić, 2007); second and every next citing in text: (Mitić et al., 2007);
- six and more authors: (Špírková et al., 2009).

In the reference list:

Avramović, D. (2011). Metode i okviri rasta vrijednosti banke. *Anali poslovne ekonomije, 5*(1), 28-37.

Žiravac-Mladenović, M. i Đurica, F. (2018). Komparativna analiza trgovanja na Banjalučkoj i Sarajevskoj berzi. *Anali poslovne ekonomije, 10*(1), 25-35.

Mitić, Ž., Nikolić, G., Cakić, M, Nikolić, R., & Ilić, LJ. (2007). The investigation of Co (II)- dextran complexes. *Hemijska industrija, 61*(5), 257-262.

Špírková, M., Strachota, A., Urbanová, M., Baldrian, J., Brus, J., Šlouf, M., Kuta, A. & Hrdlička, Z. (2009). Structural and surface properties of novel polyurethane films. *Materials and Manufacturing Processes, 24*(10-11), 1185-1189.

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- six and more authors: (Stefanović et al., 2008).

In the reference list:
Suzić, N. (2010). *Prvila pisanja naučnog rada: APA i drugi standardi.* Banja Luka: XBS.
Peterlin, J. i Mladenović, M. (2007). *Finansijski instrumenti i menadžment finansijskih rizika.* Banja Luka: Univerzitet za poslovni inženjering i menadžment.
Đuranović, D., Todorović, S. i Tešić, R. (2016). *Strategijski menadžment.* Banja Luka: Univerzitet za poslovni inženjering i menadžment.
Stefanović et al. (2008). *Kretanje šinskih vozila.* Banja Luka: Društvo za energetsku efikasnost.

An example of citing a chapter of a book in the text:
- (Harly, 1981)

In the reference list:
Harley, N. (1981). Radon risk models. U A. Knight, & B. Harrad (Eds.), *Indoor air and human health* (str. 69–78). Amsterdam: Elsevier.

An example of citing a paper published in the Scientific Conference Proceedings in the text:
- one author: (Grgurević, 2014);
- two authors: (Medić i Živadinović, 2014);
- three to five authors: first citing in text: (Krstić, Skorup, Skorup, 2014); second and every next citing in text: (Krstić et al., 2014);
- six and more authors: (Kojić et al., 2019).

In the reference list:
Grgurević, N. (2014). Kuba i Nikaragva (Revolucija i postrevolucionarni period). U M. Žiravac-Mladenović (Eds.), *Conference proceedings, International Scientific Conference on Social and Technological Development* (pp. 124-131). Banja Luka, B&H: University of Business Engineering and Management.
Medić, Z. i Živadinović, J. (2014). Neravnoteže i krize savremenog doba i ekonoska politika. U M. Žiravac-Mladenović (Eds.), *Conference proceedings, International Scientific Conference on Social and Technological Development* (pp. 102-1112). Banja Luka, B&H: University of Business Engineering and Management.
Krstić, M., Skorup, A. i Skorup, S. (2014). Inovativnost – ključni element preduzetničke strategije rasta i razvoja privrednog subjekta. In Žiravac-Mladenović, M. (Eds.), *Conference proceedings, International Scientific Conference on Social and Technological Development* (pp. 51-58). Banja Luka, B&H: University of Business Engineering and Management.
Kojić, D., Pavličević, J., Špírková, M., Aroguz, A., Jovičić, M., Bera, O., MarinovićCincović, M. (2019). THE IFLUENCE OF SILICA ON THE SOLVENT RESISTANCE OF POLYURETHANE HYBRIDE MATERIALS. In Gligorić, M., Došić, A. i Vujadinović, D. (Eds.), *Proceedings VI International Congress "Engineering, Environment and Materials in Processing Industry"* (pp. 568-572). Jahorina, BiH: University of East Sarajevo, Faculty of Technology.

An example of citing a master thesis or PhD thesis in the text:
- (Petrović, 2001)
- (Žiravac-Mladenović, 2009)

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In the reference list:

Petrović, R. (2001). *Dehidratacija etera na mordenitnim katalizatorima.* Magistarski rad. Univerzitet u Banjoj Luci, Tehnološki fakultet, Banja Luka, BiH.

Žiravac-Mladenović M. (2009). *Bankarski nadzor i regulative zemalja u tranziciji na Balkanu – globalizacija bankarskog sektora.* Alfa Univerzitet, Beograd, Srbija.

An example of citing a publication of an institution as the author, downloaded from the Internet and citing a text from the web site

Citing internet sites should be avoided, but if it is necessary, then they should include names of the authors, if they are available, the title, internet site and access date.

In the text:
- institution: first citing in text (Zavod za statistiku Republike Srpske [ZSRS], 2009); second and every next citing (ZSRS, 2009);
- call to authors: (Degelman, 2000); - unknown author: (Compiere, 2017) (Purdue University, n.d)

In the reference list:

Zavod za statistiku Republike Srpske. (2009). Saopštenja. Preuzeto 10.02.2009. sa http://www.rzs.rs.ba/SaopstenjaRadLAT.htm

Degelman, D. (2000). APA Style Essentials. Retrieved May 18, 2000 from: http://www.vanguard.edu/psychology/apa.pdf

Compiere, (2017). Products. Preuzeto 11.10.2018. sa http://www.compiere.com/products/

Purdue University Writing Lab [Facebook page]. (n.d). Retrieved January 22, 2019, from https://www.facebook.com/PurdueUniversityWritingLab/

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Zakonik o krivičnom postupku, Službeni glasnik RS, 72/2011, 101/2011, 121/2012, 32/2013, 45/2013, i 55/2014; Regulation (EU) No. 1052/2013 establishing the European Border Surveillance System (Eurosur), OJ L 295 of 6/11/2013, 1; Directive 2013/32/EU on common procedures for granting and withdrawing international protection (recast), OJ L 180 of 29/6/2013, 60.

Vrhovni sud Srbije, Rev. 1354/06, (6. 9. 2006). Paragraf Lex; Vrhovni sud Srbije, Rev. 2331/96, 3. 7. 1996, Bilten sudske prakse Vrhovnog suda Srbije 4/96, 27; CJEU, case C-20/12, Giersch and Others, ECLI:EU:C:2013:411, para. 16; Opinion of AG Mengozzi to CJEU, case C-20/12, Giersch and Others, ECLI:EU:C:2013:411, para. 16.

CONCLUSION

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7. СТАНАР, Сњежана. Анализа релација између ставова наставника о промјенама у образовању, идентификације са школом и задовољства послом у школи. *STED journal : journal of social and technological development*. [Štampano izd.]. 2023, vol. 5, no. 2, pp. 1-19. ISSN 2637-2150. http://dx.doi.org/10.7251/STED2302001S. [COBISS.RS-ID 139427073]

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