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University “Union – Nikola Tesla“
School of Engineering Management

Univerzitet „Union – Nikola Tesla“
Fakultet za inženjerski menadžment



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A Message from the Editor-in-Chief

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Nove perspektive u pogledu borbene upotrebe komercijalnih dronova u kontekstu rusko-ukrajinskog sukoba

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Apstrakt: Upotreba borbenih dronova dobija na svom značaju. Poslednjih godina je sve više prisutan fenomen upotrebe komercijalnih dronova za realizaciju vojnih zadataka. Cilj ovog rada je da kroz analiziranje aktuelnog vojnog sukoba u Ukrajini ukaže na moguće pravce dalje upotrebe ove tehnologije, kao i na efekte i dimenzije postojeće primene od značaja za odbrambeni sistem Republike Srbije. Moguće dimenzije primene komercijalnih dronova u lokalnim konfliktima su analizirane putem situacione SWOT analize. Izvedeni zaključak pruža realnu sliku stava do koga se došlo putem analize i daje pogled na dimenzije njihove upotrebe iz dva oprečna ugla.

Keywords: komercijalni dronovi, borbena primena, Ukrajina, SWOT

New Perspectives Regarding the Combat Use of Commercial Drones in the Context of the Russian-Ukrainian Conflict

Abstract: The use of combat drones is gaining momentum. In recent years, the phenomenon of the use of commercial drones for the realization of military tasks increased significance. The aim of this paper is to provide an answer to the possible directions of further use of this technology, as well as to the effects and dimensions of the existing application, by analyzing the current military conflict in Ukraine as a lesson for the defence system of the Republic of Serbia. Possible dimensions of the application of commercial drones in local conflicts are analyzed through a situational SWOT analysis. The derived conclusion provides a realistic picture of the position reached through the analysis and gives a view of dimension of its use from two opposite angles.

Keywords: commercial drones, combat application, Ukraina, SWOT

1. Introduction

During the last decade, the number of conflicts in the world in which drones play a significant role is continuously increasing in importance. War in Iraq (2013–2017), the civil war in Syria (2011 -), Yemen (2014 -), Libya (2014 -) and the conflict between Armenia and Azerbaijan over the disputed region of Nagorno-Karabakh (2020) are some of the glaring examples of training grounds for the use of drone technology for military purposes. The use of drones in these conflicts differs both in terms of scope, strategy, and the degree of sophistication of the aircraft used. There is also a big difference in the measures taken to combat drone attacks and to minimize the consequences of their use. What sets the conflict in Ukraine apart from all the aforementioned conflicts is the use of drones, which is unprecedented in scope and breadth of missions that are carried out with their help. It should also be emphasized that the war is characterized by a massive, never-before-seen application of Commercial off-the-shelf (COTS) solutions for the execution of various missions. In this article, after introduction, in the second chapter, a brief history of the application of commercial drones to achieve military goals will be presented. In the third chapter, a concise account of the genesis of the Ukrainian-Russian conflict is given. In the fourth chapter, a view of new perspectives regarding the combat use of commercial drones in the context of the Russian-Ukrainian conflict is given. In the fifth chapter, a SWOT Analysis of the applicability of commercial drones in local conflicts was made, based on the lessons learned from the Ukrainian-Russian conflict. The sixth chapter presents the conclusion of the work with the possible direction of future research.

2. A brief history of commercial drones application for military purposes by state and non-state actors

During the last decade, there are numerous testimonies about the misuse of commercial drones both for military purposes and for the purpose of carrying out terrorist attacks. Use of commercial and hobbyist drones for military purposes is carried out by both states and non-state actors.

During the fighting for the Iraqi city of Mosul in 2014, the terrorist organization ISIS used commercial drones that had the ability to use improvised grenades in order to strike the positions of the Iraqi security forces (Conditt, 2016).

Houthi rebel forces in Yemen civil war are actively using modified commercial drones against the Saudi-led coalition. The Houthis use commercially available unmanned aerial vehicles and equip them with cameras and arm them with improvised bombs made from explosives inserted into ball bearings. The mentioned commercial drones represent a very economical use of available resources although they do not pose a huge problem in terms of firepower. The purpose of their use is to generate media attention and to send a clear message to coalition forces regarding their vulnerability (Reinl, 2019). On several occasions, with the help of small drones, the Houthis have carried out attacks on oil pipelines and air fields, thanks to the fact that they represent a difficult target due to the low radar reflection, they fly extremely low and they are able to exploit the weak points of anti-aircraft defense (Brumfiel, 2019)

Non-state actors operating in the Middle East, Sahel and East Africa region they mostly use drones for reconnaissance purposes, but a slightly smaller number of drones are adapted for the purpose of carrying weapons. There are two primary types of armed drones used in the Middle East. The first one that has the ability to hover over the target and throw explosives at it and those that are armed with explosive and upon collision with the target they detonate. Both modifications of civilian drones pose a serious threat to both the civilian population and security forces (Haugstvedt, 2021). In Africa, the acquisition of drones intended for commercial use and for hobbyists, which are then subject to modifications, is gaining momentum (Allen, 2021).

From the very beginning of the conflict in Syria, commercial drones have become a key technology both for gathering intelligence and for carrying out attacks on enemy targets. The Islamic State went the farthest in weaponizing commercial drones, and that approach has since been copied by many others, including both regular military units and non state actors outside the Middle East. The commercial drones used during the war in Syria were not exclusively used for reconnaissance, surveillance, information gathering and propaganda purposes. At some point, a trend appeared to arm drones with small bombs, making them a serious threat to government forces. A little later, the world witness the use of larger home-made drones equipped with small bombs for attacks on Russian airbases Hmeimim in Latakia, which led to a greater engagement of Russian air defense units (Pol & Zwijnenburg, 2022).

Cartels and criminal organizations use drones for drug smuggling and law enforcement surveillance on the US southern border, and as of August 2021, over 8,000 illegal drone incursions into US territory have been registered. These criminal groups also have armed drones (Joyal, 2022).

3. A brief history of the Russian-Ukrainian conflict

After the overthrow of Ukrainian President Viktor Yanukovich on February 22, 2014 by pro-Western forces in Ukraine, Russia tried with all its might to regain its influence on Ukraine and regain its presence on the Crimean peninsula. Russia then launched a large-scale covert operation using its military resources in Crimea, whose movements were masked by the military exercises of Russian troops along the border with Ukraine. Soon, Russian troops took full control of the peninsula (Kofman et al., 2017). Along with the events in Crimea, the first conflicts in the Donetsk and Luhansk regions in eastern Ukraine began at the beginning of March 2014. The self-proclaimed Donetsk and Luhansk People's Republics (DNR and LNR) declare their independence from Ukraine in a referendum held on May 11, 2014. After the declaration of independence, the conflicts between the separatists backed by Russia and the Ukrainian state gained more and more intensity until the signing of the second Minsk agreement on February 12, 2015, which turned the hostility into a kind of frozen conflict (Hauter, 2021). During 2021, the Russian Federation began concentrating military units along the border of Russia with Ukraine, which resulted in the Russian invasion of Ukraine, on February 24, 2022. The

Russian leadership and state media are treating the aforementioned conflict as a military operation based on several bases (Harris, 2022).

4. New perspectives regarding the combat use of commercial drones in the context of the Russian-Ukrainian conflict

The Russian military intervention in Ukraine is characterized by the extremely large use of drones for military purposes, which by its scope exceeded all the conflicts that had been fought up to that time. Not only are military drones used in the conflict, but it is a widespread phenomenon that commercial off-the-shelf (COTS) drones and hobbyist drones are being used in combat by both sides.

The widespread use of drones is characterized by the use of three basic types of aircraft: rotary wing drones, fixed wing drones and loitering ammunition:

- The rotary wing drones used in the conflict in Ukraine include the following types of aircraft: KBLA-IVT (Russia), Autel Evo II (China), DJI Mavic Series (China), Golden Eagle (USA), Skydio X2 (USA), Aerorozvidka R18 (Ukraine) and Kvazimachta (Russia).
- Fixed wing drones used in the conflict in Ukraine include the following types of aircraft: Kronshtadt Orion (Russia), Bayraktar TB2 (Turkey), UJ-22 Airborne (Ukraine), Forpost (Russia), Zala 421 (Russia), PD-1 People's Drone (Ukraine), Tupolev Tu-141 Strizh (Former Soviet Union), WB FlyEye (Poland), Granat-4 (Russia), Orlan-10 (Russia), Orlan-30 (Russia), Quantum Systems Vector (Germany), RQ-20 Puma (USA), E95 (Russia), Tupolev Tu-143 Reis (Former Soviet Union), Zastava (Russia and Israel), Punisher (Ukraine), Mini-Bayraktar (Turkey), Takion (Russia), Leleka-100 "Stork" (Ukraine), Athlon Avia A1-CM Furia (Ukraine), Eleron-3 (Russia), and AeroVironment Quantix (USA).
- Loitering munitions used in the conflict in Ukraine include the following types of aircraft: Switchblade 300 (USA), Switchblade 600 (USA), Phoenix Ghost (USA), WB Group Warmate (Poland and Ukraine), Geran-2 / Shahed-136 (Iran) and Zala KYB (Russia) (Hambling, 2022; Chapple, 2022; Lowther & Siddiki, 2022).

Some of these aircraft, and we are primarily referring to the Autel Evo II and the DJI Mavic Series, are civilian commercial aircraft.

Professor Peter Lee, an expert on unmanned aerial vehicles at the University of Portsmouth, believes that in a situation where no side has absolute control over the airspace, the use of drones to gather information gains importance (Sabbagh, 2022).

What largely characterizes the war in Ukraine is the extensive use of small commercial drones, piloted by civilian volunteers. Civilian drones are used primarily to collect various intelligence data (Wolf & Dunn, 2022). According to Valerii Iakovenko, the founder of the Ukrainian company DroneUA, which provides advisory services regarding the use of drones, Ukraine has more than 6,000 commercial drones, most of which are of Chinese origin and they are used for military purposes (Galey, 2022). Even before the outbreak of hostilities in 2022, Aerorozvidka, Ukraine's drone unit, put armed COTS drones into operational use. The mentioned unit has developed two types of drones: quadcopters with smaller payloads capable of carrying anti-personnel hand grenades, and octocopters capable of carrying anti-tank or mortar shells. Numerous videos of commercial DJI drones equipped to carry hand grenades used by Russian units can also be seen on social media (Fogel & Mathewson, 2022).

According to Mark Cancian advisor at the Center for Strategic and International Studies, the essence of the use of commercial drones and drones intended for hobbyists by Ukraine is that with an investment of several thousand euros you get the opportunity to destroy Russian equipment worth several hundred thousand euros. An ordinary hand or mortar grenade can cause serious damage to a tank or an armored personnel carrier, and the damage is incomparably larger when the target is light fortified enemy position or unarmoured vehicle (Ayad & Brody, 2022).

Russian and Ukrainian forces are coming up with innovative new ways to incorporate commercial drones into their war efforts. Applications of commercial drones for military purposes include a wide range of missions such as: intelligence, surveillance, target acquisition, and reconnaissance, electronic warfare, psychological operations and cyber operations and with various modifications for attacking ground targets. Russia, like Ukraine, also uses Chinese commercial drones produced by the company

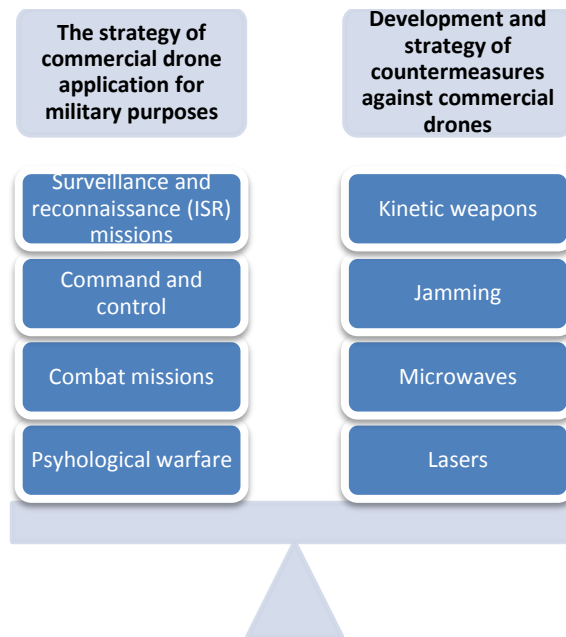
DJI for the implementation of various missions. The Ukrainian side appealed to the DJI company to find a way to disable the drones used by the Russian army in Ukraine. Russian forces have made certain modifications to the DJI firmware to eliminate the possibility of using the DJI technology in order to detect drones. The Ukrainians claim that in certain situations Russian troops used the DJI-produced AeroScope drone tracking system to pinpoint the location of a Ukrainian drone operator. After the location was completed, artillery attacks would follow with the aim of eliminating the operator (Joyal, 2022).

There are two basic elements within the Aeroscope system. The first element of the system is the Signal, which is automatically emitted by each DJI drone and through which information is provided about the position of the drone in space, its height, speed, direction of movement, as well as the serial number and location of the drone pilot. The second element consists of receivers that are able to detect the mentioned signals at a distance of up to 50 kilometers (Hollister, 2022). In April 2022, the Chinese drone manufacturer DJI announced that it was temporarily suspending its operations in Russia and Ukraine. The company vehemently opposed the use of their drones for military purposes, as well as modifications in order to use drones for military purposes (Burgess, 2022).

What greatly favours the use of drones and therefore commercial solutions used for military purposes is the length of the front line. Ukraine is working intensively on a so-called "drone army program" a large fleet of drones consisting mostly of commercial drones and drones donated by enthusiasts. Col. Oleksii Noskov, assistant commander-in-chief of Ukraine's armed forces, stated that with the help of the army of drones, monitoring of the 2,470 km long front line will be facilitated (Vallance, 2022).

Both sides in the conflict, in parallel with the intensive use of drones to achieve war goals, are trying to disable the drones belonging to the opposing side. During the conflict, Russia used some of the modern electronic warfare systems such as Krasukha-2/4, R-330Zh Zhitel, and RB-301B Borisoglebsk-2, whose original purpose is not to implement measures against drones (Lowther & Siddiki, 2022). On the front line in the fight against militarized COTS solutions, the Ukrainian side uses both fire from small-calibre infantry weapons and directed jammers. Cannons for jamming drones can be seen more and more often, namely the American "Drone Defender" and the Lithuanian "Sky Viper" EDM4S (Fogel & Mathewson, 2022).

Figure 1. Seesaw of strategies from new perspective - Authors based upon (ZenaDrone, n.d.; Thompson, 2022; Fogel & Mathewson, 2022)



How difficult the fight against drones is is not only evidenced by the experiences from the current Russian-Ukrainian conflict. It is enough to look back at the experience from Syria, Libya, as well as the one in Nagorno-Karabakh, or let's say the attacks on the territory of the UAE and Saudi Arabia. These examples clearly show how much modern state of the art anti-aircraft defense struggle in the fight

against small low-flying targets (Millburn, 2022).

5. SWOT Analysis of the applicability of commercial drones in local conflicts

This chapter will analyze the internal and external factors regarding the possibility of using commercial drones for military purposes. The immediate focus will be on the current conflict in Ukraine and the impact that mentioned conflict has on the implementation of commercial (COTS) solutions.

Strengths

Samuel Bendet, a military analyst at Virginia-based research group CNA, believes that the future availability of combat drones for sophisticated long-duration operations coupled with the need to have low-cost tactical drones for close support operations will significantly affect the battlefield of tomorrow (Khurshudyan, Ilyushina & Khudov, 2022). According to Roger Bohn, professor emeritus of technology management at the University of California San Diego, the use of commercial drones in conflicts is attractive for several reasons. The necessary knowledge as well as the parts necessary to assemble drones are readily available online, so even self-taught enthusiasts can assemble them. No special training is required to operate the aircraft, and thanks to their small size, they can be transported on the ground in an ordinary backpack (Moumen, 2022). Commercial unmanned aerial vehicles of small size and low cost make the war in Ukraine completely unique, providing hitherto unimagined possibilities of surveillance over the battlefield with the enviable possibility of correction of usually imprecise artillery fire (Khurshudyan, Ilyushina & Khudov, 2022).

It should be pointed out that both sides (predominantly Ukrainian) use a large number of commercial drones, and among them the DJI Mavic 3 quadcopter model dominates for the Tactical Intelligence, Surveillance and Reconnaissance (ISR) Mission, which indirectly confirms the increasing importance of civil technology in warfare (Borsari, 2022). In the early days of the war, the Russian military relied on heavy weapons such as artillery and tanks, and was less prepared and open to adapting consumer technology to the battlefield. It is also more than noticeable the lack of small commercial drones that the Ukrainian forces have been receiving in the form of donations. The Ukrainian side has numerous workshops where commercial aircraft are adapted to carry different types of modified shells (Kramer, 2022). The ability of commercial drones used by Ukrainian forces to evade fairly powerful air defenses reveals numerous adversary vulnerabilities and plays a notable role as an important tactical victory that boosts the morale of troops on the ground. At the same time, it is a strong psychological blow for Russia, since Ukraine, using commercial drones, demonstrates its ability to retaliate against the enemy, regardless of the overestimated capabilities of Russia's anti-aircraft defense (Wolff, 2012).

Weaknesses

There are numerous limiting factors regarding the use of commercial drones for military purposes. There is primarily a relatively small payload, which in most cases is limited to a gimbal, camera and battery, while there are commercial drones with slightly higher payloads. The next limiting factor is range in terms of range by signal transmission and image relay distance and battery power. Then commercial drones have a limited use in adverse weather conditions that cannot be compared to military drones capable of flying in all weather conditions. It should be noted that the quality of the sensor (camera resolution) is weaker compared to the military drones (Abbott et al., 2015). Commercial drones face certain obstacles when carrying out their missions. Those obstacles are embodied in the technologies that have been developed to combat drones (anti-aircraft systems, jamming the aircraft's telecommunications and GPS, and various approaches to computer hacking. The aforementioned vulnerability of aircraft to jamming, and the lack of robustness compared to drones for military use, make commercial drones a less reliable tool for the implementation of certain operations in the field. In addition, the operator of commercial drones may be exposed to risk if the adversary uses systems to determine the operator's position, such as the AeroScope system of the Chinese company DJI (Moumen, 2022). Many technology companies retain a certain degree of control over their product even after it has been sold to a customer. It should be mentioned that all DJI drones are delivered to the customer with geofencing technology, which means that the drone potentially will not be operational in a certain protected area (Greenwood, 2022).

Opportunities

According to Strategic Market Research, there are expectations that the size of the commercial drone market is expected to reach a value of around \$47.38 billion by 2030 and to record a very strong growth at a CAGR of 28.58% from 2022 to 2030. (STRATEGIC MARKET RESEARCH LLP, 2022). Today on the market it is possible to acquire a large number of extremely high-quality drones intended for commercial use, and some of the prominent models are listed in Table 1.

Table 1. Commercial drones comparison table (Gross, 2023)

Model	Range (km)	Size (mm)	Flight time (min)	Weight (kg)	Max Speed (m/s)	Camera
DJI Matrice 300 RTK	15	810×670×430	55	3.6	23	960p, 30 fps
Freefly Alta 8	3,22	1346 diagonally	12-15	6.2	15,65	Not included
DJI Mavic 2 Enterprise Advanced	10	322×242×84	31	0,909	20	48 MP, 3840×2160@30fps
DJI Phantom 4 Professional+	7	350 diagonally	30	1,388	12,5	20M, 4096×2160 24/25/30p @100Mbps
Yuneec H520E RTK	7	551x482x309	30	1,860	20	Not included
DJI Agras MG-1	1	1471 x 1471 x 482	24	8,8	22	Not included
Autel Evo Lite+	12	427×384×95	40	0,835	18	50M, 3840x2160 p 60/50/48/30/25/24
DJI Mavic Air 2	10	183×253×77	34	0,570	19	48 MP, 3840×2160 24/25/30/48/50/60 fps
Parrot Anafi	4	175x240x65	25	0,320	15	16MP (4608x3456)
DJI Inspire 2	7	604 diagonally	27	3,440	26,11	Not included

When purchasing a commercial drone, you should focus on certain aspects that the system provides, such as: flight time, range, payload capacity, camera quality, speed, size and weight (Gross, 2023). There are four key military drone technologies in terms of sensors that are being exported to the Commercial Market: Hyperspatial Sensors, Wide Area Surveillance, Multi-spectral Targeting Systems and Light Detection and Ranging (LIDAR) (Miltech, n.d.). The essence of choosing the right energy source for commercial drones is reflected in the fact that an energy source that can last a long time is necessary, that it is based on a resource that is widely available and affordable, that it has a good energy-to-weight ratio, that it has as little negative impact as possible on the environment, that it creates little noise or vibration, and that it can be refilled quickly and easily (Sharewater Aerospace, n.d.).

Commercial drones have a bright future as they expand their presence into new industries, and more companies are becoming aware of the potential profits from their use. The future of autonomous commercial drones is particularly bright due to the FAA's move to simplify approvals for fully autonomous drone flights. With this roadblock removed, autonomous drones will be implemented on a much larger scale in both the consumer and commercial industries (Alkobi, 2019). During conflict, in addition to performing a surveillance role that can greatly contribute to the collection of valuable intelligence, video captured by commercial drones could help in determining responsibility for documented crimes after the war ends (Burgges, 2022).

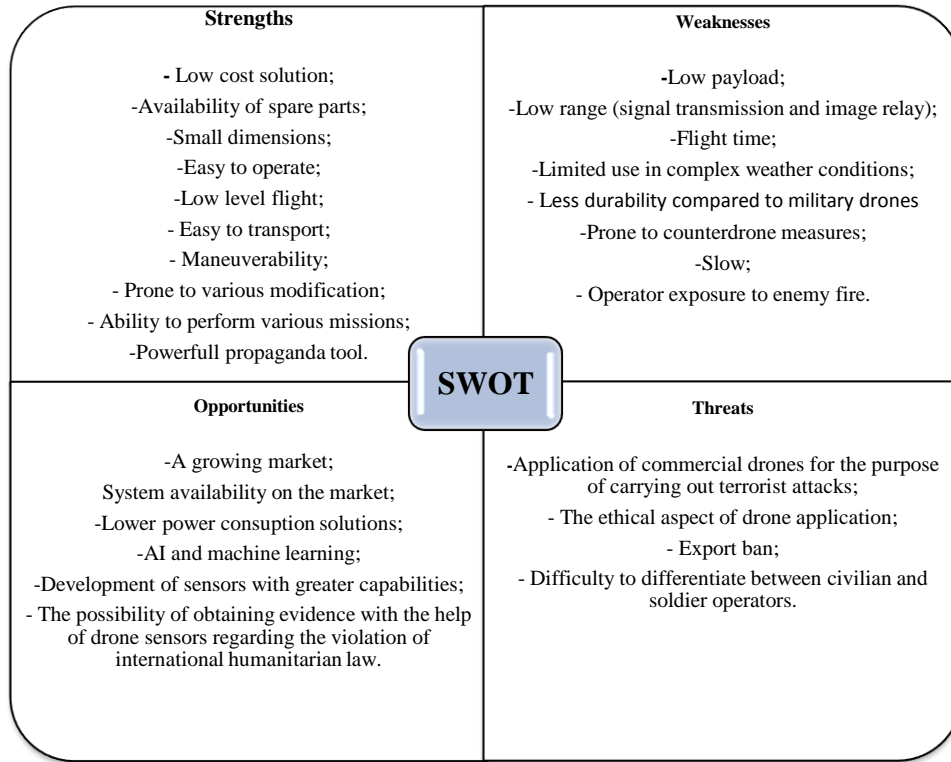
Threats

The wide availability of cutting-edge technology embodied in civilian drones has provided violent non-state actors (VNSA) or terrorists with new possibilities. Due to their accessibility and variety of uses, drones have provided the VNSA with an advantage over the aerial component that they used until their appearance (balloons, missiles, rockets or the hijacking of commercial planes). One of the most important reasons why commercial drones are attractive to VNSA is the fact that they are affordable for procurement and that the matter is still quite unregulated, which greatly complicates the interruption of the supply chain. To make things even worse, the VNSA also has centers for the production and modifications (examples of terrorist groups that operated in Iraq and Syria). In other words, the use of civilian drones provides the VNSA with a completely innovative, extremely effective platform for the realization of their plans (Chavez & Swed, 2020). In April 2022, DJI, the world's largest drone manufacturer, issued a statement that it was temporarily suspending operations in Russia and Ukraine. Adam Lisberg, DJI's director of corporate communications for North America, said on that occasion that DJI abhors any use of their drones to cause harm, and that they are temporarily suspending sales in Russia and Ukraine to ensure that no one uses their drones for execution of combat missions (Al Jazeera, 2022).

US Air Force Maj. Gen. James Poss recently stated that commercial drones have proven so effective that they have created an entirely new way of warfare. In the following, the general apostrophizes and fears that if non-governmental organizations and commercial companies are able to have such an influence on the implementation of combat operations, what could be the influence that terrorists could potentially have (Zoldi, 2022). There is a great risk to people who fly small drones both on and near the battlefield. According to the International Committee of the Red Cross, it is clearly stipulated that parties to an armed conflict must make a clear distinction between the civilian population and combatants. It is also necessary to distinguish between civilian and military objectives. This is certainly the case when combat aircraft are used on the battlefield.

Small consumer or commercial drones are very difficult to distinguish visually in the air. Drones intended for civilian use have an unclear status under international humanitarian law. Civilian users of drones, such as journalists and curious citizens, who operate drones in or around a combat zone may not be aware of the implications of their actions and the extent to which they are putting themselves in danger (Greenwood, 2022). Numerous videos of commercial drones dropping improvised grenades on enemy personnel can be seen on media (The Telegraph, 2022; The Sun, 2022a; Express, 2022; The Sun, 2022b; The Sun, 2022c) and social networks.

Figure 2: SWOT analysis of the applicability of commercial drones in local conflicts



6. Conclusion

The conflict in Ukraine is accompanied by an unprecedented deployment of various commercial drones performing different tasks. Some carry out Intelligence, surveillance, and target acquisition missions, while others are modified into combat drones or suicide drones (loiterng munition). We can agree with many of the sources cited in the paper who expressed their view on the extent to which the use of commercial drones has changed the course of warfare, especially the current Russian-Ukrainian conflict. When we look at footage of commercial drones in action, our view of the brutal reality is divided.

On the one hand, the inventiveness of the users and the versatility of the use of aircraft give the impression that commercial drones, or rather their use in conflict, have largely changed the character of warfare. Let's clarify. A commercial drone that costs a few hundred or thousands of dollars is able to accurately direct artillery fire on enemy units. Commercial drones capable of carrying out combat missions are capable of knocking out expensive air defense systems worth several hundred thousand or even million dollars. You don't need to mount large amount of explosives to disable a sophisticated air defense system. Most armored vehicles and tanks have extremely weak armor protection on the top side of the vehicle, precisely on the side where they can suffer a drone attack. Additionally, commercial drones are extremely difficult to detect due to their flight profile, size and speed. And when they can be detected it raises the question of the justification of launching very expensive rockets at a target that costs incomparably less. Again, the same cheap commercial drone is capable to cause immeasurable damage to your troops, either by correcting the artillery fire, monitoring the movement of units and their direction in real time, or directly acting on the target with improvised devices. If the adversary is ready to act, it is simply necessary to saturate the airspace with drones. This is what awaits us in the near future with an increased level of AI (human-out-of-the-loop systems) and acting in swarm formations.

On the other hand, the application of commercial drones in some of its segments is in conflict with the existing conventions of international humanitarian law. What we observe today in Ukraine may one day return to the whole world like a boomerang (the methods of action of certain violent non-state actors have already been mentioned in the paper). What we see every day in Ukraine materialized with

the help of commercial drones has nothing to do with compliance with International Humanitarian Law. Commercial drone manufacturers are not at all to blame for this situation. That must be clear to everyone. They cannot be blamed because it was not by their decision that the tool was transformed into a weapon.

Commercial drones are here to help us in carrying out various business activities from a whole new perspective. Commercial drones should not be part of the military effort.

Which of these two realities we choose depends only on us. The authors of this paper still want to see commercial drones as a tool that will change the human future for the better.

Future research will address the use of loitering munition in this conflict and its implications for further development.

Literature

1. Abbott, C., Clarke, M., Hathorn, S. & Hickie, S. (2016) Hostile drones: The use of civilian drones by non-state actors against British targets. Remote Control project. Oxford Research Group. Retrieved December 18, 2022, from: https://www.files.ethz.ch/isn/195685/Hostile%20use%20of%20drones%20report_open%20briefing_0.pdf.
2. Al Jazeera (2022) Chinese drone giant DJI suspends business in Russia, Ukraine. Retrieved March 1, 2023, from: <https://www.aljazeera.com/economy/2022/4/27/chinese-drone-giant-dji-suspends-business-in-russia-ukraine>
3. Alkobi, J. (2019) The Evolution of Drones: From Military to Hobby & Commercial. Percepto. Retrieved December 17, 2022, from: <https://percepto.co/the-evolution-of-drones-from-military-to-hobby-commercial/>
4. Allen, K. (2021) Drones and Violent Nonstate Actors in Africa. Africa Center for Strategic Studies. Retrieved December 24, 2022, from: <https://africacenter.org/research/>
5. Ayad, P., & Brody, P. (2022). Ukrainian soldiers are turning consumer drones into formidable weapons of war. Observers.france24.com. Retrieved February 4, 2023, from: <https://observers.france24.com/en/europe/20220808-ukraine-russia-modified-commercial-drones-battlefield-donations-weapons>
6. Borsari, F. (2022) Assessing Drone Operations in Ukraine: Trends and Implications. Orion Policy Institute. Retrieved February 12, 2023, from: <https://www.orionpolicy.org/orionforum/110/assessing-drone-operations-in-ukraine-trends-and-implications>
7. Brumfiel, G. (2019) In Yemen Conflict, Some See A New Age Of Drone Warfare. NPR. Retrieved December 16, 2022, from: <https://www.npr.org/2019/05/29/726760128/in-yemen-conflict-some-see-a-new-age-of-drone-warfare>
8. Burgess, M. (2022) Small Drones Are Giving Ukraine an Unprecedented Edge. Wired. Retrieved February 4, 2023, from: <https://www.wired.co.uk/article/drones-russia-ukraine-war>
9. Chapple, A. (2022). The Drones Of The Ukraine War. RFE/RL. Retrieved January 10, 2023, from: <https://www.rferl.org/a/ukraine-russia-invasion-drones-war-types-list/32132833.html>
10. Chávez, k., & Swed, O. (2020) Off the Shelf: The Violent Nonstate Actor Drone Threat. Air & Space Power Journal, 34(3), 29–43.
11. Conditt, J. (2016) ISIS has converted commercial drones into bombers. Engadget. Retrieved December 14, 2022, from: <https://www.engadget.com/2017-01-16-isis-drones-weaponized-bombers-iraq-mosul.html>
12. Express (2022) Russian troops scramble to load wounded soldiers as Ukrainian drones launch strikes – VID. Express. Retrieved February 6, 2023, from: <https://www.express.co.uk/news/world/1662426/russia-ukraine-war-kherson-military-equipment-soldiers-troops-vn>

13. Fogel, B., & Mathewson, A. (2022) Will the Drone War Come Home? Ukraine and the Weaponization of Commercial Drones. The Modern War Institute (MWI). Retrieved January 25, 2023, from: <https://mwi.usma.edu/will-the-drone-war-come-home-ukraine-and-the-weaponization-of-commercial-drones/>
14. Galey, P. (2022). Big guns and small drones: The devastating combo Ukraine is using to fight off Russia, NBC News, Retrieved January 12, 2023, from: <https://www.nbcnews.com/news/world/ukraine-army-uses-guns-weapons-drone-combo-rca27881>
15. Greenwood, F. (2022) Ukraine War Is Being Watched From the Sky. Foreignpolicy. Retrieved March 2, 2023, from: <https://foreignpolicy.com/2022/04/02/russia-ukraine-war-drones-risks/>
16. Gross, R.J. (2023) 10 Best Commercial Drones In January 2023 | Updated List. PROPEL. Retrieved March 1, 2023, from: <https://www.propelrc.com/best-commercial-drones/>
17. Hambling, A. (2022). Every. Single. Drone. Fighting In Russia's War Against Ukraine. Popular Mechnaics. Retrieved February 5, 2023, from: <https://www.popularmechanics.com/military/a40298287/drone-fighting-ukraine-war-russia/#sidepanel>
18. Harris, R. L. (2022) Editorial Essay: Why Ukraine is Important. Journal of Developing Societies (Sage Publications Inc.), 38(2), 127–143. <https://doi.org/10.1177/0169796X221098801>
19. Haugstvedt, H. (2021) A Flying Threat Coming to Sahel and East Africa? A Brief Review. Journal of Strategic Security 14, no. 1 (2021) : 92-105.doi: <https://doi.org/10.5038/1944-0472.14.1.1848> Retrieved December 18, 2022, from: <https://digitalcommons.usf.edu/jss/vol14/iss1/6>
20. Hauter, J. (2021) Civil War? Interstate War? Hybrid War? : Dimensions and Interpretations of the Donbas Conflict in 2014–2020.
21. Hollister, S. (2022) DJI drones, Ukraine, and Russia — what we know about AeroScope. The Verge. Retrieved February 10, 2023, from: <https://www.theverge.com/22985101/dji-aeroscope-ukraine-russia-drone-tracking>
22. Joyal, P. M. (2022) Weaponization of Commercial Drones is a Global Threat. SecurityInfoWatch.com. Retrieved January 11, 2023, from: <https://www.securityinfowatch.com/perimeter-security/robotics/anti-drone-technologies/article/21277392/weaponization-of-commercial-drones-is-a-global-threat>
23. Khurshudyan, I., Ilyushina, M., & Khudov, K. (2022) Russia and Ukraine are fighting the first full-scale drone war. The Washington Post. Retrieved February, 4, 2023, from: <https://www.washingtonpost.com/world/2022/12/02/drones-russia-ukraine-air-war/>
24. Kofman, M., Migacheva, K., Nichiporuk, B., Radin, A., Tkacheva, O., & Oberholtzer, J. (2017) Lessons From Russia's Operations in Crimea and Eastern Ukraine. Rand Cooperation.
25. Kramer, A.E. (2022). From the Workshop to the War: Creative Use of Drones Lifts Ukraine. The New York Times. Retrieved February 8, 2023, from: <https://www.nytimes.com/2022/08/10/world/europe/ukraine-drones.html>
26. Lowther, A., & Siddiki, M. K. (2022). Combat Drones in Ukraine. Air & Space Operations Review, 1(4), 3. Retrieved from February 2, 2023, from: https://www.airuniversity.af.edu/Portals/10/ASOR/Journals/Volume-1_Number-4/Lowther.pdf
27. Millburn, A. (2022) The New Face of War: Devastating Drone Attacks in Ukraine Have Implications for the US Military in the Middle East. Middle East Insitute. Retrieved February 17, 2023, from: <https://www.mei.edu/publications/new-face-war-devastating-drone-attacks-ukraine-have-implications-us-military-middle>
28. Miltech (n.d.) 4 Military Sensor Technologies that Drones are Transporting to the Commercial Market. Retrieved March 7, 2023, from: <https://www.militaryethernet.com/4-military-sensor-technologies-drones-transporting-commercial-market/>
29. Moumen, H. (2022) Commercial Drone Tech Proliferates in Ukraine. National Defense, 826, 41. Retrieved March 1, 2023, from: <https://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=158715877&site=ehost-live>.
30. Pol, A. M., & Zwijnenburg, W. (2022) A Laboratory of Drone Warfare. PAX. Retrieved January 24, 2023, from: https://paxforpeace.nl/media/download/PAX_Syria_A%20Laboratory%20of%20Drone%20Warfare_2022.pdf

31. Reinl, J. (2019) Cheap drones are changing the calculus of war in Yemen. The World. Retrieved December 12, 2022, from: <https://theworld.org/stories/2019-06-03/cheap-drones-are-changing-calculus-war-yemen>
32. Sabbagh, D. (2022) War-enabling, not war-winning?: how are drones affecting the Ukraine war? Guardian. Retrieved February 24, 2023, from: <https://www.theguardian.com/world/2022/may/15/war-enabling-not-war-winning-how-are-drones-affecting-the-ukraine-war>
33. Sharewater Aerospace, (n.d.) 6 Energy Sources Powering Today's Commercial Drones. Sharewater Aerospace. Retrieved March 7, 2023, from: <https://www.shearwater.ai/post/6-energy-sources>
34. STRATEGIC MARKET RESEARCH LLP (2022) Commercial Drone Market – Report on \$47.38 Billion Industry Opportunity, Increasing Usage of Small Drones in Commercial Applications & Remote Sensing Technologies to propel the industry growth. Retrieved March 1, 2023, from: <https://www.globenewswire.com/en/news-release/2022/12/30/2581124/0/en/Commercial-Drone-Market-Report-on-47-38-Billion-Industry-Opportunity-Increasing-Usage-of-Small-Drones-in-Commercial-Applications-Remote-Sensing-Technologies-to-propel-the-industry-.html>
35. The Sun (2022a) Ukrainian drone fires three grenades at wounded Russian soldier. The Sun. Retrieved February 5, 2023, from: https://www.youtube.com/watch?v=ZpjP_5lwCjs
36. The Sun (2022b) Ukrainian drone drops bomb on Russian soldiers hiding in foxholes. Retrieved February 5, 2023, from: <https://www.youtube.com/watch?v=N1J4voqfGhE>
37. The Sun (2022c) Russian drones stalk Ukrainian troops before dropping bombs in trenches. The Sun. Retrieved February 5, 2023, from: <https://www.youtube.com/watch?v=fqIxiEVasgw>
38. The Telegraph (2022) Footage shows Russian soldiers being attacked by a night vision-equipped drone. The Telegraph. Retrieved February 25, 2023, from: <https://www.youtube.com/watch?v=vIITGdKEBWE>
39. Thompson, L. (2022). Defeating Drones: The Most Promising Weapons Are All Non-Kinetic. Forbes. Retrieved January 3, 2023, from: <https://www.forbes.com/sites/lorenthompson/2022/11/01/defeating-drones-the-most-promising-weapons-are-all-non-kinetic/?sh=7663492b5b8a>
40. Vallance, C. (2022) Ukraine sent dozens of 'dronations' to build army of drones. BBC. Retrieved from February 24, 2023, from: <https://www.bbc.com/news/technology-62048403>
41. Wolf, S., & Dunn, D. H. (2022) Ukraine war: drones are transforming the conflict, bringing Russia on to the frontline. The conversation. Retrieved February 10, 2023, from: <https://theconversation.com/ukraine-war-drones-are-transforming-the-conflict-bringing-russia-on-to-the-frontline-196229>
42. Wolff, S. (2022) Ukraine War: Drones Are Transforming the Conflict, Bringing Russia on to the Frontline. Homeland Security News Wire. Retrieved February 17, 2023, from: <https://www.homelandsecuritynewswire.com/dr20221213-ukraine-war-drones-are-transforming-the-conflict-bringing-russia-on-to-the-frontline?page=0,1>
43. ZenaDrone (n.d) The Impact of Drones on Future of Military Warfare. Retrieved February 4, 2023, from: <https://www.zenadrone.com/drones-impact-the-future-of-military-warfare/>
44. Zoldi, D. M. K. (2022) 2022 Top Drone Industry Developments. Inside Unmanned Systems. Retrieved February 17, 2023, from: <https://insideunmannedsystems.com/looking-back-to-look-ahead-are-the-top-5-developments-in-the-drone-industry-this-year-indicators-of-what-we-might-see-in-2023/>

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Efekti fiskalne politike na Republiku Srbiju i zemlje u okruženju

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Apstrakt: Fiskalna politika predstavlja moćan instrument za stabilizaciju nacionalne ekonomije, i uz pomoć nje se kontroliše nivo i struktura poreza, izdataka i upravljanje dugom. Upravljanje fiskalnom politikom utiče na agregatnu tražnju, distribuciju bogatstva i sposobnost ekonomije da proizvodi dobra i usluge. Ona predstavlja alat makroekonomske politike a u ovom radu autori će se naročito baviti uticajem fiskalne politike na određene makroekonomske komponente: javni dug, platni bilans, ali i na privlačenje stranih direktnih investicija i konkurentnost. Države moraju da vode odgovornu fiskalnu politiku u skladu sa svojim mogućnostima kako bi smanjile siromaštvo i socijalne nejednakosti, a istovremeno obezbedile privredni rast. Fiskalna održivost je složeno pitanje naročito u periodima krize i zato je potrebno donositi odluke koje će dugoročno imati pozitivne efekte na privredni razvoj.

Ključne reči: fiskasna politika, privredni razvoj, javni dug, konkurentnost

Effects of Fiscal Policy on the Republic of Serbia and Neighboring Countries

Abstract: Fiscal policy is a powerful instrument for stabilizing the national economy, and with its help the level and structure of taxes, expenditures and debt management are controlled. Fiscal policy management affects aggregate demand, the distribution of wealth, and the economy's ability to produce goods and services. It represents a tool of macroeconomic policy, and in this paper the authors will particularly deal with the impact of fiscal policy on certain macroeconomic components: public debt, balance of payments, but also on the attraction of foreign direct investments and competitiveness. States must conduct a responsible fiscal policy in accordance with their capabilities in order to reduce poverty and social inequalities, and at the same time ensure economic growth. Fiscal sustainability is a complex issue, especially in periods of crisis, and therefore it is necessary to make decisions that will have positive effects on economic development in the long term.

Keywords: fiscal policy, economic development, public debt, competitiveness

1. Introduction

Taxes are one of the most important and powerful instruments of the state through which it redistributes GDP, so taxation has its economic, social, regional, and political dimensions. They also represent a key component when it comes to a country's international competitiveness, so it is important to favor tax incentives in order to make the economic environment more competitive. The main characteristic of tax systems in countries in the region is low tax rates on capital and labor, with the aim of providing appropriate guarantees for their economic performance in business investments and activities. In recent years, all Balkan countries have recognized this fact and have embarked on tax law reforms to become more competitive (Taxation trends in Western Balkans, 2020).

States must pursue responsible fiscal policies in line with their capabilities in order to reduce poverty and social inequalities, which are particularly pronounced in rural areas where agriculture is the dominant economic activity. Economic policy should not be limited to responsible implementation of fiscal policy alone but should encompass all elements that contribute to sustainable development. This should involve all social groups that will reduce inequality and create conditions for economic development (Veselinovic et al., 2019). The reform of corporate profit tax in Serbia has abolished some tax incentives, such as incentives for companies for professional rehabilitation, for companies operating in free zones, for companies operating in underdeveloped areas, tax credits, etc. It is estimated that the abolition of these incentives, under the conditions of still low tax rates, is justified and will contribute to reducing the possibility of abusing tax incentives, but it will not significantly contribute to an increase in tax revenues, as the number of companies that have used these incentives is very small. Considering that even with a rate of 15%, the tax burden on profits for companies in Serbia will be significantly lower than in most other European countries, retaining these incentives is considered unjustified and an expensive mechanism for attracting foreign direct investments. Based on empirical analysis in other Central and Eastern European countries, we come to the conclusion that tax incentives do not significantly contribute to the inflow of foreign direct investments.

2. Effects of Taxation Policy on Economic Development

Despite the contribution taxation can make to the gross domestic product (GDP) of a country overall, it is important to pay close attention to the secondary effects of taxes on the growth of small and medium-sized enterprises (SMEs). This is because SMEs play a crucial role in driving economic growth both in developing and developed countries. Taxes imposed on income are only worthwhile if they can generate significant revenue at acceptable rates and procedures (Musgrave and Musgrave, 1984). According to Gordon and Dawson (1987), through taxation, the government takes money from individuals that would otherwise be spent in the private sector. As a result, the purchasing power per unit of production in the private sector diminishes. They further argue that one of the most common arguments against taxes is that they destroy incentives for business people and employees to work more and efficiently. A study on SMEs shows that regulations and laws concerning companies in the manufacturing and retail sectors have a negative impact on SMEs (Oludela and Emile, 2012). Atavodi and Ojeka (2012) explain that the choice of tax policy for employment depends on the use of one or both sets of instruments. The first is the use of special tax privileges and other incentives to support the establishment and growth of small companies (Atavodi & Ojeka, 2012). These incentives consist of reducing corporate tax rates, special tax exemptions or reliefs, and concessions for small enterprises. The underlying reason for all of this is to effectively increase revenue through measures that suit the country's circumstances and administrative capacity (Atavodi & Ojeka, 2012).

Fiscal policy can play an important role in fostering innovation through its effects on research and development, entrepreneurship, and technology transfer. However, some scholars have shown that excessive government financial intervention hinders the technical input and output of companies (Busom, 2000; Klapper and Larraín, 2012). Zhang et al. (2017) found that the corporate profit tax inhibits investment in innovation in the Eastern region; the tax burden on companies in the Eastern region is higher than in the Central and Western regions, but companies in the Eastern region attract more innovative investments.

Different results on the effectiveness of tax incentives for research and development do not provide a valid basis for dismissing the effectiveness of such incentives. A successful fiscal strategy for research and development largely depends on understanding the benefits of different policy instruments.

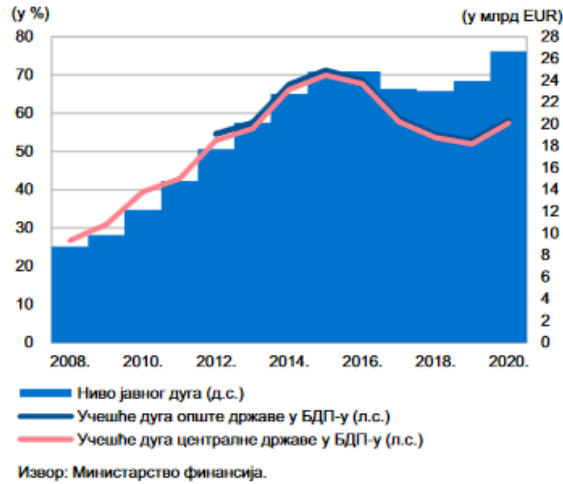
Government fiscal subsidies and tax incentives are the two most important policy instruments for the government to support business innovation (Lee, 1996; Aghion et al., 2012). In many economies, fiscal subsidies and tax incentives have become an integral part of a broader strategy to increase investment in research and development and promote innovation.

3. Fiscal Consolidation of the Republic of Serbia

In 2020, the Republic of Serbia recorded a fiscal deficit amounting to 442.8 billion dinars, or 8.1% of GDP (compared to 0.2% of GDP in 2019). Examining the levels of government, the general government budget deficit of the Republic of Serbia amounted to 459.1 billion dinars.

The primary fiscal result in 2020 was also negative, reaching 332.5 billion dinars, or 6.1% of GDP (compared to a positive primary result of 1.8% of GDP in 2019). Considering that interest costs are a consequence of fiscal policy and past deficits, the primary fiscal result indicates that the fiscal revenues generated were sufficient to cover fiscal expenditures that are not a result of debt servicing costs.

Graph 1. Public Debt Trends



Achieved macroeconomic and fiscal stability, as well as the timely implementation of monetary and fiscal policy measures, have been confirmed by maintaining the credit rating throughout 2020. The credit rating agency, Fitch Ratings, maintained Serbia's credit rating for long-term domestic and foreign currency borrowing at the level of BB+ (one step below investment grade) with stable outlooks in March and September 2020, and then in March 2021. This was possible due to Serbia's strong economic indicators, which were sustained even during the COVID-19 pandemic.

Graph 2. Fiscal Result Trends (% of GDP)



Tax rates in Serbia are currently lower than the average in the Central and Eastern European region, and significantly lower compared to Western European countries. Value-added taxes burden domestic

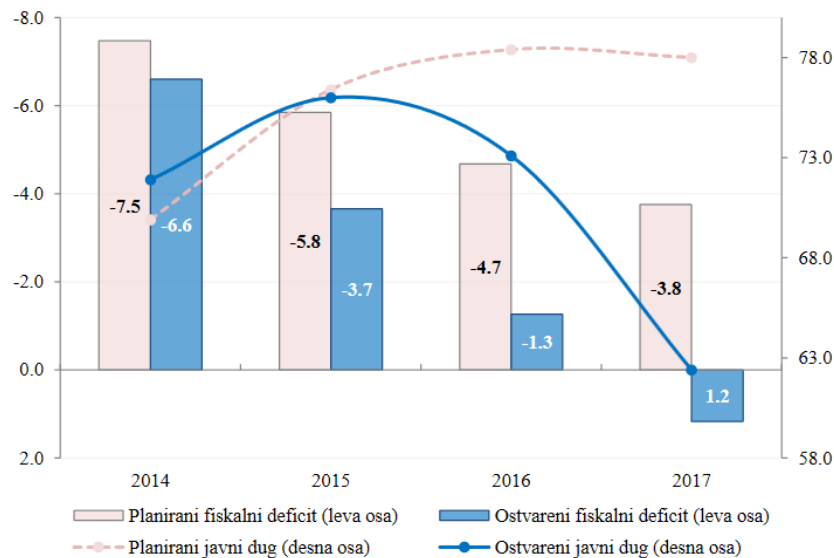
consumption. This form of taxation does not diminish the international competitiveness of the Serbian economy. The current corporate profit tax rate in Serbia of 15% is in line with the regional tax rate and does not pose a significant obstacle to its economic growth. An optimal approach to reducing the tax burden that would stimulate economic activity is the reduction of wage taxes. By reducing labor costs, the domestic economy would become more competitive compared to other countries in the region. (Fiscal Council of the Republic of Serbia, 2019)

Table 1. Tax Rates in the Republic of Serbia and Surrounding Countries

Country	Income Tax and Contributions	VAT	Corporate Profit Tax
Bulgaria	52	20	10
Czech Republic	78	21	19
Croatia	67	25	18
Hungary	79	27	9
North Macedonia	48	18	10
Romania	75	19	16
Slovakia	78	20	21
Slovenia	78	22	19
Montenegro	68	21	9
CEI Average	69	21	15
Serbia	62	20	15

Source: Calculation by the Fiscal Council based on official national statistics

Image 1: Fiscal result and public debt 2014-2017, plan & realization (% of GDP)



Source: IMF (2015). Republic of Serbia: 2014 Article IV Consultation and Request for Stand-By Arrangement – Staff Report; Press Releases; and Statement by the Executive Director for the Republic of Serbia. IMF Country Report 15/50.

In 2015, the Republic of Serbia reached its highest level of public debt, which was the moment that called for serious fiscal consolidation. A more detailed analysis can identify three main reasons responsible for this unplanned increase in public revenues, driven by domestic factors and favorable international circumstances. These reasons include:

- Improvements in the macroeconomic environment,
- More efficient tax collection,

- Combating the informal economy (with some minor changes in tax policy) and several one-off factors that temporarily boosted public revenues in 2017. (Fiscal Council of the Republic of Serbia, 2018).

The largest contribution to the unexpected increase in public revenues during the period of 2015-2017 (around €700 million) can be attributed to higher economic growth than projected by the program. Accordingly, labor market developments also exceeded initial expectations, resulting in nearly three-quarters of the overall increase in public revenues coming from higher contributions for mandatory social security and income taxes. The remaining unplanned increase in public revenues is reflected in higher VAT and customs revenue due to a stronger recovery of private consumption.

4. Effects of Fiscal Policy on Surrounding Countries

It is important to note that differences between macroeconomic projections and actual economic performance are one of the most common reasons (positive or negative) for deviations in fiscal results compared to the fiscal consolidation plan (Mauro & Villafuerte, 2013). It is evident that there have been macroeconomic improvements that generated high revenue growth. It is estimated that this partly occurred as a result of fiscal consolidation itself, which contributed to reducing the country's risk and consequently lowering interest rates on government and private sector borrowing, thus providing a stimulus to economic growth. However, what seems indisputable at this moment is that it is largely a positive shock that came from external sources, as the macroeconomic developments in Serbia and other Central and Eastern European (CEE) countries have been exceptionally favorable in the past few years. Exploring the drivers of economic growth in CEE countries during 2015-2016, Petrović et al. (2017) have shown that a significant portion of the unexpected acceleration of regional economic activity (including Serbia) in the observed period can be explained by the positive impact of external factors such as the decline in commodity prices (particularly oil and gas), lower interest rates in Europe, and increased export demand for these countries due to a stronger recovery of the Eurozone and the CEE region itself.

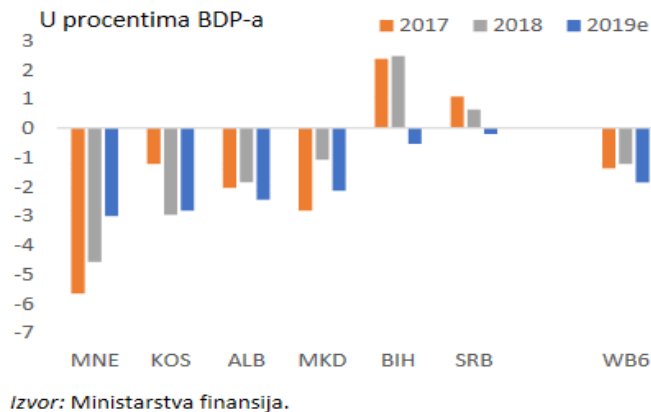
Many transitional countries have realized that fiscal policy is a powerful tool for attracting foreign investments. During the 1990s, countries in Central Europe used "tax holidays" and other fiscal incentives for this purpose. As a result, there was an increase in the volume and quantity of capital inflows, leading to economic growth in those countries and an increase in their competitiveness.

As taxpayers strive to reduce their tax liability to the lowest possible level, they have an interest in taking advantage of tax breaks offered through tax competition between countries. There is a conflict of interest for the state, on the one hand, to attract as many investments as possible (through lower tax burdens), and on the other hand, to collect as much revenue as possible to finance public functions (through higher tax burdens). Research conducted by Djankov et al. (2010) shows that taxes in non-OECD countries affect FDI flows, but they do not have a significant impact in OECD countries.

In recent years, economic growth and fiscal consolidation have contributed to the improvement of the fiscal position in Western Balkan countries. However, aggregate data conceal the existence of underlying sensitivity factors. After reaching high values of over 4% of GDP in 2013 and 2014, deficits since 2016 have not exceeded 2% due to fiscal consolidation measures taken by countries in this region. Nevertheless, expenditure structures have changed slowly, and countries with inflexible consumption patterns have little fiscal space for maneuvering.

Some countries, such as Bosnia and Herzegovina (BiH) and North Macedonia, have implemented consolidation measures by limiting capital expenditure. Despite fiscal consolidation efforts in all of these countries, expenditures for mandatory items such as wages in the public sector and pensions remain high. BiH and Montenegro spend relatively less on wages in the public sector compared to 28 EU member states or smaller EU member countries. Additionally, social benefits in BiH, North Macedonia, and Serbia are more generous than in smaller EU countries. All of this indicates that countries in the region have less flexible budgets and narrower room for maneuvering in times of crisis.

Picture 2. Fiscal balance of observed countries.



Furthermore, after two years of tightening fiscal policies, several countries in the Western Balkans have relaxed these measures, resulting in the depletion of funds that are now crucially needed. The deficit in this region increased by 1.8% in 2019, representing a 0.6% GDP increase compared to the previous year.

5. Effects of tax policy on external trade and balance of payments

Fiscal policy is the management of the national economy using fiscal policy tools. It involves adjusting government spending and taxation to influence the economy in desired directions. On the other hand, the balance of payments is the accounting record of financial transactions (receipts and payments) between the domestic economy and the rest of the world. These transactions include the import and export of goods and services, as well as the flow of capital and financial transfers. The main components of this account (balance of payments) include the current account and the capital account. Any imbalance between a country's income (exports, receipts of loans and investments) and payments (imports, foreign investments) can result in the country accumulating net foreign assets or liabilities in the case of a surplus or a decrease in reserves in the case of a deficit in the balance of payments.

A country's foreign reserves are crucial for its economic stability, and therefore, managing them is an important responsibility of any government. To achieve this goal, the national government has various tools at its disposal, including fiscal policy. By adjusting different fiscal policy instruments, the government is able to steer or influence the economy in the desired direction.

Most developing countries face the challenging task of fiscal management due to multi-year resource deficits resulting in high levels of borrowing and high interest rates on borrowed funds. This has led to a fiscal crisis exacerbated by weak institutions, spending and tax control, debt servicing, and unstable domestic capital flows (Talvi, Vegh, 2005; Blejer, Chu, 1989).

When considering fiscal policy in terms of competitiveness among countries in the region (BIH), it can be said that it is not the most significant factor for economic growth and attracting investments, especially in conditions of fiscal deficits and a global crisis. It is even increasingly perceived as a reflection of unfair competition under conditions of fiscal deficits and a global crisis. In comparison to neighboring countries, no level of government has excessively high tax burdens. The key cause of weak competitiveness should be sought in other factors. Tax policy can only provide limited contributions, mainly through simplifying administrative procedures to make them more favorable to foreign and domestic investors, and thus, be easily understandable and implementable.

6. Conclusion

Fiscal policy in modern business conditions is an important tool for stabilizing economic and social policies, and public revenues, expenditures, and public debt are powerful forms of government intervention. Tax systems reflect the effects of global trends in which many public goods have crossed national borders and become global, while national governments are facing increasing difficulties in financing their public needs. In practice, taxes are seen as a tool for achieving budget revenues, and

elasticity is expected from them, that is, the ability to quickly adapt to emerging changes in order to establish budget equilibrium. Tax elasticity is particularly important in conditions of economic growth, as it requires high government investments in infrastructure, and revenue growth ensures that such investments are not financed by foreign sources or domestic borrowing.

After the year 2000, the Republic of Serbia implemented significant reforms of its tax system, following the examples of tax systems in European Union countries, and similar policies were pursued by countries in the region. Tax competition has emerged among these countries, manifested through the reduction of tax rates on corporate profits and the provision of significant incentives to foreign investors, with the aim of attracting foreign capital and promoting faster economic development. It is necessary to ensure stable business conditions over a longer period of time, through the influx of foreign and domestic investments in sectors that can be drivers of sustainable growth and economic development.

The structure of the tax system provides stable and relatively high tax revenues that approximate the relative tax revenues in Europe, although tax rates are generally moderate or significantly lower than the European average. The reason for this lies in the structure of the economy, as Serbia is a net importer while most European countries are net exporters. It is estimated that the structure and creation of such a tax system in Serbia are relatively favorable from the perspective of stimulating economic growth, as the rates of the most distortionary taxes (profit tax and income tax) in Serbia are significantly lower than the European average, and there are also incentives for entrepreneurship and investment in innovation.

Literature

1. Atawodi, O.W. & Ojeka, S.A. (2012). Factors that affect tax compliance among small and medium enterprises (SMEs) in north central Nigeria. *International Journal of Business and Management*, 7(12), 87
2. Aghion, P.; Dewatripont, M.; Du, L.; Harrison, A.; Legros, P. Industrial policy and competition. *Natl. Bur. Econ. Res.* 2012
3. Blejer, M. I. and Chu, K. (1989). Fiscal Policy, Stabilization and Growth in Developing Countries.
4. Busom, I. An empirical evaluation of the effects of R&D subsidies. *Econ. Innov. New Technol.* 2000, 9, 111–148
5. International Monetary Fund (IMF). External Relations Publication Services, Washington DC
6. Gordon and Dawson (1987). Taxation and small scale businesses in Kampala
7. Klette, T.J.; Jarle, M. R&D investment responses to R&D Subsidies: A theoretical analysis and a micro-econometric study. *World Rev. Sci. Technol. Sustain. Dev.* 2012, 9, 169–203.
8. Lee, J.W. Government interventions and productivity growth in Korean manufacturing industries. *J. Econ. Growth* 1996, 1, 391–414.
9. Musgrave, S. (1984). *Public Finance Theory in practice*, Second edition, New York.
10. Максимовић, Љ., Бирчаковић, Р., Улога пореске конкурентности у јачању конкурентности Босне и Херцеговина, Школа бизниса бр.2/2013, UDC 336.221.4:339.137.2(497.6)
11. Mauro, P., & Villafuerte, M. (2013). Past fiscal adjustments: Lessons from failures and successes. *IMF Economic Review*, 61(2), 379-404.
12. Oludele, A.A., Emile, 2012. Regulation Awareness, compliance and SME performance in Cameroon's manufacturing and retail sectors", *international journal of social economics*, vol.39.
13. Petrović, P., Brčerević, D., & Minić, S. (2017). Fiscal consolidation and growth in Serbia, 2015-2017: Program, accomplishments and drivers. *Ekonomika preduzeća* 65(1-2), 43-66
14. Djankov, Simeon, Tim Ganser, Caralee McLiesh, Rita Ramalho, and Andrei Shleifer. 2010. "The Effect of Corporate Taxes on Investment and Entrepreneurship." *American Economic Journal: Macroeconomics* 2 (3): 31–64.
15. Talvi, E. and Vegh, C. A. (2005). 'Tax Base Variability and Procyclical Fiscal Policy in Developing Countries', *Journal of Development Economics*, Vol 78 No. 1 Page 156-190.
16. Veselinović, P., Dimitrijević, M., Kostić, M., , SIGNIFICANCE OF FISCAL POLICY FOR ECONOMIC DEVELOPMENT AND AGRICULTURE 358 <http://ea.bg.ac.rs> *Economics of Agriculture*, Year 66, No. 2, 2019,

17. Zhang, K.; Liu, X.L.; Fu, Z.R. Value added tax relief, enterprise tax burden, and innovation input: An analysis based on 2013-2015 survey Data. *Commer. Res.* 2017, 11, 39–45 (pp. 357-373), Belgrade

Internet sources:

1. TAXATION TRENDS IN WESTERN BALKANS, 2020
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3637612
2. REPUBLIKA SRBIJA FISKALNI SAVET (2019), Strateške preporuke za budžet i fiskalnu politiku u 2020 godini. Preuzeto sa sajta: http://www.fiskalnisavet.rs/doc/analize-stavovi-predlozi/2019/FS_%20Strateske_preporuke_za_budzet_i_fiskalnu_politiku_u_2020_%20godini.pdf
3. REPUBLIKA SRBIJA FISKALNI SAVET (2018) [http://www.fiskalnisavet.rs/doc/istrazivacki-radovi/FS%20radni%20dokument%20\(2018-01\).pdf](http://www.fiskalnisavet.rs/doc/istrazivacki-radovi/FS%20radni%20dokument%20(2018-01).pdf)
4. /Doing-Business-2020-Comparing Business-Regulation-in-190-Economies.pdf,
<https://documents1.worldbank.org/curated/en/688761571934946384/pdf>
5. The-Economic-and-Social-Impact-of-COVID-19-Fiscal-Policy.pdf
<https://documents1.worldbank.org/curated/en/342801591288854080/pdf>
6. IMPACT OF FISCAL POLICY ON THE CURRENT ACCOUNT OF THE BALANCE OF PAYMENT: A CASE OF KENYA 1973-2014. M. A RESEARCH PAPER BY GIDEON IMBUGI ALENGA http://erepository.uonbi.ac.ke/bitstream/handle/11295/98811/Alenga_Impact%20of%20Fiscal%20Policy%20on%20the%20Current%20Account%20of%20the%20Balance%20of%20Payment%20a%20Case%20of%20Kenya%201973-2014..pdf?sequence=1&isAllowed=y

Korišćenje otpada od rušenja u procesu proizvodnje polimernih betona

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Apstrakt: Procenat otpada koji nastaje aktivnostima rušenja je značajan. Štaviše, postoji mali deo ovog otpada koji se podvrgava procesu reciklaže. Sa izuzetkom čelika, većina materijala, kao što je drobljeni beton, obično se odlaze na divlje deponije, što je uobičajen problem u Srbiji. Istovremeno, važno je napomenuti da konvencionalni betoni, koji se u velikoj meri koriste u građevinskom sektoru, pokazuju nekoliko nedostataka. Implementacija revolucionarnih tehnologija u oblasti hemije ima potencijal da značajno transformiše pristupe trajnom odlaganju građevinskog otpada, a istovremeno proširi obim potencijalnih primena otpadnih materijala. Ovaj rad predstavlja sveobuhvatnu analizu literature kako bi ponudio novu perspektivu o izvodljivosti korišćenja otpada od rušenja u procesu proizvodnje polimernih betona, veoma obećavajućih materijala za podzemne konstrukcije, zbog njihovog hemijskog sastava i sposobnosti da obezbede efikasnu hidroizolaciju. Nalazi ove studije sugerišu da otpad od rušenja ima značajan potencijal kao održiva sirovina za proizvodnju polimer betona. Međutim, očigledno je da je dalji napredak u tehnologiji reciklaže neophodan da bi se povećala konkurentnost polimer betona dobijenih od otpada od rušenja u poređenju sa konvencionalnim betonima.

Ključne reči: izgradnja i rušenje, C&D otpad, cirkularna ekonomija, zelena hemija, upravljanje otpadom.

The Utilization of Demolition Waste in the Manufacturing Process of Polymer Concretes

Abstract: The proportion of waste generated by demolition activities is substantial. Furthermore, there is a minuscule fraction of this waste that undergoes the process of recycling. With the exception of steel, the majority of materials, such as crushed concrete, are typically disposed of in wild landfills, a common problem in Serbia. Simultaneously, it is noteworthy that conventional concretes, extensively utilized in the construction sector, exhibit several shortcomings. The implementation of breakthrough technologies in the field of chemistry has the potential to significantly transform the approaches to permanent disposal of construction waste while also broadening the scope of potential applications for waste materials. This paper presents a comprehensive literature analysis to offer a novel perspective on the feasibility of utilising demolition waste in the manufacturing process of polymer concretes, a highly promising materials for underground constructions. This is due to its chemical composition and ability to provide effective waterproofing. The findings of this study suggest that demolition waste possesses significant potential as a viable raw material for the manufacturing of polymer concrete. However, it is evident that further advancements in recycling technology are necessary to enhance the cost competitiveness of polymer concrete derived from demolition waste in comparison to conventional concrete.

Keywords: construction and demolish, C&D waste, circular economy, green chemistry, waste management.

1. Introduction

The process of economic growth has resulted in significant alterations to the environment by human society. The impact of human activities on the environment is increasingly evident and has been considerably amplified in the context of the scientific and technological revolution, as well as rapid technological advancements.

The changes resulting from the intensified development of key sectors such as energy and processing industry, chemical industry, oil refining, mining, and metallurgy pose significant environmental hazards. The process of agricultural intensification, together with the expansion of transportation infrastructure including roads, waterways, and air routes, also plays a significant role in the exacerbation of environmental pollution. Anthropogenic activities have resulted in the pollution of various environmental components, including air, water, land, and agricultural resources.

Annually, significant quantities of aerosols, exhaust gases, and soot are emitted into the atmosphere by industrial and transportation activities. Every year, an enormous quantity of wastewater, amounting to billions of tons, is released into aquatic bodies. In major industrial hubs, the concentration of aerosols and other air pollutants frequently surpasses the established thresholds, resulting in adverse effects on human health such as respiratory disorders and allergies. Pollutants originating from water and air sources undergo long-distance transportation through the circulation of water and air pathways, subsequently reaching the soil. These pollutants tend to accumulate in plants and propagate throughout the food chain. Nutrients are present inside the physiological systems of both humans and animals. Heavy metals are considered to be highly hazardous carcinogens. The contaminants primarily focus on both surface and groundwater sources, subsequently accumulating in the food chain and organisms of humans and animals.

In order to address the issue of environmental pollution, it is important to do thorough study on technogenic environmental alterations at all levels, analyze and monitor these changes, and assess their influence on diverse ecosystems and human populations. The topic of discussion pertains to the field of health. In order to enhance the efficiency of the interaction between human society and the environment, it is imperative to prioritize the preservation of nature and the sustainable utilization of raw material resources (Ugrinov, Markov & Nikolić, 2021). Additionally, it is crucial to actively transition production processes towards innovative waste-free circular production technologies, while also adopting renewable energy sources for energy conversion purposes (Pavlović, Nestić & Bošković, 2021).

The disposal techniques of building waste play a crucial role in the overall amount of waste generated (Luangcharoenrat, Intrachotoo, Peansupap et al., 2019; Latinović, Marjanović & Bajrović). This aspect holds particular importance (Park, Kim, Roh et al., 2020). The investigation of permanent disposal methods for construction waste and the complete eradication of waste through waste processing holds significance in its potential use across many manufacturing processes (Białko & Hoła, 2021). Contemporary waste management technologies contribute to the attainment of the green growth objectives outlined in the Green Agenda of the European Union, as well as the green economy advancement strategies within the Circular Economy in the Republic of Serbia. The use of innovative technologies in the field of Green Chemistry has the potential to significantly transform the approaches to permanent disposal of construction waste. Additionally, these advancements can broaden the scope of potential applications for waste materials, allowing them to be utilized as valuable resources in various industrial processes.

Simultaneously, it is noteworthy that classic concretes, which are extensively employed in the construction industry, possess several limitations including delayed hardening, inadequate tensile strength, the occurrence of cracks during the drying process, insufficient ductility, relatively high capillary porosity, and limited chemical resistance (Radonjanin, Malešev, Lukić & Milovanović, 2009). The majority of the faults described can be attributed to the inherent structural composition of traditional concrete. An endeavor to address the limitations of traditional concrete while enhancing its favorable characteristics involves investigating the potential for altering or modifying the internal composition of concrete through the application of polymers (Radonjanin et al., 2009). The evolution of polymer-concrete composites necessitated the integration of conventional cement concrete technology with novel polymer technology in the field of concrete. Consequently, following extensive

research conducted in numerous laboratories worldwide, a diverse array of novel polymer concrete composites has commenced practical implementation in various everyday applications. Conversely, within urban settings, the demolition of structures results in a substantial accumulation of aged concrete, hence presenting a conspicuous environmental challenge in terms of its extraction and disposal. Hence, the examination of the feasibility of substituting natural aggregate with recycled materials, such as aged concrete, ceramic fragments, grout, shattered glass, chopped wood waste, and other similar substances, has gained significant attention in recent years (Radonjanin et al., 2009).

2. Polymer concretes

Polymer concrete refers to a type of concrete in which the binding agent is derived from an organic polymer. Polymer concrete is a construction and structural substance. The substance in question can be described as a composite material consisting of a high-molecular compound combined with a mineral filler. Furanic, polyephyrhc, epoxy, phenol-formaldehyde, and kumaro-indene polyvinyl resins, as well as bitumen, are utilized as binding agents. Chargers commonly employed in many applications include quartz sand, granite, basalt shredded gravel, and construction trash. Polymeric elements incorporated into cement concrete result in a composite material known as polymer-cement or cement-polymer concrete. The polymer serves as a constituent that enhances the characteristics of concrete. Polymers are introduced into the concrete mixture through the utilization of water dispersions, such as latex and emulsions, or solutions, as discussed by Alhazmi et al. (2021). Water-soluble monomers are additionally employed, wherein they undergo polymerization subsequent to their incorporation into the concrete mixture. The polymer content in polymer-cement concrete varies between 1-3% and 15-20% of the mass of cement, depending on its intended application. The aqueous dispersions of polyvinyl acetate are commonly utilized. In contrast to traditional cement concretes, polymer concretes and polymer-cement concretes have enhanced tensile strength, reduced brittleness, and increased deformability. According to Alhazmi et al. (2021), these materials exhibit enhanced waterproofing properties, increased resistance to frost, improved durability against abrasions, and heightened resilience against the effects of corrosive liquids and gases. Polymer concretes and polymer-cement concretes are commonly employed in the construction of flooring systems within industrial facilities, garages, and hospitals. These materials are utilized in the production of high-quality coatings for roadways and airport runways, as well as in the restoration of deteriorated concrete surfaces and the remediation of fissures. Polymer-cement composites and polymer concretes containing fine aggregate are commonly employed for their waterproofing and protective properties, as well as their application as finishing products, coatings, and mastics. Thermal insulation plates can be made from polymer concretes that use lightweight fillers such as expanded clay or perlite sand. Polymer concretes are utilized in the production of unreinforced items featuring slender walls, as well as models representing various architectural structures. These rods are utilized in subterranean buildings and facilities, including as the manufacturing of mining cladding and sewage collectors, among others.

Concrete-polymer composites refer to materials that involve the substitution of a polymer and reinforcement cement-based binder for the traditional cement binder mixed with water in conventional mortar and concrete. The application of polymers in concrete technology can be categorized into three primary classifications: Polymer-Portland-Cement concrete, polymer-impregnated concrete, and polymer concrete capillary cavities. Polymer concrete exhibits favourable characteristics as a constituent blend for subterranean constructions due to its chemical composition and inherent impermeability. Although cement-bonded mortars are not capable of withstanding acidic solutions due to the effects of chlorine and sulphate, polymer-based plasters exhibit resilience and can be used as repair mortar or coating materials. Polymer concretes are characterized by their favourable water resistance and notable hydraulic capacity, which can be attributed to their inherent smoothness. The adhesive property of these materials holds utmost significance. Hence, in practical applications, polymer concretes are mostly employed for the purposes of repair and adhesion (Asdollah-Tabar, Heidari-Rarani & Aliha, 2021).

One notable aspect of polymer concrete is its ability to mitigate the occurrence of shrinkage fractures commonly observed in conventional cement concrete, owing to the absence of water during its production process. Polymer concretes exhibit the desirable characteristic of frost and chemical resistance, rendering them suitable for construction applications that necessitate robust resistance against chemical agents. One notable characteristic of polymer concrete is its relatively low weight relative to its ultimate bearing capacity. Polymer concretes, possessing superior bending strength compared to conventional concrete, are employed as an additive material in Portland cement concrete.

This application serves to mitigate surface erosion in concrete, and finds utility in various domains including structural and decorative construction panels, sewage pipes, underground tunnel equipment, drainage channels, carbon coating, steel pipes in geothermal applications, and structures such as swimming pools. A considerable body of research has been conducted to ascertain the properties of various polymer concrete materials (Tawfik & Eskander, 2006; Sosoi et al., 2018; Alhazmi et al., 2021; Asdollah-Tabar, Heidari-Rarani & Aliha, 2021). One notable benefit is the utilization of diverse aggregates in the manufacturing process of polymer concrete, including construction waste. This practice aligns with the principles of the circular economy, thereby potentially contributing to the sustainability of the construction sector (Alhazmi et al., 2021; Asdollah-Tabar, Heidari-Rarani & Aliha, 2021).

3. Construction and demolish waste in the process of polymer concrete manufacturing

According to Cheyne (2002), waste can be described as any substance resulting from human and industrial actions that lacks any remaining value. Based on several sources, it has been determined that construction and demolition operations (C&D) account for a substantial proportion, approximately 40%, of the overall share. When considering the demolition of buildings, it is noteworthy that a considerable proportion of construction debris comprises black metals, wood, paper, packing material, and fractured concrete. Therefore, by increasing the share of recycling of these materials in C&D activities, unnecessary waste would be reduced and significant effects could be achieved in terms of reducing the production of virgin materials. Hence, the use of circular economy principles and the thorough management and disposal of construction waste should be prioritized across a wide range of construction sites (Białko & Hoła, 2021). Once the structure of construction waste has been identified, along with its underlying causes, it becomes imperative to explore strategies for its mitigation. We suggest implementing a requirement for every construction company to develop a customized construction waste management strategy that aligns with their unique business practices. This will ensure that all personnel, from management to operational workers, are working collectively towards the objective of effectively managing construction trash.

Furthermore, alongside the implementation of several tactics, the role of reductions and economic considerations in construction waste management is of considerable importance. Numerous suggested approaches for recycling materials exist, the practical implementation of C&D waste recycling is still restricted to a narrow range of solid waste categories. When evaluating materials for recyclability, it is crucial to examine three primary factors (Mindess et al., 2003):

- economic implications,
- its compatibility with other materials,
- and its inherent qualities.

From a strictly economic perspective, the attractiveness of C&D waste recycling is contingent upon the competitiveness of the recovered product in relation to natural resources, namely in terms of price and quantity. In places characterized by a scarcity of raw materials and limited landfill capacity, the utilization of recycled materials is expected to exhibit more competitiveness. Conversely, in areas where an abundance of building materials is readily accessible, the elevated costs associated with recycling procedures, stemming from their inefficiencies, are likely to result in higher pricing. Hence, it is imperative to closely monitor the technological advancements in recycling construction waste, with particular emphasis on the techniques employed to incorporate these reclaimed elements into the manufacturing processes of building materials for subsequent construction cycles. The subsequent enumeration shows a compilation of materials that exhibit significant potential for the application of circularity principles through the research of recycling and reuse technologies in the manufacturing of building materials:

- asphalt,
- brick,
- concrete,
- black steel,
- glass,
- walls,
- colored metals,
- paper and cardboard,

- plastics, and
- wood.

3.1 Saw dust and polyethylene terephthalate (PET)

In the process of polymer concrete fabrication, several agricultural, municipal, and industrial types of wastes can be used as supplementary cementitious materials. However, they need to exert adequate physical and chemical properties in terms of their pozzolanic properties for potential use in sustainable concrete.

In an experimental study, Sosoi Barbuta, Serbanoiu, Babor & Burlacu, (2018) prepared a control mix of polymer concrete and two mixes of polymer concrete with aggregate substitution. They prepared the control mix of polymer concrete (CPC) with 12.4 percent of epoxy resin, 12.8 % of fly ash filler, and two sorts of natural river aggregates in concentration of 37.4% both:

1. sort I (0-4 mm), and
2. sort II (4-8 mm).

The authors used Romanian POLICOLOR S.A. product from Bucuresti, which is activated by a hardener type ROPOXID P401. The fly ash was from Electric Power Plant Holboca Iasi, used by several other authors in previous experimental studies by Barbuta, Taranu & Harja, (2009), and Barbuta, Harja & Babor (2010). The two mixes with wastes were prepared with the same dosage of epoxy resin, fly ash and sort 4-8 mm, only the sort 0-4 mm were replaced by saw dust and pulverized PET bottles. PET packaging is a material from which it is relatively “ungrateful” to extract useful production raw material by recycling (Latinović, 2018). In the first mix the aggregate sort 0-4 mm was replaced with saw dust in dosages of 25%, 50%, 75% and 100% by (Sosoi et al., 2018). In the second mix the aggregate sort 0-4 mm was replaced with chopped PET bottle in dosages of 25%, 50%, 75% and 100% by. For preparing concrete the aggregates, fly ash and waste were mixed together; the epoxy resin was combined with hardener and was introduced in the mix. The sample cubes of 70 mm size were poured, and demolded after 24 hours, according to the European standard EN 12390-3 2010 (EN, 2010). After fourteen days, the authors measured, weighed and tested samples to the compression. The density of hardened concrete mixes and compressive strengths were determined on three samples for each test, according to standard prescription (Sosoi et al., 2018). The density of hardened polymer concrete with aggregate substitution in both cases (with saw dust and pulverized PET packaging) was under 2000 kg/m³, indicating that a lightweight concrete and varied between 1919 and 1762 kg/m³ for the mix with saw dust and between 1948 and 1703 kg/m³ for the mix with pulverized PET, Fig. 1 (Sosoi et al., 2018). Except the first mix, all values of density of polymer concrete with PET were smaller than that of the polymer concrete with saw dust (Figure 1).

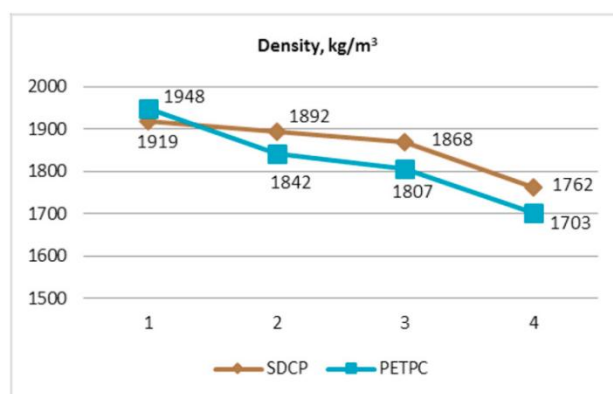


Figure 1. Variation of density for polymer concrete (Sosoi et al., 2018).

The density of both mixes with substitution were smaller than that of the control mix, which had a density of 2117 kg/m³. The authors also found out that the workability of fresh concrete increased with increasing PET concentrations (Sosoi et al., 2018). In the case of polymer concrete with saw dust, the workability was negatively correlated with the waste concentration (Sosoi et al., 2018). The highest value of compressive strength $f_c = 56.6$ MPa (Figure 2) was obtained for polymer concrete with saw dust substitution of aggregate (SDPC1), a value bigger than that of control mix with an increase of 18.1% (Sosoi et al., 2018).

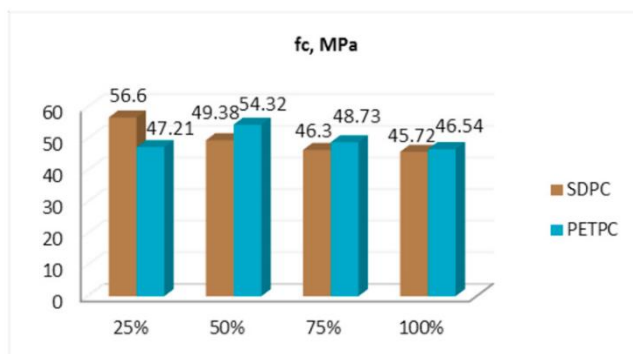


Figure 2. Variation of compressive strength of polymer concrete (Soso et al., 2018).

3.2 Styrenated polyester (SP), Marble waste and PET

Tawfik & Eskander (2006) prepared polymer concrete from using marble wastes, and also, pulverized PET bottles as fillers. The polymer concrete was synthesized by mixing 12 wt% SP resin with 88 wt% filler. The high filler content, as authors noted, is important from an economic point of view, in order to improve the final properties and dimensional stability of the obtained materials (Tawfik & Eskander, 2006). The authors prepared polymer concrete and subjected cured casts to physical, mechanical, and chemical evaluations. Figure 3 shows the effect of changing basalt (mesh size 0.5–1.0 cm): marble powder (≥ 0.1 cm) ratio on the compressive strength with casting under pressure at 300 kg/cm^2 .

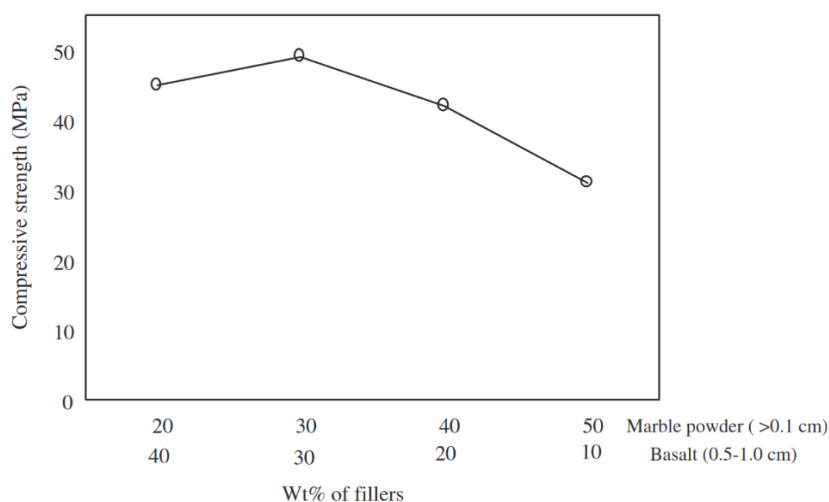


Figure 3. The effect of changing marble powder ratio on the compressive strength of polymer concrete under casting pressure 300 kg/cm^2 and constant marble ratio (Tawfik & Eskander, 2006)

The authors' findings indicated that the specimen, comprising 30 wt% basalt and 30 wt% marble powder, exhibited enhanced compressive strength under a pressure of 300 kg/cm^2 . The researchers also discovered that subjecting the polymer concrete to pressure during the casting process resulted in a noticeable improvement in the compressive strength of the resulting products. According to Tawfik and Eskander (2006), it is posited that the observed phenomenon can be ascribed to the influence of applied pressure on the expulsion of voids amidst the filler particles within the casted polymer concrete, resulting in enhanced compaction and rigidity of the blocks. However, authors also noted that increasing the applied pressure from 300 to 900 kg/cm^2 corresponded with slight changes in the compressive strength values of the casted polymer concrete. The mechanical properties for various polyester-filler composites depended on the type and amount of filler and also on the particle size of the filler used (Tawfik & Eskander, 2006). Finally, the authors concluded that a fast cured polymer concrete, with acceptable physical properties, good mechanical integrity, enhanced chemical characterization, and providing better heat and flame resistance, can be synthesized from the recycled PET soft drink bottles and marble waste materials. The production of the polymer concrete mentioned can be developed for semi-industrial and industrial scales for its economic advantages, as well as environmental benefits where its main raw materials are wastes.

3.3 Coarse Recycled Aggregates

Coarse Recycled Aggregates (CRA) are composed of several constituents and this is a natural consequence of the different types of waste present in construction & demolish waste (CDW). The European Standard EN 933-11 defines the following constituents of CRA (EN 933-11):

- Ru—unbound stone (in fact, natural aggregates);
- Rc—concrete and mortar;
- Rb—clay masonry, calcium-silicate masonry, aerated non-floating concrete;
- Ra—bituminous materials;
- Rg—glass;
- X—other materials (clay, soils, metals, non-floating wood, plastic, gypsum-based and rubber);
- FL—floating materials.

The components exhibit distinct qualities, and their appropriateness as aggregates for concrete varies. According to Silva, de Brito, and Dhir (2014), there is a positive correlation between the adequacy of a concrete recycling aggregate (CRA) and its water absorption and density. Specifically, a lower water absorption and higher density are indicative of a more suitable CRA for concrete applications. Ruthenium (Ru), which can be seen as a non-applicable (NA) element in practical contexts, is the most suitable component, followed by Rhodium (Rc) and Rubidium (Rb). It is advisable to exercise caution when considering the inclusion of other constituents, as standards and national specifications restrict the utilization of CRA based on constituent properties (Pacheco & de Brito, 2021). In general, it is ideal for CRA to possess a substantial number of constituents belonging to the categories of Ru and Rc. The primary rationale for favouring the use of crushed recycled aggregates (CRA) over fine recycled aggregates (FRA) is due to the presence of unwanted constituents in FRA, such as type X contents and disaggregated mortar, which are specific poor-quality constituents found in types Rc and Rb. According to Bravo, de Brito, Pontes, and Evangelista (2015), a comparison between CRA and FRA from the same source reveals notable disparities, indicating that CRA is a superior aggregate. As stated by Pacheco and de Brito (2021), the utilization of FRA is subject to more rigorous requirements and guidelines compared to the utilization of CRA.

To ensure that the CRA are of sufficient quality to be used in concrete, the production process includes preliminary separation and RA may be produced from two types of CDW (Pacheco & de Brito, 2021):

- Mixed CDW, which is achieved by removal of most unintended materials (e.g., wood, large plastics, soils);
- Concrete waste, since this type of waste is of good quality (mainly constituents of the type Ru and Rc, with a small content of contaminants since preliminary sorting is not perfect).
- Based on their results, Sáez del Bosque et al. (2017) argued that the production of good-quality CRA for concrete requires that the content of wood, plastic, glass and asphalt waste is as low as possible. This is achieved through preliminary sorting and removal of deleterious materials during the production of the CRA (Pacheco & de Brito, 2021). The typical composition of CRA produced with mixed CDW is as follows (Agrela et al., 2011):
- Content of Rc plus Ru of about 65% to 85%;
- Content of Rb in the region of 10% to 35%;
- Content of Rg and Ra between 0% and 2%, but in specific cases of up to 10%;
- Content of X below 2%.

Conversely, the contents of some types of CDW, namely, those that have commercial value (metals) and those that impair the properties of concrete the most (e.g., gypsum-based), are greatly reduced (Pacheco & de Brito, 2021). This is relevant because:

- Most properties of concrete are detrimentally affected by ceramics (Paine & Dhir, 2010). Ceramics are porous and weak and their presence decreases the aggregate crushing value of the CRA and results in larger number of trans-aggregate fractures in the mechanical failure mechanisms of concrete (Pacheco & de Brito, 2021).
- Clay has different detrimental effects. Fine particles of clay may cover the particles of CRA, weakening the bond between the aggregate and the cement paste. Furthermore, since these particles are smaller than those of cement, they may also adsorb to the cement particles, impairing a regular and homogeneous crystallization of the cement hydrates (Angjuseva,

Ducman, Fidancevska & Jovanov, 2021; Pacheco & de Brito, 2021). Other detrimental effects are due to their large water absorption, which may compromise workability if unaccounted for, and the possible influence on the setting and hardening of concrete. Clay may be present as agglomerated lumps of relatively large dimension (including within the coarse aggregate size range), especially when moist. These large clay particles tend to disaggregate during handling, transport and mixing (Pacheco & de Brito, 2021).

- Gypsum-based materials, including plasters, may induce sulphate reactions that influence setting and, most importantly, these materials can lead to sulphate attack of hardened concrete, resulting in expansion, cracking and spalling (Pacheco & de Brito, 2021).
- Glass and plastics bond poorly with the binder and metallic constituents are prone to corrosion. These types of constituents are typically poorly shaped for concrete (too flaky and/or elongated) (Pacheco & de Brito, 2021).

The specificities of the constituents of CRA, as Pacheco & de Brito (2021) argue, mean that, in comparison to NA (raw stone), CRA are weaker, more deformable, more porous and lighter, and have larger water absorption.

3.3.1 Processing of CDW into Recycled Aggregates

According to Silva, de Brito, and Dhir (2017), the effectiveness of a concrete recycling aggregate (CRA) is contingent upon the utilization of appropriate equipment and techniques during its production. There are several combinations of equipment and processes that are accessible for use. This section aims to provide a summary of these processes and their respective relevance. In addition to the imperative of waste removal, the manufacturing process of CRA bears substantial resemblance to that of NA. It involves the transportation of voluminous materials, followed by their crushing and subsequent screening based on size (Pacheco & de Brito, 2021). Furthermore, according to Pacheco and de Brito (2021), it is imperative for the production process to prioritize the manufacture of high-quality CRA that adhere to the necessary standards and specifications. According to the authors' proposition, it is recommended that CDW be transported to a licensed CDW facility via truck, where a first inspection and acceptance of the load should be conducted. According to their assertion, this inspection shall verify the compliance of CDW with the reported composition before to accepting the load at the CDW factory. The composition of construction and demolition waste (CDW) that is supplied is contingent upon the level of effort exerted at the construction or demolition site in terms of segregating various waste categories (Pacheco & de Brito, 2021). The cost of delivering loads of mixed construction and demolition waste (CDW) is higher compared to delivering different types of CDW, in order to encourage segregation by the contractor. In addition, it is recommended that contractors who fail to comply with the specified CDW type and/or regulatory obligations be prohibited from accessing the CDW facility. After acceptance of the load, CDW should be either:

- Immediately sent for processing into RA, whenever CDW is delivered with low contamination of unintended constituents; or
- Undergo preliminary removal of unintended constituents and sorting whenever a significant portion of such wastes is included. Figure 4 shows different types of construction and demolish waste. Only the fraction labelled as „CDW-suitable“ should be used to produce RA. This may be either mixed CDW or only concrete waste. The removal of unintended constituents is fundamental in order to ensure that the RA behave satisfactorily (Pacheco & de Brito, 2021).



Figure 4. Separation of CDW by type (a) CDW requiring separation (b) Ongoing separation (c) Wood waste (d) Plasterboard waste (e) CDW—suitable (Pacheco & de Brito, 2021).

4. Conclusion

The utilization of construction industry waste, including sawdust, crushed concrete waste resulting from demolition, broken glass, and other similar materials, has the potential to be employed as fillers in the production of polymer concrete. However, it is necessary to conduct further research in order to develop polymer concretes that are suitable for the specific use, as these ingredients alter the properties of polymer concrete. In addition, it is worth noting that recycling processes can exhibit inefficiencies, resulting in recycled aggregates being priced higher than their virgin raw material counterparts. The following points must be addressed in order to attain sustainability in the management of building waste within the framework of a circular economy. However, if this objective were to be attained, significant beneficial impacts would be exerted on both the environment and the economy. By using this approach, the objective of the circular economy can be realized, wherein trash is utilized as a valuable resource. Furthermore, this approach facilitates the creation of polymer concrete, a sophisticated material much sought after for constructing architectural structures. Simultaneously, the use of this approach would result in a decrease in spatial pressure exerted by voluminous building trash on landfills. Ultimately, the utilization of construction waste has the potential to decrease the expenses associated with the production of polymer concrete and enhance the market competitiveness of polymer concrete manufacturers.

Literature

1. Alhazmi, H., Shah, S. A. R., Anwar, M. K., Raza, A., Ullah, M. K., & Iqbal, F. (2021). Utilization of polymer concrete composites for a circular economy: A comparative review for assessment of recycling and waste utilization. *Polymers*, 13(13). <https://doi.org/10.3390/polym13132135>
2. Agrela, F., Sánchez De Juan, M., Ayuso, J., Galdes, V. L., & Jiménez, J. R. (2011). Limiting properties in the characterisation of mixed recycled aggregates for use in the manufacture of concrete. *Construction and Building Materials*, 25(10). <https://doi.org/10.1016/j.conbuildmat.2011.04.027>
3. Asdollah-Tabar, M., Heidari-Rarani, M., & Aliha, M. R. M. (2021). The effect of recycled PET bottles on the fracture toughness of polymer concrete. *Composites Communications*, 25. <https://doi.org/10.1016/j.coco.2021.100684>
4. Angjusheva, B., Ducman, V., Fidancevska, M., & Jovanov, V. (2021). Optimizing Process Parameters of Clay-Based Ceramics with Addition of Construction and Demolition Waste. *Advanced Technologies*, 10(2), 61-65. <https://doi.org/10.5937/savteh2102061A>
5. Barbuta, M., Harja, M., & Babor, D. (2010). Polymer concrete with fly ash. Morphologic analysis based on scanning electron microscopic observation. *Revista Romana de Materiale*, 40(1), 337-345.
6. Barbuta, M., Taranu, N., & Harja, M. (2009). Wastes used in obtaining polymer composite. *Environmental Engineering and Management Journal*, 8(5), 1145-1150.
7. Białko, M., & Hoła, B. (2021). Identification of methods of reducing construction waste in construction enterprises based on surveys. *Sustainability (Switzerland)*, 13(17). <https://doi.org/10.3390/su13179888>
8. Bravo, M., de Brito, J., Pontes, J., & Evangelista, L. (2015). Mechanical performance of concrete made with aggregates from construction and demolition waste recycling plants. *Journal of Cleaner Production*, 99. <https://doi.org/10.1016/j.jclepro.2015.03.012>
9. Chandel, S. K., Goyal, R., & Singla, S. (2019). Utilization of construction waste as partial replacement of aggregates in cement concrete. *International Journal of Innovative Technology and Exploring Engineering*, 8(9 Special Issue). <https://doi.org/10.35940/ijitee.I1165.0789S19>
10. Cheyne, I. (2002). The definition of waste in EC law. *Journal of Environmental Law*, 14(1). <https://doi.org/10.1093/jel/14.1.61>
11. EN 12390-3:2010, Testing hardened concrete. Part 3: Compressive strength of test specimens
12. EN-933-11. Tests for Geometrical Properties of Aggregates. Classification Test. for the Constituents of Coarse Recycled Aggregate; CEN: Brussels, Belgium, 2009.
13. Latinović, L. (2018). A New Recycling Paradigm - an Innovative Approach to the Plastic Waste Recycling in Serbia. *Serbian Journal of Engineering Management*, 3(2), 1-12. <https://doi.org/10.5937/SJEM1802001L>
14. Latinović, L., Marjanović, M., & Bajrović, H. (2023). Informal Recycling Sector in Serbia through a Health Perspective. *Serbian Journal of Engineering Management*, 8(1), 14-22. <https://doi.org/10.5937/SJEM2301014L>

15. Luangcharoenrat, C., Intrachooto, S., Peansupap, V., & Sutthinarakorn, W. (2019). Factors influencing construction waste generation in building construction: Thailand's perspective. *Sustainability (Switzerland)*, 11(13). <https://doi.org/10.3390/su11133638>
16. Osmani, M. (2011). *Construction Waste*. *Waste*, 207–218. doi:10.1016/b978-0-12-381475-3.1
17. Pacheco, J., & de Brito, J. (2021). Recycled aggregates produced from construction and demolition waste for structural concrete: Constituents, properties and production. *Materials*, 14(19). <https://doi.org/10.3390/ma14195748>
18. Paine, K. A., & Dhir, R. K. (2010). Recycled aggregates in concrete: A performance-related approach. *Magazine of Concrete Research*, 62(7). <https://doi.org/10.1680/macr.2010.62.7.519>
19. Park, W. J., Kim, R., Roh, S., & Ban, H. (2020). Identifying the major construction wastes in the building construction phase based on life cycle assessments. *Sustainability (Switzerland)*, 12(19). <https://doi.org/10.3390/su12198096>
20. Pavlović, A., Nestić, S., & Bošković, G. (2021). Circular economy management in business organizations using digital technologies. *Serbian Journal of Engineering Management*, 6(1), 22–29. <https://doi.org/10.5937/SJEM2101022P>
21. Radonjanin, V., Malešev, M., Lukić, I., & Milovanović, V. (2009). Polimer-betonski kompoziti na bazi recikliranog agregata. *Materijali i konstrukcije*, 52(1), 91–107.
22. Sáez del Bosque, I. F., Zhu, W., Howind, T., Matías, A., Sánchez de Rojas, M. I., & Medina, C. (2017). Properties of interfacial transition zones (ITZs) in concrete containing recycled mixed aggregate. *Cement and Concrete Composites*, 81. <https://doi.org/10.1016/j.cemconcomp.2017.04.011>
23. Saribiyik, M., Piskin, A., & Saribiyik, A. (2013). *The effects of waste glass powder usage on polymer concrete properties*. *Construction and Building Materials*, 47, 840–844. doi:10.1016/j.conbuildmat.2013
24. Silva, R. v., de Brito, J., & Dhir, R. K. (2014). Properties and composition of recycled aggregates from construction and demolition waste suitable for concrete production. *Construction and Building Materials*, 65. <https://doi.org/10.1016/j.conbuildmat.2014.04.117>
25. Silva, R. v., de Brito, J., & Dhir, R. K. (2017). Availability and processing of recycled aggregates within the construction and demolition supply chain: A review. In *Journal of Cleaner Production* (Vol. 143). <https://doi.org/10.1016/j.jclepro.2016.12.070>
26. Sosoi, G., Barbuta, M., Serbanoiu, A. A., Babor, D., & Burlacu, A. (2018). *Wastes as aggregate substitution in polymer concrete*. *Procedia Manufacturing*, 22, 347–351. doi:10.1016/j.promfg.2018.03.052
27. Tam, V. W. Y., & Tam, C. M. (2006). *A review on the viable technology for construction waste recycling*. *Resources, Conservation and Recycling*, 47(3), 209–221. doi:10.1016/j.resconrec.2005.1
28. Tawfik, M. E., & Eskander, S. B. (2006). Polymer Concrete from Marble Wastes and Recycled Polyethylene terephthalate. *Journal of Elastomers & Plastics*, 38(1), 65–79. doi:10.1177/0095244306055569
29. Ugrinov, D., Markov, M., & Nikolić, M. (2021). Small-town Sustainable Development Opportunities. *Serbian Journal of Engineering Management*, 6(2), 32–42. <https://doi.org/10.5937/SJEM2102032U>

Evropska unija i Japan: spoljno-trgovinske relacije i transfer japanske biznis prakse u evropskom biznis okruženju

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Apstrakt: Evropsko tržište predstavlja jedno od najatraktivnijih tržišta inostranih investicija. Prisustvo japanskih direktnih investicija, kao i velikog broja japanskih kompanija koje koegzistiraju sa evropskim kompanijama ukazuje na međusobne uticaje različitih menadžment filozofija u evropskom biznis okruženju. Rezultati istraživanja u radu ukazuju na identifikaciju oblasti u kojima je sa uspehom izvršen transfer japanske biznis prakse na evropskom tržištu. Istovremeno analiza kompanijski i poslovno specifične biznis prakse i kulturno zavisnih menadžment filozofija u radu identifikuju ključne parametre otežanog transfera japanske poslovne filozofije u evropskom biznis okruženju što predstavlja i osnov za dalja istraživanja u ovoj oblasti.

Ključne reči: menadžment, biznis, transfer biznis prakse, okruženje, relacije

The European Union and Japan: Foreign Trade Relations and the Transfer of Japanese Business Practices in the European Business Environment

Abstract: The European market is one of the most attractive markets for foreign investments. The presence of Japanese direct investments, as well as a large number of Japanese companies that coexist with European companies, indicates the mutual influence of different management philosophies in the European business environment. The results of the research in the paper indicate the identification of areas in which the transfer of Japanese business practices on the European market has been successfully carried out. At the same time, the analysis of company- and business-specific business practices and culturally dependent management philosophies in the work identify the key parameters of the difficult transfer of Japanese business philosophy in the European business environment, which is also the basis for further research in this area.

Key words: management, business, transfer of business practices, environment, relations

1. Introduction

The European market is one of the most attractive markets in international business. The presence of Japanese investments, as well as a large number of Japanese companies that coexist with European companies, indicate the mutual influence of different management philosophies on the European business scene. Acknowledging the differences between Japanese and European management styles, as well as a comparative analysis of the impact of Japanese management philosophy in the European business environment, points to the perspectives of the development of the European business environment.

The researches of Pascal and Athos, together with those of Ohmae and Ouchi, represent one of the most comprehensive studies that analyzed the characteristics and impacts of the Japanese management model as an alternative to the dominant Western model (Ohmae, 2003). According to them, the best companies are characterized by harmony among the elements of the "7 S" model. The similarity is expressed in the way they manage strategy, structure and systems, but they differ in the way they manage the remaining components: capabilities, style, professional staff and subordinate goals. The Japanese value interdependence as a relationship modality, individuals are considered an obstacle to development, individuals define their identity in the group they belong to.

Western society values independence and attaches importance to the individual. These authors quote T. Fujisawa (co-founder of Honda) who says that he advocates the view that management in Japan and management in the West are 95 percent similar and completely different in the remaining 5 percent, the essential 5 percent (Pascal, Athos, 2003).

These differences are also commented on in other researches. The Western system is identified with "professional management" and is based on strategic planning. In contrast, in Japanese companies, priority is given to on-the-job training and is based on the definition of a long-term strategic goal and the careful implementation of the strategy (Hamel, Prahalad, 2010).

Abegglen and Stark used a radically different perspective in their study of Japanese corporations. They advocate the view that "people power strategy" and not management style make Japanese management the one that sets the pace. Japanese companies tend toward "developmental management" that involves the expectation of continuous development while decisions and planning are formulated to lead to development (Abegglen, Stark, 1990).

Lester Thurow confirms this key difference in business logic: for the European and generally Western systems, the ultimate goal is profit and strengthening the company, while for the Japanese, profit means creating an empire and strengthening their company. This means that these two systems are fundamentally different: European society is oriented towards consumption and the interests of the owners, while Japanese society is oriented towards savings and investments. There are also significant differences between the roles played by governments in these two systems. The European system is characterized by liberalism. The Japanese government participates in the development of national industrial strategies by indirectly protecting domestic industries. The Japanese government never fully disbanded the "zaibatsu" so that the conglomerates remained, developed in the form of "keiretsu" (Thurow, 2005).

The comparative analysis of the European and Japanese management systems enabled a broader comparison of the "Anglo-Saxon individualistic form (Great Britain and the USA) and the "group model of management" (Japan and Germany). In this sense, Michel Albert distinguishes between "Capitalisme Anglo-Saxon" and "Capitalisme Rhenan". According to this author, Great Britain and the USA have a common paradigm: liberalism, orientation towards profit, dominance of finance over industry, orientation towards shareholders, individualism, and greater mobility of personnel. Germany and Japan have similar paradigms: organized competitive power, long-term orientation, large investments, stable capital structure, loyalty to the company (Albert, 1998). However, in addition to the similarities, some non-existences also appear. German companies definitely belong to the western circle in which the individual dominates the working relationship, the German manager is a specialist, while the Japanese manager is a generalist. The German market economy and the relationship between top management and labor unions are fundamentally different from the Japanese model. Finally, both systems are characterized by a group decision-making model, but in Japan it is the result of a neutral consensus, while in German companies it is through a system of internal negotiations and co-determination (Zečević, Nedeljković, 2014).

When such contrasts between these two management systems are taken into account, it is clear that the five percent difference mentioned by Fujisawa is essential. However, these findings indirectly indicate that within Europe there are characteristics that make the European management system specific in relation to the Japanese one, but at the same time point to mutual interpenetration and influences of these two management systems.

2. Business and foreign trade relations between the European Union and Japan

The large increase in direct investments and the presence of Japanese companies in Europe represents a specific challenge for the European business environment - at the same time a "threat" and an "opportunity". The threat is through direct competition and the presence of Japanese companies on the European market, and the opportunity of the crisis is the creation of jobs where Japanese production units are located (Zečević, Nedeljković, 2014).

For the European Union, Japan is the second largest trading partner in Asia, after China. At the same time, Japan is the seventh largest partner for the European Union in the export and import of goods. Also, the European Union and Japan together account for a quarter of the world's GDP. Imports from Japan to the EU are dominated by machinery, engines, chemical products, optical and medical instruments and plastics. EU exports to Japan are dominated by chemical products, engines, food and beverages. Traditional trade relations between Japan and the EU are characterized by a larger surplus in favor of Japan. In the period from 2009 to 2021, the EU's trade deficit with Japan will increase from 18 billion euros to 82 million. At the same time, the export and import from Japan in the period 2009-2021 increased. EU exports to Japan reached the highest level in 2021 (62.4 billion), and the lowest in 2009 (32 billion euros). EU imports from Japan were the highest in 2019 (63 billion euros), and the lowest in 2013 (40 billion euros) (European Commission, Directorate-General for Trade, 2023).

In order to support and improve business relations, several agreements were concluded between Japan and the EU: Economic Partnership Agreement, 2019, Strategic Partnership Agreement, 2019, EU-Japan Mutual Recognition Agreement, 2002, Agreement on Co-operation on Anti-competitive Activities, 2003, Science and Technology Agreement, 2009.

Table 1. Japan and the EU in world trade-export

Country	In billion EUR	Percentage
China	2.268	18,0
EU	1.933	15,4
USA	1.253	10,0
Japan	561	4,5
Hong Kong	480	3,8
others		48,3

Source: Eurostat, 2022.

Table 2. Japan and the EU in world trade - imports

Country	In billion EUR	Percentage
USA	2.108	16,4
China	1.801	14,0
EU	1.717	13,4
Japan	556	4,3
Great Britain	556	4,3
others		47,5

Source: Eurostat, 2022.

Tables 1 and 2 show the world's largest importers and exporters. Japan, with 561 billion euros or 4.5%, is the fourth largest exporter in the world. In front of him are China (with 2,268 billion euros or 18%), the EU with 1,933 euros or 15.4% and the United States with 1,253 billion or 10%. Also, Japan was the fourth largest importer in the world, with 556 billion or 4.3%, followed by the United States with 16.4%, China with 14% and the European Union with 1,717 billion euros or 13.4%. These data indicate that the EU and Japan represent the world's key markets in international business and foreign trade.

Table 3. The largest export partners of the EU

Country	Percentage %
USA	18,3
Great Britain	13,0
China	10,2
Swiss	7,2
Turkey	3,6
Japan	2,9
Norway	2,6

Source: Eurostat, 2022.

Table 4. The largest import partners of the EU

Country	Percentage %
China	22,4
USA	11
Russia	7,5
Great Britain	6,9
Norway	3,5
Japan	3,0
South Korea	2,6

Source: Eurostat, 2022.

The data indicate that the European Union's exports to Japan and imports from Japan increased in the period from 2011 to 2021. The position of Japan among the most important trade partners of the European Union can be analyzed based on the data from tables 3 and 4. The four largest export partners of the EU were the United States with 18.3%, Great Britain with 13%, China with 10.2% and Switzerland with 7.2%. The four largest import partners of the European Union were China (22.4%), the United States (11%), Russia (7.5%) and Great Britain (6.9%). These data show that Japan is the seventh largest export partner of the EU with 2.9% (62 billion euros). In terms of imports, Japan ranks sixth among the EU's largest partners (3%), between Norway and South Korea. This shows that Japan represents one of the ten most important trading partners of the EU and further improvement of trade relations between these two markets.

Table 5. Trade balance (surplus-deficit) between EU countries and Japan

EU countries	Saldo Eur million
Italy	3.100
Denmark	1.726
Ireland	1.702
Sweden	1.382
Finland	1.352
Germany	1.191
France	724
Spain	638
Austria	509
Greece	80
Malta	74
Slovakia	72
Latvia	51
Estonia	42
Croatia	4
Romania	1
Lithuania	-10
Slovenia	-27

Cyprus	-92
Bulgaria	-152
Luxemburg	-283
Portugal	-305
Czechia	-809
Hungary	-852
Poland	-1.497
Belgium	-1.679
Netherlands	-6.930

Source: Eurostat, 2022.

The trade balance between the EU member states and Japan is shown in Table 5. These data show that 16 EU member states had a trade surplus with Japan. Italy had the largest surplus with Japan (EUR 3,100 million), followed by Denmark (EUR 1,726 million) and Ireland (EUR 1,702 million). A significant share of exports to the Japanese market was achieved by Sweden, Finland, Germany and France. At the same time, a significant number of eleven EU member states had a trade deficit with Japan. The Netherlands (6,930 million euros), Belgium (1,679 million euros) and Poland (1,497 million euros) had the largest deficit. It is also important to point out that the three largest exporters to Japan were Germany (18,515 million euros), Belgium (7,629 million euros) and Italy (7,555 million euros). With 10.8%, Malta had the largest share of Japan in exports outside the EU. On the other hand, the three largest importers from Japan are Germany (EUR 17,323 million), the Netherlands (EUR 11,248 million) and Belgium (EUR 9,308 million). Luxembourg had the highest share of Japan in non-EU imports (15.4%) (Eurostat, 2022). These data indicate a further increase in the volume of foreign trade exchange between Japan and the European Union and a gradual equalization of import and export relations.

3. Transfer of Japanese business practices in the European business environment

In considering the influence of Japanese management philosophy, the main question is related to the behavior of Japanese companies on the European business scene: do they conduct their operations as "insiders" trying to adapt their operations to European business practices, or have they taken positions within the European market with the aim of transferring their own management model.

Most of the business operations of Japanese companies in Europe are of recent date and their adaptation to the local way of doing business has not yet been fully achieved. The main reason for this is the problem of transferring the methods and techniques of the Japanese management system to Europe. On the one hand, in the domain of production (organization and quality), the transfer of Japanese business practices in Europe was successfully achieved. On the other hand, in the domains of decision-making, leadership, communications and human resource management, cultural and social differences increase the complexity of Japanese companies' operations in Europe. Several limiting factors can be singled out here.

First, key managerial positions in branches of Japanese companies in Europe are mostly occupied by Japanese people, who have not yet adopted local cultural and social customs. Japanese companies do not recruit top and higher levels of managers from the country where the branch is opened, due to the possibility of losing control in the process of making and implementing decisions and creating difficult communication between the branch and the directorate.

Second, the existence of a cultural gap between Japan and Europe that greatly affects the conduct of business operations. Because of their "long-term isolation", the Japanese shaped original principles in the process of making and implementing decisions. They can be described as follows: collective spirit, introversion, consensus, precision, group responsibility. These characteristics are opposite to most characteristics in the European management system: individualism, extroversion, approximation, acceptance of different options, control focused on the individual (Sachwald, 2016).

In contrast to European companies where decision-makers are top managers, in Japanese companies the decision-making center is at the level of middle managers ("Kacho" - heads of departments). In the Japanese management system, middle managers initiate and develop projects. The first stage in this

process involves intensive communication of middle managers with heads of departments and lower hierarchical levels of the company's management. It aims to carry out the necessary consultations and test the idea. This phase is referred to as "Nemawashi" – consensus building process). In the second stage, middle managers consult the higher hierarchical levels to which they report. This phase is referred to as "Ringisho". The third stage involves obtaining the consent of the top management and after that the "ringisho" goes back to the middle level management who initiated the project and the implementation can begin (Lincoln J., Kerbo H., Wittenhagen E., 1995) (Naoki, 2013).

In European companies, similar processes of "nemawashiu" (system of co-determination in the German system or in the Scandinavian countries) may appear. However, in European business practice, the system of communication and information flow is limited, a smaller number of people are involved in the decision-making process (and these are rarely lower hierarchical structures).

One of the frequent challenges that European managers face in the European business environment is vertical organization. In European companies, each department is considered relatively "autonomous". Communication between departments is weak and no employee can "intervene" outside the department. Communication between departments in Japanese companies is much more direct. The flow of information is free both within and between the company's departments. In Japan, information is a common good, while information in the European business environment is an asset owned by a company department.

Cultural differences between the Japanese management system and management in Europe have influenced the management of Japanese companies to limit or slow down the transfer of their domestic management practices in their operations in the European business environment.

Table 6. Transfer of Japanese management practices in Japanese companies in Europe

Characteristics	Japanese companies in Europe incorporating Japanese business practices
„just in time“	10,09 %
Lifetime employment	14,90 %
On-the-job training	69,90 %
Slow career progression	4,60 %
Daily meeting	36,20 %
Work uniforms	56,90 %

Source: JETRO Japanese External Trade Organization, 2020

The data from Table 6 shows some of the results of the study conducted by JETRO (Japanese External Trade Organization, 2020) which shows and confirms certain previously stated dilemmas. It is noticeable that the highest index in the transfer of Japanese business practice was achieved in the field of on-the-job training, and the lowest in the specific Japanese policy of slow career advancement. Also, lower indices are present in the "just in time" and "lifetime employment" categories. This speaks in support of the already stated position about expressed individualism, greater mobility; more pronounced orientation towards profit in the European management system, as opposed to the collective spirit, consensus and group responsibility in Japanese business practice.

Among the Japanese multinational companies that conduct their operations in Europe, Sony has become a pioneer among Japanese companies that have an organizational structure in which "global integration" and "local responsibility" are harmoniously applied. The company's headquarters is located in Germany, and two production branches are located in Great Britain and France. A "Frenchman" was appointed as the president of the Sony France branch, which was a rare practice of Japanese companies to appoint staff from the host country at the top level of their branches, and the directors of the three production plants were also French. Only 12% of the 2000 employees were Japanese (technicians and one executive director). Responsibility for making and implementing decisions is delegated to managers from the host country. The directorate of Sony in Japan retained the right to make decisions in the area of defining goals and determining strategy (Zečević, Nedeljković, 2014). Sony's management has put into practice such a model that integrates the positive aspects of Japanese and European corporate culture with the aim of preventing different interpretations of the decisions made.

In this way, other Japanese companies, such as Sony, from the former "outsider" approach, began to implement the "insider" approach in the European business environment.

Japanese companies incorporated only a part of their management practices (in the field of production) into their business operations in Europe, but the management of Japanese companies was simultaneously forced to adapt to European local management practices (especially in the field of leadership and management of shell resources).

Most of the typically "Japanese" business policies and techniques are successfully transferred and incorporated into the European branches of Japanese companies. They include the long-term perspective of goals, the demand for superior quality, priority in production and horizontal integration (Yamazaki, 2012).

The management of Japanese companies does not prioritize short-term profitable goals, as is the case with managers of European companies. The management of Japanese companies is guided by the goal of "long-term strategic intent". Japanese companies generally start their operations in Europe with small investments. Only in the second phase, after getting to know the market better and establishing stable networks of relations with suppliers and clients, they expand the network of investments. The dominant goal of the management of Japanese companies is constant development and increase in market share. Another characteristic of Japanese management, when it comes to the transfer of business policy on the European market, is the prioritization of production and production departments. Japanese managers possess specialized technical knowledge, skills and experience in production. With the exception of the German management system, in European companies, manufacturing is far less "prestigious" than marketing, research and development or finance. That is why technical staff and production employees in European branches of Japanese companies accept with approval the attention given to their functions, and Japanese skills in this area are easily transferred and adopted (Zečević, Nedeljković, 2014).

Japanese business strategies prioritize consumers in terms of product or service quality. In this sense, Japanese companies in Europe implement this type of strategy without facing much resistance: consumers approve of excellent service (to the extent that the price difference is not too great), and employees are incentivized to perform quality operations (as long as their training).

Japanese business strategies are based on product quality, and it is the primary goal in both domestic and foreign markets. In the European business environment, where consumers consider quality to be essential, the management of Japanese companies has successfully carried out the transfer of the Japanese quality strategy.

A large number of researchers, including Bartlett and Ghoshal, define the organization of Japanese companies as a "centralized node". In their research, Bartlett and Ghoshal compared a large number of Japanese and European companies: "Kao" with "Unilever" (in the cosmetics industry), "Nec" with "Ericsson" (in the telecommunications sector), "Matksushita" with "Philips" (in the field of electronics). These examples indicate that the specific way of decision-making and control characteristic of Japanese companies is the result of a "culturally dependent management system based on collective-oriented behavior" (Bartlett, Ghoshal, 2002).

4. Conclusion

Researches in the paper point to growing trends in business relations between the EU and Japan. In the observed period, according to the analyzed parameters, the EU and Japan together participate with about 20% in world trade, while the increase in imports and exports on these two markets is constantly on the rise.

The more significant presence of Japanese companies and investments in the European Union market has led to an increase in the trend in the transfer of Japanese business practices in the European business environment. The operation of Japanese companies in Europe made it possible for the European business environment to adopt certain principles and adapt to Japanese business practices, such as: orientation towards interpersonal relations and social responsibility, orientation towards quality, adoption of the principles of workplace training, long-term development of the company as a dominant priority.

The research in the paper also identified some of the basic problems in the transfer of Japanese business practices and problems in the business of Japanese companies on the European market, which primarily relate to specific decision-making systems (Japanese consensus versus the European system of internal negotiation), the relationship between the European orientation of management towards individualism and Japanese collectivism, mobility of human resources, communication and information flow systems in business, as well as control systems (individual-oriented control in European companies, as opposed to group-oriented control in Japanese companies).

Analysis and research of company- and business-specific business practices and culturally dependent management philosophies at work point to the need for further research, especially in the area of more efficient business adaptation of Japanese companies in the European business environment.

Literature

1. Abggeln, J., Stark, G., (1990), *Kaisha The Japanese Corporation*, Basic Books, ISBN 0465037127
2. Albert, M., (1998), *Capitalisme Contre Capitalisme*, Seul, Pris, ISBN 2-02-033427-5
3. Bartlett, C. A., Ghoshal, S., (2002), *Manining across Borders, The Transnational Solution*, Mass Harvard Business Press, Boston, ISBN 978-1578517077
4. European Commission, Directorate Generale for Trade, 2023
5. EUROSTAT, 2022
6. Hamel, G., Prahalad, C. K., (2010) *Strategic Intent*, Harvard Business Review Press, ISBN 978-1633694989
7. JETRO Japanese External Trade Organization, 2020
8. Linkoln, J., KERBO, h., Wittenhagen, E., (1995), *Japanese Companies in Germany: A Case Study in Cultural Management*, Industrial Relations, A Journal od Economy and Society, 34 (3), p. 417-440
9. Naoki, K., (2013), *Japanese Global Companies: The Shift from Multinationals to Multiculturals*, Global Advances in Business Communication Conference and Journal, vol2, issue 1, article 3
10. Ohame, K., (2003), *The Mind of Strategist: The Art of Japanese Business*, McGraw Hill, New York, ISBN978-0070479043
11. Pascale, R. T., Athos, A. G., (2003), *The Art of Japanese Management*, Penguin, ISBN 978-0140061048
12. Sachwald, F., (2016), *Japanise Firms in Europe*, Routledge, ISBN 978-1138992818
13. Thurow, L., (2005), *Head to Head*, Harper Business, ISBN 978-0060750695
14. Yamazaki, K., (2012), *Japanese Global Management*, Palgrave MacMilan, ISBN 978-0-230-28015-1
15. Zečević, M., Nedeljković, D., (2014), *Menadžersko odlučivanje*, Evropski univerzitet, Beograd, ISBN 86-82915-12-X

Uloga lokalne samouprave u sprovođenju plana održivog razvoja - analitički okvir procesa implementiran u jedinici lokalne samouprave u opštini Opovo

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Apstrakt: Uloga lokalne samouprave u promovisanju politika ogleda se u usvojenom i sprovedenom planu održivog razvoja i odnosi se na teritoriju jedinice lokalne samouprave. Proces izrade i implementacije Plana zasniva se na participativnom pristupu, koji podrazumeva direktno uključivanje svih zainteresovanih strana tokom čitavog procesa. Na konceptualnom i analitičkom nivou, u članku su prikazani doprinosi iz perspektive javnih politika i modela organizacionog upravljanja u cilju uvođenja analitičkog okvira zasnovanog na strategiji, analitici i menadžmentu. Ovaj okvir je razvijen na osnovu dizajna strategije za merenje sposobnosti u datoj lokalnoj samoupravi pomoću specifičnih indikatora: migracija, slaba diverzifikacija privrednih aktivnosti, ekstenzivna poljoprivreda kao dominantna ekonomska aktivnost, visoka stopa nezaposlenosti, nedostatak mogućnosti zapošljavanja, slaba i nerazvijena infrastruktura, nizak BDP po glavi stanovnika u odnosu na urbana područja. Područja i nezagađena životna sredina koja se suočavaju sa potencijalnim pretnjama. Ovaj analitički okvir se primenjuje kroz studiju slučaja opštine Opovo i njenih politika za promovisanje održivog razvoja. Većina ovih problema rezultat je globalnih promena, pa rezultati analize ističu značaj kombinovanog delovanja kao rezultat napora da se sprovedu politike na nivou lokalne samouprave.

Keywords: Regionalni plan, održivi razvoj, analiza, lokalna samouprava.

The Role of Local Self-Government in The Implementation of The Sustainable Development Plan - Analytical Framework of The Process Implemented in The local Self-Government Unit in The Municipality Opovo

Abstract: The role of local governments in promoting policies is reflect in adopted and implemented sustainable development plan and refers to the territory of the local self-government unit. The process of creating and implementing the Plan is based on a participatory approach, which implies the direct involvement of all interested parties during the entire process. At the conceptual and analytical level, the article presents the contributions from the perspective of public policies and organizational management models in order to introduce an analytical framework based on strategy, analytics and, management. This framework is developed based on the design of a strategy to measure a capabilities in a given local government by means of specific indicators: migration, poor diversification of economic activities, extensive agriculture as the dominant economic activity, high unemployment rate, lack of employment opportunities, weak and underdeveloped infrastructure, low GDP per capita compared to urban areas. Areas and an unpolluted environment facing potential threats. This analytical framework is applied through a case study of the municipality Opovo and its policies to promote sustainable development. Most of these problems are the result of global changes, therefore the results of the analysis highlight the importance of the combined action as a result of effort to implement policies at the local government level.

Key words: Regional plan, sustainable development, analysis, local self-government.

1. Introduction

The LGU development plan (local self-government unit) is a development planning document, and as such it represents a planning document of the widest scope and highest importance for the local self-government unit. The development plan of the municipality of Opovo was drawn up in accordance with the Law on the Planning System of the Republic of Serbia (hereinafter: ZPS), adopted on April 19, 2018, and accompanying decrees: Decree on Methodology for Public Policy Management; Regulation on methodology for the preparation of medium-term plans of state administration bodies and Regulation on mandatory elements of the development plan of autonomous provinces and local self-government units. In addition to the aforementioned regulations, during the process of developing the Development Plan, the Municipality fully consulted the Guidelines for the development of development plans of local self-government units prepared by SKGO, in cooperation with RSJP. The aforementioned guidelines represent a detailed methodological guide through the process of developing the LGU Development Plan.

With the adoption of the ZPS, a system of coordinated, efficient and transparent planning was established, with the aim of introducing a system of responsibility for results and measuring the efficiency of public administration work. When it comes to local self-government units, the ZPS regulates the obligation of the local government to, in accordance with the defined methodology and uniform general approach, plan public affairs within its jurisdiction. LGUs, according to the Law on Local Self-Government, are obliged to plan, organize and manage public affairs within their jurisdiction, which are of interest to the local population. The process of creating the Opovo Municipality Development Plan included several phases, clearly defined and structured, and was carried out through public consultations with all interested parties. Public consultations were carried out through organized meetings, focus groups, workshops, but also through exchange of materials electronically. The following consultative and working bodies were involved in the process: Partnership Forum made up of representatives of all interested parties, three thematic working groups and a coordination team made up of local self-government representatives with clearly defined tasks and with the aim of monitoring and directing the entire process. (Smernice za izradu planova razvoja, 2020). When creating the Development Plan, the municipality of Opovo took care of compliance with development planning documents/public policies at the national and regional level, and above all with the Sustainable Development Goals given within the 2030 Agenda and negotiation chapters with the EU.

1. 2 Manufacturing process

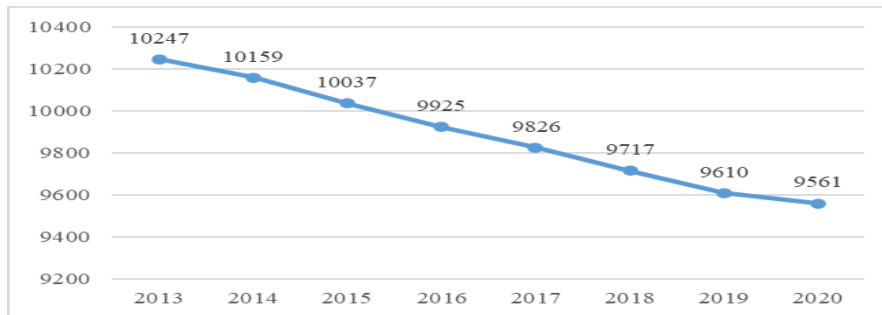
When preparing the Development Plan for the period 2022 - 2029, the Municipality of Opovo fully respected the methodology and instructions given in the Guidelines for the preparation of LGU development plans, as well as the elements defined by the Law on the Planning System of the Republic of Serbia and accompanying regulations. The process of developing the Development Plan in terms of phases and their interrelationships (Zakon o planiranju i izgradnji, 52/2021). The phases of the development process have a clear chronology, with the completion of one phase, the second phase begins. Public consultation is an ongoing activity that was included in all phases of the Development Plan. Consultations were carried out through working and consultative meetings, but also through the public publication of information and documents resulting from the process of developing the Development Plan. Also, the collection and processing of data are continuous processes that pervade several stages of the Development Plan development process.

2. Overview and analysis of the existing situation

The municipality of Opovo is located in AP Vojvodina, in the South Banat district, 30 km from Belgrade and Pančevo and 40 km from Zrenjanin. The favorable geographical position of the municipality of Opovo is one of the greatest potentials for its further development. The municipality of Opovo borders on the north and east with the municipality of Kovačica (Ko Idvor, Ko Kovačica, Ko Debeljača and Ko Crepaja), on the south with the municipality Pančevo (Ko Glogonj), on the southwest with the city of Belgrade, and on the northwest with the municipality Zrenjanin (Ko Čenta and Ko Farkaždin) and is in close, lower or higher degrees of conditioning and connection with them (Ugrinov et al., 2021). According to the last census (2011), there are 10,440 inhabitants in the municipality of Opovo. The gender structure of the total population indicates a very slight advantage of the female population (50.1%, ie 4,787) compared to the male population (49.9%, ie 4,774). When

observing the trend of the population of Opovo municipality in the period 2011-2020. year, a constant decline in the number of inhabitants is observed from year to year. The described trend is also characteristic of the South Banat region. Compared to the census year 2011, the number of inhabitants in the municipality of Opovo in 2020 decreased by 879 inhabitants. The population of the municipality of Opovo participates in the total population of the South Banat region with 3.5%, and in the total population of AP Vojvodina with only 0.5%.

Chart 1. Trend of the number of inhabitants 2013-2020. years

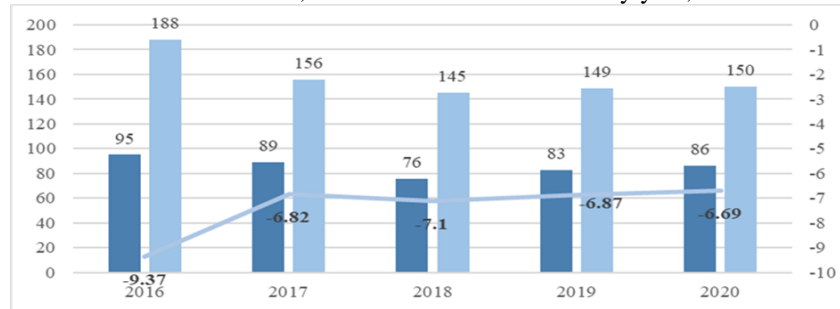


Source: RZS, Vital statistics

Natural increase recorded negative values (-64), since the number of live births (86) is less than the number of deaths (150). The rate of natural increase in the municipality of Opovo in 2020 is slightly more favorable than the value of the same indicator in AP Vojvodina (-6.69 ‰ and -7.5 ‰ respectively).

In the period 2016-2020. year, the value of the rate of natural increase was the most favorable in 2020 (-6.69‰), while the highest number of live births and deaths was recorded in 2016 (95, i.e. 188 children). Since 2018, the number of live births has recorded a slight increase. The most unfavorable value of the rate of natural increase was recorded in 2016 (-9.37‰).

Chart 2. Number of live births, deaths and natural increase by year, 2016-2020. Year



Source: RZS, Vital statistics

The fertility rate in the municipality of Opovo in 2020 was 1.5%, identical to the rate recorded in the South Banat Region and AP Vojvodina. The average age of the mother at the birth of the first child was 26.5 years. The low birth rate is a direct consequence of low fertility (1.5%) and, from the point of view of birth, a very unfavorable age structure (low participation of women in the fertile age (15-49)). Family planning and the reproductive power of the population is strongly influenced by the modern reproductive model that leads reducing the fertility rate.

2.1 Economic development and structure of the economy

According to the data of the Agency for Business Registers, in the period from 2018 to 2021, there are no major fluctuations in the number of active companies. The number of newly founded companies was constant until 2020, and in 2021 it decreased to 3. The number of companies per 1000 inhabitants during the observed period is fairly uniform. However, the number of businesses per 1,000 inhabitants is lower than the average of the South Banat region (9.75 in 2020), as well as the average at the level of the Republic (12.23 in 2020). The net effect of the establishment of new companies in 2019 is 0.4, and

means that 4 new companies are opened for every 10 closed companies, which is higher than the level of the South Banat region (0.3) and at the same level when compared to the average of the Republic of Serbia (0.42). When it comes to the number of entrepreneurs per 1,000 inhabitants, growth at an average annual rate of 9.1% is evident. In 2020, the number of entrepreneurial shops per 1,000 inhabitants is 34, which is 13% below the average of the Republic (the RS average is 39 entrepreneurial shops per 1,000 inhabitants), i.e. 3% more than the regional average of 33 entrepreneurs per 1,000 inhabitants. The net effect of the establishment of new entrepreneurs grows until 2019, while in 2020 the indicator drops to 1.7, which means that for every 10 closed entrepreneurial shops, 17 new ones are opened (Uzelac, et.al., 2022).

Chart 3. Number of active entrepreneurs



Source: Agency for economic Registers

Only small and medium-sized enterprises operate on the territory of the municipality of Opovo. The most represented activity besides agriculture is processing. Agriculture is the primary economic branch of the Municipality. Intensive agricultural production is dominant, primarily corn. Wheat, buckwheat, sunflower and onion are grown to a significant extent. Animal husbandry is also developed, and pig and poultry breeding is dominant. Although some households are dedicated exclusively to animal husbandry, a slightly larger number are engaged in combined agriculture and animal husbandry. There is a high orientation towards primary agricultural production and the placement of products mainly as raw materials, although there are several processing businesses. This type of production orientation results in low profitability (Josipovic et.al. 2013).

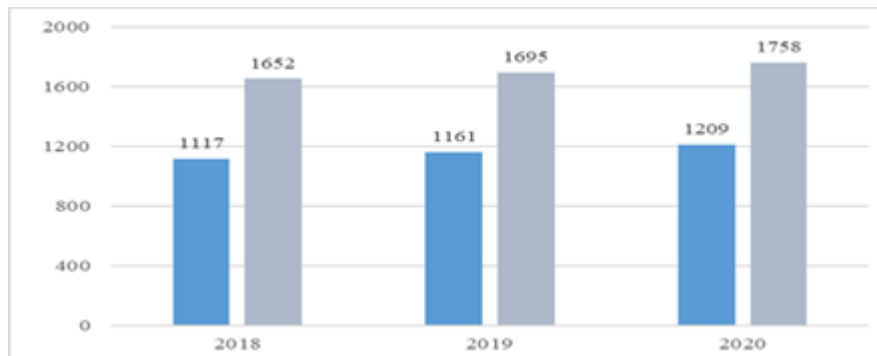
The local self-government unit is the biggest beneficiary of regional development incentives. According to the data of the Agency for Economic Registers, in the period 01.01-30.06.2021. The municipal administration participates with 80% in regional development incentives. Agricultural farms follow with 18.2%, while other users have a very small share (below 1%). The largest part of incentives refers to the development of transport infrastructure and agriculture, where non-reimbursable financial support and non-reimbursable subsidies are used to the greatest extent, and the largest implementers of these incentives are the Administration for Capital Investments of AP Vojvodina, the Ministry of Finance, the Development Agency of Serbia and the Development Fund of AP Vojvodina (Ćalasan, et.al. 2021). The total amount of realized investments in the territory of the municipality of Opovo in 2020 was 279,158,000 dinars.

2.1.1 Job market

Registered employment according to the municipality of residence in relation to the number of inhabitants in the territory of the municipality of Opovo was 31% in 2020, which is above the average of the South Banat region (30%), and lower than the average of the RS (32.1%). In the period from 2016 to 2020, the number of employees grew at an average annual rate of 4.62%. In 2020, of the total number of employees, as many as 60.1% are employed by legal entities, 25.4% are private entrepreneurs and their employees, while 14.5% are registered as individual farmers. In 2020, the total unemployment rate is 19.72%, while the unemployment rate for women is 23.87% and for men 16.60%. According to the age structure, in 2020, the most unemployed are among the age group from 30 to 54 years old (55%), followed by those aged 55 and over (27%), and young people from 18 to 29 years old (18%) (Kaludevovic i Grbović, 2022). Earnings in the observed period nominally grew at an average annual rate of 9.41%. In 2020, wages in the municipality of Opovo (50,270 dinars) are lower

than the South Banat region (57,125 dinars) by 13.64%, than the region of Vojvodina (57,186 dinars) by 13.76%, and than the Republic of Serbia (60,073 RSD) by 19.50%.

Chart 4. Registered employees by municipality of residence, 2018–2020.*



Source: DevInfo, Statistics of employment and earnings, RZS

2.1.2 Agriculture and forestry

Agriculture represents the dominant economic branch of the Municipality. The Department of Economy and Finance of the Municipality is responsible for the field of agriculture and rural development. On the territory of the municipality, different types of chernozem prevail, which cover 67.11% of the total territory and provide the possibility of practicing almost all forms of agriculture. However, a significant share has alluvium that is salted or barren, which negatively affects production possibilities (Jakšić, 2023). Also, on the territory of the Municipality there are marshy soils, salt marshes (3.68%) and salty salt marshes (1.58%), while the share of meadow and rite blacks is relatively low. According to the 2018 survey, the total area under arable land and gardens is 13,893 ha, orchards 89 ha, while vineyards are 5 ha. According to data from 2012, the total area of available agricultural land was 15,496 ha, which represents approximately 0.94% of the area of Vojvodina.

The available agricultural land occupies 76.33% of the total area of the Municipality, while 9.3 ha of used agricultural land per household. The share of agricultural land used for agricultural production is 92.96%. The municipality also has significant water and forest resources, which provide an excellent basis for the diversification of economic activities, which would provide additional income for agricultural farms. The increase in floor area is also evident perennial fruit plantations, which are younger than 20 years old, which is also one of the national strategic priorities in agricultural production. Sufficient amounts of water and meadows/pastures enable the further development of animal husbandry, which already exists in the area of the municipality. An important natural resource in the territory of the municipality of Opovo are forests, which occupy an area of 1,313 hectares, that is, 10% of the total territory of the municipality of Opovo.

2.1.3 Tourism

The municipality of Opovo may not be on the maps of tourist tour operators, but this part of Srednji Potamišje still has significant tourist resources. Tourism, as an expanding economic branch, has great potential for the municipality of Opovo. The municipality has numerous cultural monuments, manifestations, exceptional natural beauty, opportunities for eco, recreational and spa tourism, active vacations, sport fishing, catering and cooking, which can make for a diverse and attractive tourist offer. The most developed tourist branch is sport fishing and active tourism (birdwatching, hiking through nature, boating, regattas and camping) has become increasingly popular in recent years. The municipality of Opovo does not have an established tourism organization, but the tourism products of the area are advertised within the tourism organization of Vojvodina (Boškov, 2016). The central place when it comes to the cultural contents of the municipality is occupied by the municipal National Library, under whose jurisdiction is also the exhibition space (pinacoteca) Gallery "Jovan Popović" in Opovo.

On the territory of the Municipality, a dozen archaeological sites whose antiquity extends from the Neolithic to the Middle Ages were explored. The most famous are Ugar Bajbuk and Beli Breg near

Opovo, Trnovačka Greda near Baranda and Truntalj near Sakule. Numerous archaeological artefacts of the Starčevo and Vinča cultures were found and processed in these localities, which today adorn the display cases of the museums in Novi Sad, Pančevo and Vršac. On the banks of the Tamis there are also numerous natural or organized places suitable for excursions and camping. These are primarily localities: Most in Sefkerin, Debelo drvo, Main beach and Spitz in Opovo, Mačkov vir, Števanija and Staro selo in Sakule. In the observed period (2016-2020), the number of employees in the accommodation and catering services sector, as a % of the total number of employees, decreased by 0.2% cumulatively. Looking at the year 2020, the number of employees in the accommodation and catering services sector, as a % of the total number of employees in the municipality of Opovo (3.0%) is lower than the South Banat region (3.08%) and the RS average (4.0%).

2.2 Environmental Protection

According to the Free Plan, there is no established monitoring of air, water and soil quality on the territory of the Municipality. Of the direct sources of soil pollution in the municipality, the poorly controlled use of chemical protection agents in agricultural production stands out, and of the indirect sources, the increased frequency of traffic in urban areas (Trklja, et.al. 2016). Agricultural land is not polluted with dangerous and harmful substances, and the amounts of pesticide residues are within limits that do not endanger agricultural production and human health. The Tamish River rises in the northern parts of the Romanian Carpathians, passes through the Banat and flows into the Danube near Pancevo. The total length, from the source to the mouth, is 359 km.

Over the years, the water quality of the river has seriously deteriorated and has a bad effect on the environment and the ecosystem of the river. When it comes to the concentrated sources of pollution of the Tamish River, the most significant group includes, among others, the outflows of the Opova sewage system, as well as numerous channels for the drainage of agricultural land (Ilic Krstić, 2015). A big problem is also inadequately regulated septic tanks, which significantly contribute to the diffuse pollution of the river with ammonia nitrogen, chlorides, etc.

The total length of the constructed sewage network in the municipality of Opovo has not changed in the past ten years and is 8 km. According to the data of the Analytical Service of local self-government units, a slight increase in the number of households connected to the sewerage network can be observed in the period from 2016 to 2018, from 3.3 to 4.5%. The municipality of Opovo is far below the average for the Republic of Serbia in terms of the number of households connected to the sewage network. In the territory of the Republic of Serbia, the number of households connected to the sewage network is 62.6%, while in the South Banat region it is 53.35%.

Organized waste collection in the territory of the municipality of Opovo has been carried out since 2006. Maintenance of cleanliness in the municipality was entrusted to JP "Mladost" RJ "Higijena" in the period from 2006 to 2009, after which the company "Brantner otpadna privereda" d.o.o. took over that role from Novi Bečej. Wild landfills, created by the disposal of household, industrial and agricultural waste, with their large area, quantity and heterogeneous composition, have a significant negative impact on the environment. This impact is reflected in the following:

- air pollution, due to the emission of landfill gas and other harmful gases created by burning waste;
- water pollution (surface and underground), a special problem is waste disposal in the valleys of streams and rivers. Also, leachate from municipal and wild landfills pollutes watercourses;
- soil pollution with municipal waste blown by the wind and animals from unkempt and wild landfills, as well as soil destruction by surface mining;
- jeopardizing people's health through the use of polluted surface and underground water and through the use of contaminated agricultural foodstuffs;
- The sanitary landfill in Pancevo started operating in 2015. Phase I of a total of three phases was built at the landfill in Pančevo, and further phased construction is planned: for waste disposal Phases I, II and III - each with subphases a and b, as well as phased construction of planned contents and facilities at the landfill.

Education

The program of preschool upbringing and education is organized in 4 facilities within PU "Bambi", which is one of the smallest preschool institutions in the South Banat district. The main activity of PU

is organized upbringing and education of children aged 20 months to 7 years, care and preventive health care of children, nutrition, social work, rest and recreation. Within the PU, a care program for school-age children is organized at the request of parents. The main facility of PU is located in the settlement of Opovo, and the other three facilities are in the settlements of Baranda, Sakule and Sefkerin. The facilities are surrounded by greenery and have yards that are adequately equipped and adapted to the needs of preschool children.

2.3 Health and social protection

On the territory of the municipality of Opovo, there is one institution of the primary level of health care - Dom zdravlja Opovo, which includes the central facility in Opovo, the Baranda health clinic, the Sakule health clinic and the Sefkerin health clinic. The health clinics are currently in solid condition and apart from ongoing investments (painting, repairs to electrical, water and sewerage networks) major investments are not necessary except for the reconstruction of the boiler room in the Sakule Health Clinic. The central facility of the Opovo Health Center requires complete reconstruction, for which there is complete project documentation, as well as funding approval from the Republic Office for Public Investment Management. In the Opovo Health Center, the following services provide health services:

- Service for the health care of the adult population, which includes the department for emergency medical assistance, the department for home treatment and medical transport of patients;
- Service for health care of children, school children, women and specialist activities;
- OJ of the dental health care department;
- Department for pharmaceutical activity;
- Department for laboratory ultrasound and X-ray diagnostics.

According to the data of the RZS, in 2020 a total of 67 people were employed at the Opovo Health Center, of which 47 were health workers and associates and 20 were non-medical workers. Compared to the previous year 2019, the number of employees has increased. The number of inhabitants per doctor in the municipality of Opovo in 2020 was 637, which is significantly less favorable than the same indicator for the South Banat district (384) and the Vojvodina region (399).

The basic institution for exercising rights in the field of social protection is the Center for Social Work. In 2005, the Assembly of the Municipality of Opovo made a decision on the establishment of the Center for Social Work "Opovo", with headquarters in Opovo. Renovation of the building is also necessary, which includes replacement of carpentry and roof repair, as well as additional construction works that would enable unhindered access and movement for people with disabilities and mobility difficulties (accessible mobile ramps, adaptation of corridors and toilets to the needs of people with disabilities) (Kostić, et.al., 2022). The Center for Social Work has one passenger vehicle, which is insufficient considering the importance of timely response to applications, the number of interventions and field visits. In the municipality of Opovo, the beneficiaries of social protection are vulnerable groups of the population, i.e. groups with an increased risk of poverty and social exclusion, primarily children and the elderly, but also those with low incomes (unemployed, elderly without pensions), vulnerable ethnic minorities (Roma), persons with disabilities, etc.

The total number of beneficiaries of social protection on the records of the Center for Social Work in 2020 was 2,082 persons, which is 21.8% of the total population of the Municipality. There is a noticeable tendency to increase the number of users, and compared to 2017, that number increased by 8.4%. The coverage of social protection beneficiaries (21.8%) is significantly higher than the coverage of that population category at the regional (11.3%) and national level (10.2%). If we look at the ratio between the number of residents and professional workers of the Center for Social Work, the capacities of the Center for Social Work are more favorable than the average of the Republic of Serbia and AP Vojvodina, but this is not the case if we look at the number of professional workers in relation to the total number of beneficiaries of social protection (Markovic, et.al., 2020).

In 2013, the Opovo Municipal Assembly passed the Decision on the establishment of the Office for Youth in the Opovo Municipality. The local office for youth was established in 2017, and in 2018 it adopted the Action Plan for Youth in the Municipality of Opovo 2018-2021. The main tasks of the Youth Office are:

- creation, implementation of activities and revision of the Local Action Plan;

- providing support to local associations of young people and for young people;
- finding new sources of funding for youth programs;
- connecting all local subjects of youth policy and enabling cooperation on common goals;
- implementing the goals of the National Strategy for Youth at the local level.

Table 1. SWOT analysis of the area of the municipality of Opovo

<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> - Good geographical position (close to Belgrade, - River Tamiš, lake, - Preserved natural environment (natural resources) - Solved the problem of the spring for drinking water supply, - Up-to-date planning and urban documentation, - Well-organized system of issuing permits and other documentation, interesting for investors, - New, modern drinking water factory - Created a modern sports and recreation center with courts, Newly built market according to the highest international standards, - Good availability of primary health care services in all populated areas, - Good availability of social protection services, - Primary schools in all populated areas, - Sufficient capacities for admission of children to a preschool institution, - An office for youth was established, - A good share of young people in the total population, - Greater involvement of children and youth in sports 	<p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> -- Unfinished asphaltting of streets in populated areas, - The problem of the pier and coastal development, - No monitoring of air pollution, - The problem of illegal landfills and the establishment of a waste management system, - Unfinished reconstruction of the water supply network in all populated areas, - - No sewage network was built in Opovo and all populated areas, - Insufficient number of wind protection belts, - Lack of sports hall and swimming pool for sports and recreation, - Poorly organized suburban transport and lack of intercity local transport, - Insufficient utilization of the capacity of renewable energy sources (biomass, sun), - Zoo hygiene problem, - - Insufficient spatial capacities of the Center for Social Work, - Insufficient financial resources for maintaining social protection services, - Bad condition of elementary school facilities, - Insufficient professional and competent staff in primary schools, - Insufficiently equipped premises of the Youth Office, - - Absence of an institution of secondary education, - The absence of a youth club
<p style="text-align: center;">Chances</p> <ul style="list-style-type: none"> - A well-organized system of applying for funds from higher authorities and international organizations, - Natural resources for the development of tourism, - Natural conditions for the development of organic production, - An environment without heavy industry and large pollutants, - Strategic proximity to major cities, good geo-economic position (Belgrade, Zrenjanin, Pančevo), - Natural prerequisites for the development of projects of alternative energy sources 	<p style="text-align: center;">Threats</p> <ul style="list-style-type: none"> - Connection to the gas network has not been resolved, - Public transport, - Connection to the Pancevo regional landfill, - Reducing the flow of potentially interested investors, - Extension of the unfavorable epidemiological situation, - Outflow of the younger population to nearby cities, - The need for secondary school

3. Conclusion

The municipal development plan is the umbrella document of development planning. It presents development directions, priorities and goals that the Municipality strives to achieve during the document's validity. The development plan equally treats all areas of vital importance for the residents of the municipality and aims at objective and realistic planning and optimal use of budget funds.

The basic idea of development is to improve the quality of life through the development of the potential of all citizens from the territory of the municipality, while respecting the basic principles of sustainable development. Emphasis is placed on the construction and reconstruction of communal and traffic infrastructure, as well as equipping industrial zones. Also, significant attention is focused on the development of economy and agriculture, revitalization of villages, environmental protection and preservation of natural resources. The goal is to make the municipality attractive for investors. Social protection and care for the family is at the very top of the priorities, as is the fight for a more favorable demographic picture in the municipalities.

All interested actors of the municipality, representatives of the public sector, councilors, businessmen, civil sector and citizens participate in the development of the Development Plan. Public insight ensured transparency in the drafting of this very important document and a general consensus on the key directions of development. Responsible planning will achieve the vision of an economically developed municipality with an organized infrastructure, create new opportunities for all residents of the municipality and improve the quality of life and work.

Literature

1. Bošković, V. (2016). Biznis plan kao izvor informacija za donošenje poslovnih odluka. *Škola biznisa*, 2, 38-46. <https://doi.org/10.5937/skolbiz2-12886>
2. Jakšić, P. (2023). Efikasno upravljanje lokalnim finansijama kao element unapređenja lokalnog ekonomskog razvoja. *Economics of Sustainable Development*, 7(1), 49-60. <https://doi.org/10.5937/ESD2301049J>
3. Josipović, S., Pokrajac, S., & Dondur, N. (2013). Proces scenario planiranja - primer ruralnog razvoja Srbije. *Ekonomski vidici*, 18(2-3), 261-273.
4. Ilić Krstić, I., & Ilić Petković, A. (2015). Inženjerska etika i održivi razvoj. *Safety Engineering*, 5(2), 109-114. <https://doi.org/10.7562/SE2015.5.02.08>
5. Marković, M., Krstić, B., & Rađenović, T. (2020). Cirkularna ekonomija i održivi razvoj. *Economics of Sustainable Development*, 4(1), 1-9. <https://doi.org/10.5937/ESD2001001M>
6. Kaluđerović, A., & Grbović, J. (2022). Uticaj liderstva u javnom i privatnom sektoru. *Serbian Journal of Engineering Management*, 7(2), 14-26. <https://doi.org/10.5937/SJEM2202014K>
7. Kostić, V., Miličević, S., & Despotović, D. (2022). Menadžment održivog razvoja sagledavan kroz prizmu imperativa očuvanja prirodnog kapitala. *Bizinfo (Blace)*, 13(1), 41-48. <https://doi.org/10.5937/bizinfo2201041K>
8. Smernice za izradu planova razvoja jedinica lokalne samouprave (2020), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, SKGO Beograd
9. Trklja, R., Dašić, B., & Grujović, M. (2016). Finansiranje zaštite životne sredine od strane lokalnih samouprava. *Ekonomski signali: poslovni magazin*, 11(2), 33-47. <https://doi.org/10.5937/ekonsig1602033T>
10. Ugrinov, D., Markov, M., & Nikolić, M. (2021). Mogućnosti održivog razvoja malih gradova. *Serbian Journal of Engineering Management*, 6(2), 32-42. <https://doi.org/10.5937/SJEM2102032U>
11. Ugrinov, D., Markov, M., & Nikolić, M. (2021). Mogućnosti održivog razvoja malih gradova. *Serbian Journal of Engineering Management*, 6(2), 32-42. <https://doi.org/10.5937/SJEM2102032U>
12. Uzelac, O., Đukić Mijatović, M., & Stojiljković, A. (2022). Održivi razvoj i korporativna društvena odgovornost - teorijska pozadina i društveno-ekonomski kontekst. *Ekonomija: teorija i praksa*, 15(4), 153-165. <https://doi.org/10.5937/etp2204153U>
13. Vujić, M. M. (2022). Tri decenije održivog razvoja - nastanak, dominacija, slabosti i perspektiva. *Sociološki pregled*, 56(4), 1270-1297. <https://doi.org/10.5937/socpreg56-40157>
14. Vukajlović, Đ. (2013). Uloga strategijskog menadžmenta u upravljanju inovacijama. *Ekonomija: teorija i praksa*, 6(3), 18-30.
15. Đurić, Z., & Ilić, B. (2023). Sistemska zaštita životne sredine i determinante održivog upravljanja. *Topola*, 211, 45-57. <https://doi.org/10.5937/topola2211045D>
16. Čalasan, V., Slavković, R., & Rajković, J. (2021). Primena zelenih alata u zelenom marketinškom pristupu. *Serbian Journal of Engineering Management*, 6(1), 72-77. <https://doi.org/10.5937/SJEM2101073C>
17. ZAKON O PLANIRANJU I IZGRADNJI ("Sl. glasnik RS", br. 72/2009, 81/2009 - ispr., 64/2010 - odluka US, 24/2011, 121/2012, 42/2013 - odluka US, 50/2013 - odluka US, 98/2013 - odluka

- US, 132/2014, 145/2014, 83/2018, 31/2019, 37/2019 - dr. zakon, 9/2020 i 52/2021).
18. ZAKON O ZAŠTITI ŽIVOTNE SREDINE ("Sl. glasnik RS", br. 135/2004, 36/2009, 36/2009 - dr. zakon, 72/2009 - dr. zakon, 43/2011 - odluka US, 14/2016, 76/2018, 95/2018 - dr. zakon i 95/2018 - dr. zakon)

Značaj informacione bezbednosti za organizacije

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Apstrakt: Informaciona bezbednost predstavlja ključni aspekt poslovanja organizacija u današnjem digitalnom dobu. Ovaj rad ima za cilj da analizira značaj informacione bezbednosti za organizacije, istražujući njen uticaj na očuvanje integriteta, poverljivosti i dostupnosti podataka. Organizacije su sve više suočene sa kompleksnim izazovima u oblasti cyber pretnji, čime se naglašava nužnost implementacije efikasnih strategija informacione bezbednosti. Efikasna zaštita podataka ključna je za održavanje poverenja klijenata i partnera, smanjenje finansijskih gubitaka i očuvanje reputacije organizacije. Pored toga, informaciona bezbednost ima značajnu ulogu u očuvanju konkurentne prednosti, omogućavajući organizacijama da inoviraju bez straha od gubitka podataka ili povrede privatnosti. Bezbedna infrastruktura takođe pruža osnovu za usklađenost sa regulatornim zahtevima, čime se smanjuje rizik od pravnih posledica. Uzimajući u obzir brzi razvoj tehnologije i sve sofisticiranije cyber pretnje, organizacije se suočavaju sa stalnim izazovom prilagođavanja svojih bezbednosnih strategija. Edukacija zaposlenih postaje ključna komponenta celokupnog sistema informacione bezbednosti, a organizacije koje ulažu resurse u obuku i svest o bezbednosti imaju bolju sposobnost odgovora na potencijalne pretnje. Informaciona bezbednost postaje neophodan stub savremenog poslovanja, čuvajući organizacije od cyber rizika, unapređujući njihovu reputaciju i pružajući osnovu za dugoročni uspeh.

Keywords: informaciona bezbednost, cyber pretnje, zaštita podataka, edukacija o bezbednosti

The Importance of Information Security for Organizations

Abstract: Information security is a key aspect of organizations' operations in today's digital age. This paper aims to analyze the importance of information security for organizations, investigating its impact on preserving the integrity, confidentiality and availability of data. Organizations are increasingly faced with complex challenges in explaining cyber threats, which emphasizes the necessity of implementing effective information security strategies. Effective data protection is the key to maintaining the trust of clients and partners, reducing financial losses and preserving the organization's reputation. In addition, information security has a significant impact on maintaining a competitive advantage, allowing organizations to innovate without fear of data loss or privacy breaches. A secure infrastructure also provides a foundation for compliance with regulatory requirements, thereby reducing the risk of legal consequences. Considering the rapid development of technology and increasingly sophisticated cyber threats, organizations face the constant challenge of adapting their security strategies. Employee education is becoming a key component of the overall information security system, and organizations that invest resources in training and security awareness have a better ability to respond to potential threats. Information security is becoming a necessary pillar of modern business, protecting organizations from cyber risk, enhancing their reputation and providing the foundation for long-term success.

Keywords: information security, cyber threats, data protection, security education

1. Introduction

In today's digital ecosystem, where technological progress is fast and ubiquitous, information security takes on the role of a crucial component of organizations' operations, representing a key defense mechanism against cyber threats. This paper aims to highlight the necessity of information security for organizations, focusing on its impact on the integrity, confidentiality and availability of data. In a global context where technological progress is taking place quickly, organizations face the challenge of

adapting their security strategies in order to preserve their operational resources (Mitchell, 2014). With the increasing digitization of the business environment, organizations face the constant challenge of adapting their security strategies in order to effectively respond to increasingly sophisticated cyber threats. In this sense, the first part of the paper is dedicated to considering the importance of a holistic approach to information security in organizations (Zimba & Chishimba, 2019). A holistic approach implies a comprehensive, integrated approach to security that includes technical, organizational and human aspects. Technical measures, such as encryption and firewalls, are important, but become more effective when combined with organizational policies and employee awareness.

The second part of the paper focuses on the importance of the implementation of information security in the context of preserving the trust and reputation of organizations, through the HAIS-Q model, which pays special attention to measuring employees' awareness of information security. Educated employees become the first line of defense against cyber threats, reducing the risk of human error. Through these aspects, this paper wants to emphasize not only the importance of information security as a defense mechanism against cyber threats, but also to emphasize that this security is not limited to technical aspects only. People, as key factors, have a crucial role, and their awareness, education and engagement become key factors for preserving information security. Preserving the integrity, confidentiality and availability of data not only preserves organizational security, but becomes imperative for organizations that want to achieve sustainable growth and success in a dynamic and increasingly digitized business environment.

2. A holistic approach to information security in organizations

In today's business environment, the use of the Internet is becoming a key resource for business operations, almost equally as electricity (Harmon & Auseklis, 2009). This dependence on the digital environment brings increased risks to information security, making it necessary to preserve the integrity, confidentiality and availability of data. Experts agree that technology, although important, cannot alone guarantee information security, especially considering two basic categories of threats - internal and external (Skopik et al., 2016). Internal threats are becoming increasingly important in the field of information security. Carelessness, mistakes and omissions of users are often the source of incidents. The earlier emphasis on external threats has today been replaced by a more comprehensive approach that also includes the human factor. A holistic approach, encompassing technical, organizational and human aspects, becomes crucial for effective information security management. User behavior is a key factor in this context. The Internet, a network of great potential, is exposed to various threats. Human error, whether the result of carelessness or lack of training, is often the source of information security incidents. A holistic approach, which includes employee training, becomes necessary to preserve information security (Da Veiga et al., 2020). Organizations face the challenge of recognizing the importance of user behavior and human error in maintaining information security. Investing in employee education becomes key to reducing the risk of security incidents.

Technology, while necessary, is not sufficient. Integrating technical measures with policies, procedures and education enables comprehensive information security. As previously mentioned, information security incidents often result from human error, lack of awareness of potential threats, and lack of information security knowledge (Alavi et al., 2013). It is crucial to encourage and train employees so that they become aware of the information security policy. Increasing employee awareness of information security can significantly reduce the risk of incidents. Empirical research on organizational information security is still in its infancy. Automation of certain security procedures makes operational tasks easier for employees, but on the other hand, behaviors that imply user responsibilities are not solved exclusively by technology. Users' attitude toward information security, their perception of social norms, threat assessment, and level of self-efficacy become key factors influencing their information security behavior. A holistic approach to information security, which integrates technical measures with training, policies and procedures, is a key strategy for organizations striving to effectively manage information security. Investing in employee training, raising awareness of information security, and promoting positive attitudes toward information security are becoming imperative to preserve the integrity, confidentiality, and availability of data in modern digital business.

3. The importance of awareness of information security among employees and the way of its quantitative measurement through the HAIS-Q model

Defining information security awareness usually focuses on two key aspects, while the first of them focuses on employees' understanding of the importance of information security (Snyman & Kruger, 2021). Kruger (2010) defined information security awareness as "the degree or extent to which each staff member understands the importance of information security, the level of information security, appropriate to the organization and its individual security responsibilities." This definition emphasizes the need for employees to understand the importance of information protection, the level of security required by the organization, and personal responsibility for maintaining information security.

The first aspect of information security awareness has three key elements – the importance of information security, the level of information security and the individual's security responsibility (Safa et al., 2016). Employees must understand why information protection is important, what measures the organization applies to ensure protection, and what their responsibilities are in that context. This understanding includes the consequences of insufficient information security, including loss of user trust, financial losses and damage to the organization's reputation.

Kruger's definition emphasizes that awareness of information security is not only about passive understanding, but about actively recognizing the importance, applying rules and taking responsibility for protecting information within the organization.

Another aspect of information security awareness focuses on employee engagement and adherence to information security best practices. This aspect is fully consistent with the knowledge-attitude-behavior (KAB) model (Khan et al., 2011), which recognizes that increasing employees' knowledge of information security policies and procedures leads to an improvement in their attitude towards the rules and ultimately, to better behavior in the field of information security.

The HAIS-Q model, as a tool for measuring information security awareness, has a significant contribution in this context. It is used for the information security process by various populations, including students, the general public and employees from various sectors. The HAIS-Q model provides a comprehensive picture of employees' awareness of information security, identifying areas where there is a lack of understanding or application of rules, allowing organizations to target education and training (Papp & Lovaas, 2021), while more detailed focus areas will be described below.

Measuring information security awareness plays a key role in improving information security in organizations. The HAIS-Q model stands out because of its comprehensiveness and proven validity and reliability, organizations can monitor progress, adapt their training and awareness strategies, and respond more effectively to changes in the technological environment and security threats.

Information security awareness consists of understanding the importance and level of information protection, as well as the commitment and behavior of employees in accordance with best practice. The HAIS-Q model represents a key instrument for organizations in achieving a higher level of information security and protecting vital resources from potential threats.

Managing an organization's information security is an extremely complex issue that requires careful planning and implementation of various strategies. One of the key aspects in preserving information security is the human factor. In this context, the HAIS-Q model, developed by Parsons et al., is an important tool for measuring employees' knowledge, attitudes and behaviors related to information security (Parsons et al., 2014). The model consists of seven focus areas, and analyzes individual, organizational and intervention factors.

The HAIS-Q model is based on the idea that a key component of information security is employee awareness (Parsons et al., 2014). Information security awareness refers to the level of understanding and attention an individual pays to security issues.

Parsons et al. (2014) designed a questionnaire consisting of seven key focus areas of information security policy, relevant to both employers and computer users. The first phase of development of the HAIS-Q questionnaire was based on the results of a study of information security in three Australian

government organizations, conducted in 2010. This study used a hybrid methodology, combining an inductive, exploratory approach (Parsons et al., 2010). The authors identified human errors as the main cause of information security violations, stressing that these errors are more often the result of uncertainty and naivety than malicious behavior. This questionnaire aims to assess the level of awareness, attitudes and behavior of employees regarding key aspects of information security. Each of the seven focus areas provides detailed insight into specific aspects of risk and security threats.

Internet usage is a field that deals with understanding the risks and threats that arise from using the Internet. Items imply the process of visitors safe web pages, downloading unverified files and using security tools while surfing the Internet.

In the area of e-mail usage, the focus is on awareness of phishing attacks, where employees must be able to recognize suspicious e-mail messages, links and attachments. Assessments in this area check whether employees send sensitive information via e-mail, use spam protection and handle attachments properly.

Use of social networking sites assesses awareness of privacy and security when using social networking sites. Items assess whether employees share work information on social networks, share sensitive information, and use privacy settings properly.

Password management is a focus area that focuses on strong passwords and proper password management. The ratings check whether employees use unique passwords, change them regularly, and implement multi-factor authentication.

By considering incident reporting, it is assessed whether individuals know how to properly report suspicious or security-threatening situations. The ratings check whether employees report suspicious activity, device loss or theft, and other incidents that could compromise information security.

Information handling is an area that involves understanding how to handle sensitive information. The assessments check whether employees properly handle sensitive information, keep documents secure and use encryption to protect data.

The final focus area, mobile computing, focuses on awareness of the security risks of mobile devices. The assessments check whether employees are properly securing mobile devices, sending sensitive information over Wi-Fi and detecting the possibility of "shoulder surfing" efforts.

The HAIS-Q model provides a structured basis for assessing employee awareness of key aspects of information security. Based on the results, organizations can develop personalized training programs to improve information security and reduce risks related to unwitting users. The model highlights human errors as a common cause of information security breaches, which points to the importance of education to minimize these errors. Through proper application of the HAIS-Q model, organizations can raise the level of awareness and training of employees, thereby strengthening overall information security.

The HAIS-Q model represents a significant advance because it provides empirical support, quantification, contextual analysis, and reliability. It was developed through a rigorous research process that included conceptual development, validity testing, and reliability testing.

The HAIS-Q model consists of 63 items, where the model underwent validity and reliability testing, including test-retest reliability and calculation of Cronbach's alpha coefficient. The results showed high validity and reliability of the HAIS-Q questionnaire.

The importance of awareness of information security among employees is crucial for preserving information security in organizations. Human errors are often the cause of information security breaches, and the HAIS-Q model provides an effective tool for measuring and analyzing human factors in this area. Its strengths, including empirical support, quantification and context analysis, make it a relevant and useful tool for improving security strategies and culture in organizations. The quantitative measurement it provides enables more precise analysis and monitoring of efficiency through training and education programs, thus providing organizations with a practical and efficient tool for managing human factors in the field of information security.

4. Conclusion

Information and communication technology has brought a revolution in the way of doing business, especially through ubiquitous electronic commerce, eliminating time and space barriers, which are characteristic of traditional shopping models. However, this progress is accompanied by a growing number of challenges, especially in the field of information security. Data breaches have become a problem with major consequences for organizations, including high recovery costs, loss of customer trust and reduced sales. A holistic approach to information security, encompassing technical, managerial and human aspects, is becoming imperative for successful business in the digital age.

One of the key challenges is the customer's perception of financial risks, especially in connection with electronic payments. Building customer trust in online transactions is becoming key to business sustainability. Various factors contribute to data theft, including human error, loss of paper documents and insider threats. Therefore, it is imperative that organizations focus their attention on information security policies, employee training, and security awareness.

Human resource management becomes crucial in the context of information security. Information security policies must become an integral part of the organizational culture, and employee training should emphasize the importance of adhering to security procedures. Studies indicate that human factors are often the key cause of safety incidents, which highlights the need for increased employee awareness and education (Parsons et al., 2014).

In order to effectively manage information security, organizations should adopt a holistic approach that integrates technical, managerial and human dimensions. Technical measures, such as data encryption and firewall systems are necessary, but they are not sufficient by themselves. Managerial aspects, including defining security policies, monitoring and responding to incidents, are also essential. However, the key role lies in the human factor, where information security awareness becomes the line of defense against threats.

In this context, the importance of the HAIS-Q model in measuring information security awareness is particularly emphasized. This model provides a structured framework for assessing the human aspects of information security, taking into account different dimensions, such as awareness, education and behavior of employees. The HAIS-Q model enables organizations to identify points of weakness, develop targeted training and implement policies aimed at increasing the level of security awareness. By incorporating the HAIS-Q model into the information security strategy, organizations can achieve long-term security culture improvement. Measuring security awareness is becoming a key indicator of success, allowing organizations to identify areas that require additional effort and investment. Also, the HAIS-Q model contributes to the creation of a proactive approach to safety, where prevention and education are placed in the foreground, instead of a reactive approach after an incident occurs.

Modern organizations face increasing information security challenges in the digital age. A holistic approach, which includes technical, managerial and human aspects, becomes the key to preserving the integrity of information. Information security awareness, especially measured through the HAIS-Q model, is becoming the cornerstone of effective security management. Organizations that recognize these challenges and take adequate steps towards building a strong security culture will be ready to face increasingly sophisticated threats and maintain the integrity of their information in the digital world.

5. Literature

1. Alavi, R., Islam, S., Jahankhani, H., Al-Nemrat, A. (2013). Analyzing human factors for an effective information security management system. *International Journal of Secure Software Engineering (IJSSSE)*, 4(1), 50-47.
2. Da Veiga, A., Astakhova, L., Bitha, A., Herselman, M. (2020). Defining organisational information security culture – Perspectives from academia and industry. *Computers and Security*, 92, 101713.
3. Harmon, R. R., Auseklis, N. (2009). *Sustainable IT services: Assessing the impact of green computing practices*. In PICMET'09-2009 Portland International Conference on Management of Engineering & Technology (pp. 1707-1717). IEEE.
4. Khan, B., Alghathbar, K.S., Nabi, S.I., Khan, M.K. (2011). Effectiveness of information security

- awareness methods based on psychological theories. *African journal of business management*, 5(26), 10862.
5. Kruger, H., Drevin, L., Steyn, T. (2010). A vocabulary test to assess information security awareness. *Information Management and Computer Security*, 18(5), 316-327.
 6. Mitchell, G. E. (2014). Strategic responses to resource dependence among transnational NGOs registered in the United States. *Voluntas: International Journal of Voluntary and Nonprofit Organizations*, 25, 67-91.
 7. Papp, G., Lovaas, P. (2021). Assessing Small Institutions Cyber Security Awareness Using Human Aspects of Information Security Questionnaire (HAIS-Q). In *Intelligent Computing: Proceedings of the 2021 Computing Conference*, Volume 3 (pp. 933-948). Springer International Publishing.
 8. Parsons, K., McCormac, A., Butavicius, M., Ferguson, L. (2010). Human factors and information security: individual, culture and security environment. DSTO-TR-2484: Report published by Defence Science and Technology Organisation.
 9. Parsons, K., McCormac, A., Butavicius, M., Pattinson, M., Jerram, C. (2014). Determining employee awareness using the human aspects of information security questionnaire (HAIS-Q). *Computers and security*, 41, 165-176.
 10. Safa, N.S., Von Solms, R., Furnell, S. (2016). Information security policy compliance model in organizations. *Computers and security*, 56, 70-82.
 11. Skopik, F., Settanni, G., Fiedler, R. (2016). A problem shared is a problem halved: A survey on the dimensions of collective cyber defense through security information sharing. *Computers & Security*, 60, 154-176.
 12. Spremić, M., Šimunić, A. (2008). *Cyber security challenges in digital economy*. In Proceedings of the World Congress on Engineering (Vol. 1, pp. 341-346), Hong Kong, China.
 13. Snyman, D. P., Kruger, H. (2021). Collective information security behaviour: a technology-driven framework. *Information and Computer Security*, 29(4), 589-603.
 14. Zimba, A., Chishimba, M. (2019). Understanding the evolution of ransomware: paradigm shifts in attack structures. *International Journal of computer network and information security*, 11(1), 26.

Guidelines for the Preparation of Papers for Publication in the Serbian Journal of Engineering Management

Title of Paper in Serbian

Authors' Name and Surname^{1*}, **Name and Surname**², **Name and Surname**³ [in this stage leave it empty for the peer review purpose]

¹ Institution and E-mail address [in this stage leave it empty for the peer review purpose]

² Institution and E-mail address [in this stage leave it empty for the peer review purpose]

³ Institution and E-mail address [in this stage leave it empty for the peer review purpose]

Summary in Serbian: This document is a template for formatting the papers in order to prepare them for printing. This summary provides briefly the information related to the content of the article so that the reader can rapidly and accurately assess its relevance. Authors should explain the goals of research or state the reason (reasons) why they have written the article. Then, it is necessary to describe the methods used in the study and briefly describe the results they have obtained in the research. The abstract should be between 100 and 250 words long.

Keywords: 3-5 keywords for indexing and search purposes

Title of Paper in English

Abstract in English: This document presents a template for preparing the print-ready papers that will be included in the Serbian Journal of Engineering Management. The abstract briefly summarizes the article and gives the reader the opportunity to assess its relevance. The authors should elaborate the goals of the research or state their reason (reasons) for writing the paper. It is additionally required for them to describe the methods used during the research and give a brief description of the results and conclusions of the research. The abstract should be between 100 and 250 words long.

Keywords: 3-5 keywords for indexing and search purposes

1. Introduction

The paper should be written using MS Word for Windows (on Serbian Cyrillic, Latin or English – UK keyboard). The length of work should not be more than 10 pages including text, diagrams, tables, references, and appendices.

The format is **A4**. Use **2 cm** for the lower and upper margin and **2.5 cm** for the left and right margin. The spacing within one paragraph should be one (single), while the spacing between paragraphs is double. To format the text, it is recommended to use font Times New Roman.

2. Structure of the paper

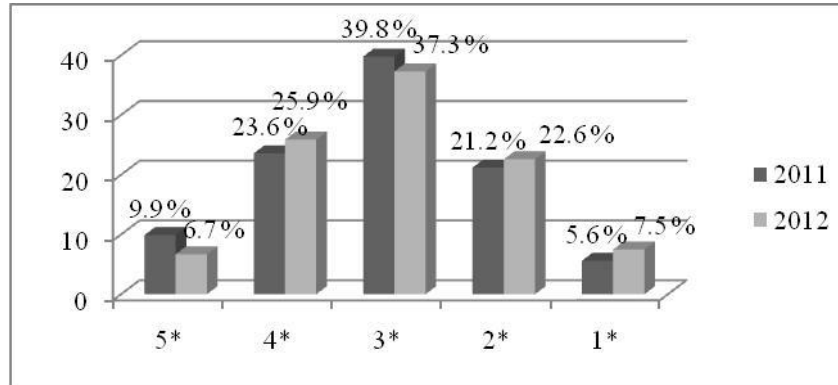
In the first line of the first page the title should be written in Serbian language (16 pt). Under the title of the paper the spaces for name(s) of the author and the names of the author's institutions should be indicated as specified and aforementioned in this Guideline. After the space for the institution of the last author, leave one blank line and write the short summary (10 pt) in Serbian. After the summary, provide an overview of key words. After the paper title you indicated, include the summary and key words in the Serbian language, whereas they should be indicated in English like above.

Numbered subtitles of the first level must be formatted using the font 12 pt bold, a second-level subtitles should be 10 pt bold. The text, and a list of references should be formatted using the font 10 pt.

3. Graphs, tables and formulae

All illustrations, regardless of whether they are diagrams, photographs or charts are referred to as images. The name and number of images should be displayed as centred.

Figure 1: Accommodation units according to the structure of hotel capacities in 2011 and 2012, written in the form of percentage



Source: (The Ministry of Finance and Economy, 2013)

The title and number of the table should be presented above the table as centred

Table 1: Accommodation units according to the structure of hotel capacities in 2011 and 2012, written in the form of percentage

Category	2011	2012	Number of accommodation units (2011)	Number of accommodation units (2012)
5*	9,9	6,7	1452	990
4*	23,6	25,9	3486	3911
3*	39,8	37,3	5895	5636
2*	21,2	22,6	3102	3420
1*	5,6	7,5	1133	1132
total	100	100	15068	15089

Source: (The Ministry of Finance and Economy, 2013)

Submit your article, including tables, images, etc., as a single file. In addition, you should submit all figures and tables (which are entered in black and white) as separate files in TIFF or JPF format with a minimum resolution of 300dpi.

Formulae should be centered on the page and properly numbered, as in the following example. It is recommended that you format the rows with formulae in Microsoft Word (using MathType).

$$PV_0 = \frac{FV_n}{(1+i)^n} \quad (1)$$

4. Conclusion

In conclusion, the authors should summarize the results they have obtained in the research.

5. Literature

When quoting the literature, the APA referencing system should be used. For more information, see the Publication Manual of the American Psychological Association (6th ed.).

When quoting within the text, as in the sentence where you mention the author and specify his words, then after the author's name you should indicate the year of publication of the quoted text in parentheses, at the end of the sentence there should be the number of page in which the text should be indicated: according to Čerović (2012) „quoted text” (p.10). When the author is not mentioned in the sentence, then his last name, the year of publication and the number of page should be indicated in parentheses at the end of a sentence, and if the quote was created by paraphrasing or summarizing, then data about the page number is not required: (Čerović, 2012). If there are two or more references by the same author, but they were published at the same time in the same year, the referencing should look like this (Harish, 2008a; Harish, 2008b). When two authors wrote the paper together, the surnames of both authors are written as follows (Petković and Pindžo, 2012), or (Tew & Barbieri, 2012). The call for references in the text requires working with more than two authors and should be stated as follows (Luque-Martinez et al., 2007). When citing a source that does not show the number of pages (such as electronic sources) use the author's name and year of publication if the author is known, and if the author is a corporation or an organization, write down the organization name and year of publication (Ministry of Finance and Economy, 2013).

References should be given at the end of the main text in alphabetical order, following the last name of the author. Below are shown examples of using APA style for citations appearing in various forms (books, journal articles, proceedings, electronic resources, etc.).

A book with one author:

Example: Hrabovski, Tomić, E. (2009). *Health tourism destinations*. Novi Sad: Prometheus.

A book with several authors:

When you have multiple authors, all of them are supposed to be mentioned, but as soon as the last surnames are added and if there are more than seven authors, mention the first six and then write ... at the end of the last author.

Example: Barrows, C. & W. Powers, T. (2009). *Introduction to the Hospitality Industry*. 7th edition. Hoboken, New Jersey: John Wiley & Sons, Inc.

A book which was translated from a foreign language:

Example: Spic, E. H. (2011). *Art and psyche: a study of psychoanalysis and aesthetics*. (A. Niksic, prev.). Belgrade: Clío.

A book with an editor for a collection of papers; proceedings:

If the book is a collection of papers on the appropriate topic, the authors should mention the editor of their work with the surname and first initial in parentheses as they add "edit" if the person is editor, or "Ed." as editor if the book is written in a foreign language.

Example: Đurković, M. (ed.) (2007). *Serbia 2000-2006: state, society, economy*, Belgrade: Institute for European Studies.

Papers in the proceedings:

Example: Cerovic, S. (2012). *Modern concepts of strategic tourism destination management*. Scientific conference with international participation "Tourism: Challenges and Opportunities", Trebinje.

Papers published in the journal by one author:

Example: Harish, R. (2008). Brand Architecture and its Application in Strategic Marketing. *The Icfai University Journal of Brand Management*, 7 (2), 39-51.

Papers in a journal with two authors:

If the article to which you refer has a DOI number, references need to be added.

Example: Tew, C. Barbieri, C. (2012). The perceived benefits of agritourism: The provider's perspective. *Tourism Management*, 33 (6), 215-224. doi: 10.1016 / j.tourman.2011.02.005

Papers in a journal with more than two authors:

Example: Luque-Martinez, T. Castaneda-Garcia, A. J., Frias-Jamilena, D. M., Munoz-Leiva, F. & Rodriguez-Molina, M. A. (2007). Determinants of the Use of the Internet as a Tourist Information Source. *The Service Industries Journal*, 27 (7), 881 to 891. doi: 10.1080 / 02642060701570586

Newspaper article with the aforementioned author:

Example: Muscle, M. (days 1 February 2012). US Steel has reduced its losses. *Politika*, p. 11

Newspaper article with no author specified:

Example: Straževica ready in two months. (Days 1 February 2012). *Politika*, p. 10

Thesis in the printed version:

Example: Dewstow, R. A. (2006). *Using the Internet to enhance teaching at the University of Waikato* (Unpublished master's thesis). University of Waikato, Hamilton, New Zealand.

Document or database from the Internet, the private or official web page for which we know the database author:

Example: Kraizer, S. (2012). Safe child. Retrieved on 29 October 2012, from <http://www.safechild.org/>

Document or databases from the Internet, the official web page for which we do not know the author:

Example: Penn State Myths. (2006). Retrieved December 6, 2011, from <http://www.psu.edu/ur/about/myths.html>

Document or databases from the Internet, private or official web page where the author is a corporation or organization:

For example, the Ministry of Finance and Economy. (2013). Information on tourist traffic in Serbia. Retrieved on 06 February 2013 from <http://www.turizam.mfp.gov.rs/index.php/sr/2010-02-11-17-24-30>

The sources which were not used in the paper should not be included in the list of references. References should be cited in the language in which they are published without translating them into the language of paper.

Obrazac za pripremu radova za objavljivanje u časopisu Serbian Journal of Engineering Management

Naslov rada na srpskom jeziku

Ime Prezime^{3*}, Ime Prezime², Ime Prezime³ [ostavite u ovoj verziji prazno za potrebe recenzije]

¹ Institucija i i-mejl adresa [ostavite u ovoj verziji prazno za potrebe recenzije]

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Apstrakt: Ovaj dokument predstavlja obrazac za formatiranje radova tako da izgledaju kao da su već spremni za štampu. Sažetak predstavlja kratak informativni prikaz sadržaja članka koju čitaocu treba da omogući brzu i tačnu ocenu njegove relevantnosti. Autori treba da obrazlože ciljeve istraživanja ili navedu razlog (razloge) zbog koga pišu članak. Zatim, potrebno je da opišu metode korišćene u istraživanju i ukratko opišu rezultate do kojih su došli u istraživanju. Sažetak treba da sadrži od 100 do 250 reči.

Ključne reči: 3-5 ključnih reči za indeksiranje i pretraživanje

Title of Paper in English

Abstract: This document presents a template for preparing the print-ready papers that will be included in the Serbian Journal of Engineering Management. The abstract briefly summarizes the article and gives the reader the opportunity to assess its relevancy. The authors should elaborate the goals of the research or state their reason (reasons) for writing the paper. It is additionally required for them to describe the methods used during the research and give a brief description of the results and conclusions of the research. The abstract should be between 100 and 250 words in length.

Keywords: 3-5 keywords

1. Uvod

Rad pisati koristeći MS Word za Windows (tastatura za srpsku ćirilicu, latinicu ili engleski jezik - UK). Dužina rada treba da bude najviše 10 strana uključujući tekst, slike, tabele, literaturu i ostale priloge. Format stranice je A4. Koristite 2 cm za donju i gornju marginu, a 2,5 cm za levu i desnu marginu. Razmak između redova u okviru jednog pasusa je jedan, dok je razmak između paragrafa dvostruki. Za formatiranje teksta preporučuje se korišćenje fonta **Times New Roman**.

2. Struktura rada

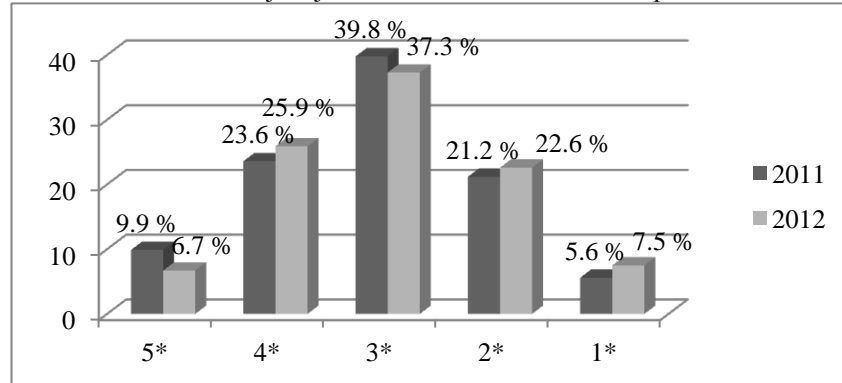
U prvom redu na prvoj strani treba napisati naslov rada na srpskom jeziku (16 pt). Ispod naslova rada treba ostaviti mesto za navođenje ime(na) autora, nazive institucija autora onako kako je naznačeno u ovom Obrascu. Nakon institucije poslednjeg autora, ostaviti jedan prazan red i u sledećem napisati kratak sažetak (10 pt). Nakon sažetka sledi pregled ključnih reči. Nakon prikazanog naslova rada, sažetka i ključnih reči na srpskom jeziku, potrebno je i na engleskom jeziku naznačiti prethodno navedeno.

Numerisane podnaslove prvog nivoa treba formatirati korišćenjem fonta 12 pt boldovano, a podnaslove drugog nivoa 10 pt boldovano. Tekst, kao i spisak literature treba formatirati korišćenjem fonta 10 pt.

3. Grafički i tabelarni prikazi i formule

Sve ilustracije, bez obzira da li su dijagrami, fotografije, grafikoni nazivaju se slike. Naziv i broj slike treba prikazati na sredini reda iznad slike.

Slika 1: Procentualno učešće smeštajnih jedinica u strukturi hotelskih kapaciteta u 2011. i 2012. godini



Izvor: (Ministarstvo finansija i privrede, 2013)

Naziv i broj tabele treba prikazati iznad tabele na sredini reda.

Tabela 1: Procentualno učešće smeštajnih jedinica u strukturi hotelskih kapaciteta u 2011. i 2012. godini

Kategorija	2011.	2012.	Broj smeštajnih jedinica (2011)	Broj smeštajnih jedinica (2012)
5*	9,9	6,7	1452	990
4*	23,6	25,9	3486	3911
3*	39,8	37,3	5895	5636
2*	21,2	22,6	3102	3420
1*	5,6	7,5	1133	1132
ukupno	100	100	15068	15089

Izvor: (Ministarstvo finansija i privrede, 2013)

Pošaljite svoj rad, uključujući tabele, slike itd, kao jednu datoteku. Pored toga, treba dostaviti sve slike i tabele (koje se unose u crno-beloj tehnici) kao posebne fajlove u JPF ili TIFF formatu sa najmanje 300dpi rezolucije.

Formule treba centrirati na stranici sa numeracijom, kao u narednom primeru. Preporučuje se formatiranje redova sa formulama u Microsoft Word-u (MathType).

$$PVo = \frac{FVn}{(1+i)^n} \quad (1)$$

4. Zaključak

U zaključku autori treba da sumiraju rezultate do kojih su došli u istraživanju.

Literatura

Prilikom navođenja literature, treba se pridržavati uputstva APA sistema navođenja literature. Za više informacija pogledajte *Publication Manual of the American Psychological Association* (6th ed.).

Prilikom citiranja unutar teksta, kada u rečenici spominjete autora i navodite njegove reči, onda posle imena autora treba navesti godinu izdanja citiranog teksta u zagradi, a na kraju rečenice potrebno

je navesti broj strane na kojoj se nalazi rečenica u tekstu iz koga navodite: prema Čeroviću (2012), „citirani tekst“ (str.10). Kada se autor ne spominje u rečenici onda njegovo prezime, godinu izdanja rada i broj strane u radu navesti u zagradi i na kraj rečenice, a ako je citat nastao parafraziranjem ili rezimiranjem, onda podatak o broju strane nije neophodan: (Čerović, 2012). Ukoliko se navodi dve ili više referenci istog autora, a pri tom su objavljene u istoj godini, poziv na reference treba navesti na sledeći način (Harish, 2008a; Harish, 2008b). Kada su dva autora rada, navode se prezimena oba autora na sledeći način (Petković i Pindžo, 2012), odnosno (Tew & Barbieri, 2012). Poziv na reference u tekstu za radove sa više od dva autora treba navesti na sledeći način (Luque-Martinez i sar., 2007). Kada citirate izvor koji ne prikazuje broj strana (kao što su elektronski izvori) koristite prezime autora i godinu objavljivanja, ukoliko je autor poznat, a ukoliko je autor korporacija ili organizacija, naziv organizacije i godinu objavljivanja (Ministarstvo finansija i privrede, 2013).

Reference treba navesti zajedno na kraju glavnog teksta azbučnim redom po prezimenu autora. U nastavku su prikazani primeri korišćenja APA stila za citiranje u raznim oblicima pojavljivanja (knjiga, rad u časopisu, zbornik, elektronski izvori itd.).

Knjiga sa jednim autorom:

Primer: Hrabovski, Tomić, E. (2009). *Destinacije zdravstvenog turizma*. Novi Sad: Prometej.

Knjiga sa više autora:

Kada imamo više autora navodimo ih sve, s tim što pre poslednjeg prezimena dodajemo i, odnosno &, ako imamo više od sedam autora, navodimo prvih šest, zatim pišemo pišemo tri tačke, i na kraju poslednjeg autora.

Primer: Barrows, C. W. & Powers, T. (2009). *Introduction to the Hospitality Industry*. 7th edition. Hoboken, New Jersey: John Wiley&Sons, Inc.

Knjiga, prevod dela:

Primer: Spic, E. H. (2011). *Umetnost i psiha: studija o psihoanalizi i estetici*. (A. Nikšić, prev.). Beograd: Clio.

Knjiga sa urednikom ili priređivačem, zbornik radova:

Ako je knjiga zbornik radova na neku odgovarajuću temu, kao autora navodimo priređivača tog dela i uz njegovo prezime i inicijal imena u zagradi dodajemo "ured." ako je urednik, ili "prir." ako je priređivač, ili pak "Ed." kao editor ako je knjiga pisana na stranom jeziku.

Primer: Đurković, M. (ured.) (2007). *Srbija 2000-2006: država, društvo, privreda*, Beograd: Institut za evropske studije.

Rad u zborniku radova:

Primer: Čerović, S. (2012). *Savremeni koncepti strategijskog upravljanja turističkom destinacijom*. Naučni skup sa međunarodnim učešćem "Turizam: izazovi i mogućnosti", Trebinje.

Rad u časopisu sa jednim autorom:

Primer: Harish, R. (2008). Brand Architecture and its Application in Strategic Marketing. *The Icfai University Journal of Brand Management*, 7(2), 39-51.

Rad u časopisu sa dva autora:

Ako članak na koji se pozivate ima DOI broj, treba ga dodati referenci.

Primer: Tew, C. & Barbieri, C. (2012). The perceived benefits of agritourism: The provider's perspective. *Tourism Management*, 33(6), 215-224. doi:10.1016/j.tourman.2011.02.005

Rad u časopisu sa više od dva autora:

Primer: Luque-Martinez, T., Castaneda-Garcia, J. A., Frias-Jamilena, D. M., Munoz-Leiva, F. & Rodriguez-Molina, M. A. (2007). Determinants of the Use of the Internet as a Tourist Information Source. *The Service Industries Journal*, 27(7), 881-891. doi: 10.1080/02642060701570586

Članak iz novina sa navedenim autorom:

Primer: Mišić, M. (1. feb. 2012). Ju-es stil smanjio gubitke. *Politika*, str. 11.

Članak iz novina bez navedenog autora:

Primer: Straževica gotova za dva meseca. (1. feb. 2012). *Politika*, str. 10.

Teza-štampana verzija:

Primer: Dewstow, R. A. (2006). *Using the Internet to enhance teaching at the University of Waikato* (Unpublished master's thesis). University of Waikato, Hamilton, New Zealand.

Dokumenta ili baze podataka sa interneta, privatne ili zvanične internet stranice kojima se zna autor:

Primer: Kraizer, S. (2012). *Safe child*. preuzeto 29. oktobra 2012, sa <http://www.safechild.org/>

Dokumenta ili baze podataka sa interneta, zvanične internet stranice kojima se ne zna autor:

Primer: *Penn State Myths*. (2006). Preuzeto 6. decembra 2011, sa <http://www.psu.edu/ur/about/myths.html>

Dokumenta ili baze podataka sa interneta, privatne ili zvanične internet stranice kojima je autor korporacija ili organizacija:

Primer: Ministarstvo finansija i privrede. (2013). *Informacije o turističkom prometu u Srbiji*. preuzeto 06. februara 2013. sa <http://www.turizam.mfp.gov.rs/index.php/sr/2010-02-11-17-24-30>

Izvori koji nisu korišćeni u radu ne treba da se nalaze u popisu literature. Reference treba navoditi na jeziku na kome su objavljene bez prevođenja na jezik rada.

Instructions for Authors

The Journal Committee strives to maintain the highest academic standards. The submitted papers should be original and unpublished until now. Also, it is forbidden that papers are in the process of reviewing in some other publication.

The papers would be subjected to check. The paper should fit the outlined academic and technical requirements.

Paper Types

Original unpublished scientific paper:

- Original scientific paper;
- Plenary lecture and paper presented at the conference;
- Review paper;
- Scientific review; discussion.

Original unpublished professional paper:

- Original professional paper;
- Contribution
- Book review.

Papers may be written in Serbian and English for authors from Serbia and the region or English for authors from other countries.

Submitted papers must be in alignment with guidelines for authors. In case they have not followed these guidelines, they would be reviewed for correction.

All manuscripts are subject to *double blind review*, i.e. the process of double “blind” anonymous reviewing. The papers must not contain any references which may indicate the author(s).

Paper Submission

Authors should send their papers via email casopis@fim.rs in .doc or .docx format.

The application consists of two separate attachments:

- Attachment 1, which contains the following data: the title of paper, author’s name (without professional title), institution and address (email, postal address, phone number), as well as the asterisk next to the author in charge of correspondence;
- Attachment 2, which contains the paper with the following elements: paper title, abstracts, key words, the middle part of the paper, tables, graphs, references and attachments.

Authors, who pass the *double blind* anonymous review, will receive the document called the Author’s Statement of Originality, which will be filled in, underlined, scanned and sent to the email: casopis@fim.rs.

Paper content

All papers should contain: introduction, which elaborates on the aim and subject of the research, main hypothesis, work methods and paper structure; middle part of the paper where research is outlined (it is further divided into sub-headings) and conclusion, which represents summed up results and implications for further research.

Author’s rights

After accepting the paper and signing up the Author’s Statement of Originality, the author signs the statement according to the Author’s Rights of the Journal.

Author's editions

Authors of published papers will receive one print version of the paper for their personal usage.

Paper submissions:

Papers should be submitted via email: casopis@fim.rs.

Uputstvo za autore

Uredništvo časopisa nastoji da održi visok akademski standard. Radovi, koji se podnose, treba da budu originalni i do sada neobjavljeni. Takođe, radovi ne smeju da se nalaze u postupku recenzije u nekom drugom časopisu. Radovi će biti podvrgnuti proveru. **Tekst rada mora da odgovara akademskim i tehničkim zahtevima.**

Tip rada

Originalni naučni rad, koji nije objavljen:

- Originalni naučni rad;
- Plenarno predavanje i rad prezentovan na konferenciji;
- Pregledni rad;
- Naučna kritika, odnosno polemika.

Originalni stručni rad, koji nije objavljen:

- Stručni rad;
- Informativni prilog;
- Prikaz knjige.

Jeziči radova mogu biti srpski i engleski za autore iz Srbije i engleski za autore sa drugih govornih područja.

Podneti radovi moraju biti usaglašeni sa uputstvom za autore. U slučaju da nisu usaglašeni, biće vraćeni na ispravljanje.

Svi rukopisi podležu tzv. *double blind* recenziji, odnosno procesu dvostruko „slepe“, anonimne recenzije. Tekst rada ne sme da sadrži bilo kakve reference koje mogu da ukažu na autora/e rada.

Prijava radova

Autori treba da pošalju svoje radove elektronski, putem i-mejla casopis@fim.rs u vidu priloga u .doc ili .docx formatu.

Prijava se sastoji iz dva odvojena priloga:

- Prilog 1, koji sadrži sledeće podatke: naslov rada, imena autora (bez titula i zvanja), institucija/e i adresa/e (i-mejl, poštanska adresa, broj telefona), kao i zvezdicu kod imena autora koji je zadužen za korespondenciju;
- Prilog 2, koji sadrži rad sa sledećim elementima: naslov rada, apstrakt/i, ključne reči, središnji deo rada, slike, tabele, grafikoni, reference, prilozi;

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