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CONTENT/SADRŽAJ

A Message from the Editor-in-Chief

Serbian Journal of Engineering Management is a scientific journal, published by School of Engineering Management and Society of Engineering Management of Serbia. The Journal is cathegorized by the Ministry of science, technological development, and Innovation of the Republic of Serbia. From 2020, the Journal is indexed in EBSCO databases. This international Journal is dedicated to the wide scope of themes associated to engineering management and industrial engineering and is published semiannualy. The papers are presented in English.

Themes included in the journal are: Engineering management, Industrial engineering, Project management, Strategic management, Logistics, Operations management, Production systems management, Quality control, Quality management, Entrepreneurship, Risk management, Human resources management, Leadership, Organizational behaviour, Organizational culture, Financial management, Information systems, High technologies management, Environmental management, Waste management, Maintenance management, Creative industries management, Security management, and Marketing.

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Information on the journal in English and Serbian can be found at the journal web page: https://fim.edu.rs/en/serbian-journal-of-engineering-management/.

Prof. Dr. Vladimir Tomašević, FRSA

Reč urednika

Serbian Journal of Engineering Management je naučno-stručni časopis, koji izdaje Fakultet za inženjerski menadžment i Društvo inženjerskog menadžmenta Srbije. Časopis je kategorisan od strane Ministarstva nauke, tehnološkog razvoja i inovacija. Časopis je takođe od 2020. indeksiran u EBSCO bazama. Ovaj međunarodni časopis je posvećen temama povezanim sa inženjerskim menadžmentom i industrijskim inženjerstvom i izlazi dva puta godišnje (u januaru i julu). Zastupljeni jezik za članke je engleski.

Teme zastupljene u časopisu su: inženjerski menadžment, industrijsko inženjerstvo, upravljanje projektima, strategijski menadžment, logistika, menadžment operacija, menadžment proizvodnih sistema, kontrola kvaliteta, upravljanje kvalitetom, preduzetništvo, upravljanje rizikom, upravljanje ljudskim resursima, liderstvo, organizaciono ponašanje, organizaciona kultura, finansijski menadžment, informacioni sistemi, menadžment u visokotehnološkim industrijama, menadžment životne sredine, upravljanje otpadom, menadžment održavanja, menadžment kreativnih industrija, bezbednosni menadžment i marketing.

Uredništvo časopisa čine istaknuti naučnici iz različitih zemalja sveta koji su posvećeni postavljanju visokog akademskog standarda i promocije principa inženjerskog menadžmenta u Srbiji.

Informacije o časopisu i poziv za autore, na srpskom i engleskom jeziku, nalaze se na web stranici časopisa: https://fim.edu.rs/istrazivanje-i-saradnja/naucno-strucni-casopis/.

Prof. dr Vladimir Tomašević, FRSA

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Informacione tehnologije kao alat za razvoj digitalnog preduzetništva i ostvarivanje konkurentske prednosti

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Apstrakt: Informacione tehnologije i dalje predstavljaju industriju koja je u razvoju. Zahvaljujući invencijama u razvoju softvera, hardvera, kao i informacionih i komunikacionih tehnologija, javile su se brojne prednosti koje se ogledaju u poslovnoj integraciji, preduzetničkim poduhvatima, kao i mikro, malim i srednim i velikim preduzećima, gde se uštede i profit ostvaruju upravo zahvaljujući informacionim tehnologijama. Definisanje poslovne strategije, u skladu sa uticajima informacionih tehnologija, odnosi se na definisanje proizvoda i usluga, načina poslovanja i predviđanja. Upravo zahvaljujući razvoju informacionih tehnologija, tradicionalni preduzetnički poduhvati postaju digitalni preduzetnički poduhvati, koji postaju daleko konkurentniji. Ovaj rad ima za cilj da kroz pregled literature definiše digitalno preduzetništvo, da uoči osnovne prednosti digitalnog preduzetništva u odnosu na tradicionalno i da prikaže značaj korišćenja informacionih tehnologija i digitalnih platformi za razvoj konkurentnih digitalnih preduzetničkih poduhvata.

Ključne reči: tradicionalno preduzetništvo, digitalno preduzetništvo, digitalne tehnologije, digitalizacija preduzetničkog poduhvata

Information Technologies as a Tool for the Development of Digital Entrepreneurship and Achieving a Competitive Advantage

Abstract: Information technology continues to be a growing industry. Thanks to the inventions in the development of software, hardware, as well as information and communication technologies, there have been numerous advantages that are reflected in business integration, entrepreneurial ventures, as well as micro, small and medium and large enterprises, where savings and profits are realized thanks to information technologies. Defining the business strategy, in accordance with the influences of information technology, refers to the definition of products and services, ways of doing business and forecasting. Thanks to the development of information technologies, traditional entrepreneurial ventures are becoming digital entrepreneurial ventures, which are becoming far more competitive. This paper aims to define digital entrepreneurship through a literature review, to see the basic advantages of digital entrepreneurship compared to traditional ones and to show the importance of using information technologies and digital platforms for the development of competitive digital entrepreneurial ventures.

Keywords: traditional entrepreneurship, digital entrepreneurship, digital technologies, digitization of entrepreneurial enterprise

1. Introduction

Information technologists have a fundamental influence in modern society. Today, the means of transmitting and exchanging and sharing large amounts of information are greater than ever before in history. Business improvement is the main goal of using information technologies that provide innovative solutions, which are reflected in the reduction of costs and the increase of company profits. Through an innovative way of doing business, digital entrepreneurs have a great influence on the entire world, especially in the last decade. Business giants such as Google, Facebook, Apple and Microsoft have not only influenced changes in the business world, they have also influenced the shaping of the way of communicating with other people in the environment. Storing and processing information is not

only becoming easier, but also more flexible and economical, as cloud services continue to develop and the Internet turns into the so-called IoT (Internet of Thinks) (Kraus et al., 2018). As the phenomenon of digitization causes various implications through rapid changes, it is of utmost importance for entrepreneurial research and entrepreneurs must be aware of new results, they must know how to connect new results and know how to identify new opportunities for their business ventures . Digital entrepreneurship is a phenomenon that occurs through certain technological means, such as the Internet and information and communication technologies (Le Dinh et al., 2018). Any entrepreneurial activity that transfers property, service or a certain part of business digitally can be characterized as digital entrepreneurship. Digital entrepreneurs face many differences compared to traditional entrepreneurs. Products, marketing activities and the workplace can be argued to be the main criteria of differentiation between digital and non-digital entrepreneurs (Hull et al., 2007). In order to implement sustainable innovation, entrepreneurs must be aware of the opportunities that digital technologies provide them. In the following, it will be shown the way in which modern literature views digital entrepreneurship, as well as the differences between traditional and digital entrepreneurship that entrepreneurs should use in order to follow modern business conditions and create a competitive advantage that will positively affect their business.

2. Digital entrepreneurship as a modern form of business for gaining competitive advantage in turbulent market conditions

Digital entrepreneurship can be said to be one of the categories of entrepreneurship. Digital entrepreneurship is realized through innovative products and services, on different digital platforms, which are the result of progressive advances in technology where entrepreneurs have the opportunity to take advantage of the development. Newly developed software, applications, social networks, as well as easier access to information technologies, have provided numerous new opportunities for entrepreneurs. Precisely thanks to the progress of high technologies, digital entrepreneurship is becoming a new form of entrepreneurship in entrepreneurship. As previously stated, digital entrepreneurship can be defined as the realization of entrepreneurship on digital platforms (Balli, 2020). Digital platforms have provided flexibility, speed, lower costs, quality, the ability to respond to different demands and needs, as well as innovations that create the phenomenon that there are new demands and needs among consumers.

Digital entrepreneurship is an entrepreneurial activity that is carried out by developing, marketing and selling products and services that individuals can obtain via the Internet. The best examples of digital entrepreneurship today are seen through mobile software, social platforms, websites developed for information exchange and entertainment, computer software, as well as education and counseling (Vural and Cavus, 2017). In introducing innovative business practices in today's turbulent market, digital entrepreneurship has a significant role to play. Digital entrepreneurship can be defined as the digitization of one or more predefined business models, in terms of products, distribution and workplace, by entrepreneurs (Hair et al., 2012). From the above definition, it can be concluded that digital entrepreneurship consists of the sale of digital products or services, through certain digital platforms or electronic networks, and as it is a subcategory of entrepreneurship, there are certain segments in the traditional entrepreneurial venture that need to be physically digitized.

In today's consumer society, the transmission of information is accelerating thanks to the development of information and communication technologies. Geographical distances are no longer an obstacle. Digital entrepreneurship emerged as a result of current development and as such, represents a new economic order. It is precisely this that allows entrepreneurs to achieve a competitive strategy that helps them overcome the difficulties that are the answer to today's unstable environment.

Sussan and Acs (2017) expanded the view on digital entrepreneurship. They consider the user dimension. Digital entrepreneurs are viewed as Kirznar entrepreneurs who function within the constraints of existing platforms. In other words, they perform activities that require digital engagement, where they cite the example of the Uber driver - the agent needs the use of digital technologies, he searches for and acts on those opportunities within the market (Sussan & Acs, 2017). Digital technology provides the user with the effect of increasing efficiency by moving the economy closer to the technological frontier.

Digital entrepreneurship has developed as a concept that appears as a result of the development and spread of information and communication technologies. It can be said that digital entrepreneurship is

an attempt of the current entrepreneurial environment to adapt to the needs of the digital age in the context of developing and changing conditions (Le Dinh et al., 2018). Digital entrepreneurship encompasses all new and existing businesses that strive to create economic and social value through digital technologies.

As previously stated, in digital entrepreneurship, some or all of the traditional entrepreneurial activities take place digitally. According to Hull (2007), in this context, there are three forms of digital entrepreneurship - digital entrepreneurship that is viewed and implemented as a complementary element (light entrepreneurship), digital entrepreneurship in which companies digitally allocate more resources to products, distribution and some components in terms of creating additional values (medium digital entrepreneurship) and digital entrepreneurship that requires monitoring of all processes, starting from the supply chain, all the way to the end user (extreme digital entrepreneurship).

With this classification, Hull laid a certain basis for the subsequent interpretations of the components within the ecosystem of digital entrepreneurship, which have a large part in shaping digital entrepreneurship, and therefore the characteristic in which digital entrepreneurship occurs. A digital entrepreneurship ecosystem encourages entrepreneurs to generate ideas, identify and allocate resources, use digital market opportunities, as well as gather information and create legitimacy for innovation (Davidson and Vaast, 2010). The ecosystem of digital entrepreneurship can be said to be an area of interaction where entrepreneurs have the opportunity to achieve planned desired results.

The main areas that support the development of digital entrepreneurship, which is based on high technology, are based on the increase of human and financial capital, on the process of entrepreneurship that includes the search for opportunities (regardless of the limitation of resources), on the increased speed of business, on a strategic global perspective, as and on the motivation and goals that lead to closeness for cooperation (Engel et al., 2015).

Thanks to the fast and easy transfer of information flow with the developing technologies of new generations, digital entrepreneurship is taking an increasing role in the development of the economy of every country. The transition from traditional forms of entrepreneurship to digital components is necessary to gain a competitive advantage.

3. Advantages of digital entrepreneurship compared to traditional entrepreneurship

There are still not many studies in the field of digital entrepreneurship in the literature. Case studies differ, where a smaller percentage of research is within a specific sample, while on the other hand, a higher percentage of theoretical research. Hull (2007) tried to be among the first researchers to express the differences between the typology of traditional entrepreneurship and digital entrepreneurship, in typological studies of digital entrepreneurship. Then, Liao (2013) in his study reaches significant conclusions about how the digital business industry can be managed, as well as process and product innovation.

Castro (2016) concludes that digital music, digital games and social networks are something that shows a greater potential to develop new products and he proved this in his study on the potential new opportunities arising from the combination of digital music and game industries with network innovations. Nambisan (2017) explains how entrepreneurs can deal with uncertainties in the market, thanks to digital approaches in his study where he investigates the encounter of digital entrepreneurs with digital technologies. The following table shows the most significant differences between traditional and digital entrepreneurship.

Table 1: Differences between traditional and digital entrepreneurship

	Traditional entrepreneurship	**Digital entrepreneurship**
Entering the market	Difficult	Eased
Production and storage	Difficult	Eased
Distribution	Slower	Faster
Workplace	Physically garthert	The digital workplace
Organizational commitment	Made easy	Made hard
Communication form	Face to face	With computer and digital technologies
Organizational structure	Hierarchical	Flexible and corporate

Source: (Hull et al., 2007: 296-298; Hafezieh et al., 2011: 269-270; Ozdemir, 2016:6)

Through the implementation of modern information technologies, which include new information architectures, databases and data warehouses, data protection, data management, as well as computer communication and modern statistical software, the improvement of micro-competitiveness is facilitated, which is the way to a profitable business (Domazet & Neogradi , 2018). As the advantages of digital entrepreneurship compared to traditional ones are mostly reflected in electronic business, it is important to emphasize that electronic business is a concept that, with its appearance, has revolutionarily changed the way the modern world functions. The impact of information technology on creating a competitive advantage has never been stronger than it is today. This was particularly influenced by the development of the fourth industrial revolution, which put pressure on companies to review their current business strategies and explore new business opportunities, looking for space to digitize their traditional forms of business. Start-up companies must permanently transform their strategic intentions and capabilities, in order to continue to focus on the needs of a new type of active customers - members of the network and millennial generation, the new generation of connected and inclusive customers (Petković, 2021). Information technologies and digitization inevitably affect existing business models in such a way that companies that want to strengthen their competitive advantage and position must change their business models in accordance with digital trends. The digital business model itself becomes a source of innovation and a tool for gaining competitive advantage in digital entrepreneurship.

4. Conclusion

The progress of information technologies has created a huge space for the development of digital entrepreneurship. Early technology adopters under Everett Rogers' diffusion of innovation theory (Orr, 2003) use the opportunities provided by new technologies to create new opportunities and start new entrepreneurial ventures. According to Internet World Stats (2020), over 4.5 billion people use the Internet, which is only an indication of the potential opportunity for all persons who possess entrepreneurial potential and relevant entrepreneurial skills and competencies (Simović & Radović, 2018). Digital entrepreneurship is a subcategory of entrepreneurship that emphasizes the need to realize entrepreneurial opportunities based on digital media and communication and information technologies. Business opportunities in the field of digital entrepreneurship are considered efforts to generate financial gain, while knowledge opportunities are directed towards information search and other knowledge-related opportunities (Hosu & Lancu, 2017). Institutional opportunities refer to the activities of creating new institutions, as well as the transformation of existing ones. Soltanifar et al. (2020) presented in their monograph a whole set of practical tools that can be directly applied in the field of digital entrepreneurship. In this way, they motivate entrepreneurs, as well as students who have a highly developed potential of digital entrepreneurial competences, to turn to starting their own entrepreneurial venture. Entrepreneurship is undeniably a very important segment for the development of the economy and economy of any country. Digital entrepreneurship, as a consequence of the development of information and communication technologies, especially after the pandemic of the COVID-19 virus, is becoming more and more important for every developing country. Understanding how technologies can be applied in digital entrepreneurship provides a sustainable competitive advantage.

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Znanja, veštine i sposobnosti neophodni za operatere UAS

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Apstrakt: Upotreba borbenih i komercijalnih dronova je u sve značajnijem porastu. Pored upotrebe vojnih dronova u vojne svrhe i komercijalnih u civilne svrhe, takođe su poslednji sukobi u Nagorno Karabahu i Ukrajini ukazali i na mogućnost upotrebe komercijalnih dronova u vojne svrhe. Profesija operatera drona postaje sve popularnija, među mladim ljudima zaintersovanim za STEM obrazovanje. Za izvršavanje različitih zadataka i aktivnosti potrebne su donekle različite veštine operatera dronova, ali je osnova ista. Cilj ovog rada je da analizira znanja, veštine i sposobnosti za operatere UAS, kako vojne, tako i civilne. Na osnovu analize literature i rezultate diskusije fokus grupe, kreirani su opisi posla sa specifikacijom izvršilaca za vojne i civilne operatere UAS, uz preporuke za budući razvoj operatera UAS u Republici Srbiji.

Ključne reči: UAS, operateri, znanja, veštine i sposobnosti

Knowledge, Skills, and Abilities Needed for UAS Operators

Abstract: The use of combat and commercial drones is on the rise. In addition to the use of military drones for military purposes and commercial drones for civilian purposes, the recent conflicts in Nagorno-Karabakh and Ukraine also indicated the possibility of using commercial drones for military purposes. The profession of drone operator is becoming increasingly popular among young people interested in STEM education. Different tasks and activities require somewhat different drone operator skills, but the basics are the same. The aim of this paper is to analyze the knowledge, skills and abilities for UAS operators, both military and civilian. Based on the analysis of the literature and the results of the focus group discussion, the job descriptions were created with the job specifications for military and civilian UAS operators, along with recommendations for the future development of UAS operators in the Republic of Serbia.

Keywords: UAS, operators, knowledge, skills, and abilities

1. Introduction

Unmanned Aircraft Systems (UAS) are becoming more significant in the last decade, both in military and civil purposes. The expression *Unmanned Aircraft System* was coined in the United States in 2005 by Department of Defense (DoD) and the Federal Aviation Administration (FAA) (Granshaw, 2018).

Undoubtedly, recent conflicts in Nagorno-Karabakh (Ilic, Tomasevic, 2021) and Ukraine (Zabrodskyi, et al. 2022) showed the possibilities of combat implementation of UAS. Furthermore, the war in Ukraine shows that drones are becoming a significant factor in conventional warfare (Eslami, 2022). The scale of their use in the war in Ukraine is unprecedented and exceeds the conflict in Nagorno-Karabakh. The impact of drones on the changing character of warfare is a very important topic for further research, as there are still not enough studies.

However, the possibilities of civil and commercial use of UAS, are endless, and many researchers focused on the topics of non-military use of UAS. UAS can be used in scientific research (biology, archaeology, geography, etc.); education; creative industries; (Skrzypietz, 2012; González-Jorge et al. 2017); health (Restás 2022); 3D mapping; photogrammetry and remote sensing construction (Freimuth and Everaerts, 2008); agriculture, etc. (Rasmussen et al. 2013; Ehmke 2013); delivery and transport (Li, et al. 2022). UAS are seen as a powerful tool in environmental, risk prevention and management, especially in cases of floods, earthquakes, and wildfires (Fernández-Guisuraga et al. 2018; Zormpas et

al. 2018; Wang et al. 2022; Gebrehiwot et al. 2019; Gray, & Weston, 2021). In the area of security (critical infrastructure security, border security, traffic control, manmade disasters, like radiation leaks, etc.), UAS is also becoming very important tool for prevention and monitoring (Li et al. 2018; Kamnik et al. 2020).

The limitless possibilities of UAS application in military and civil purposes require recruitment, hiring and training of greater number of UAS operators with specific set of knowledge, skills, and abilities. An UAS operator can be defined as a person who operates, or controls, or navigates an unmanned aircraft system. The first part of this paper explores existing literature on specific set of knowledge, skills, and abilities needed for UAS operators both for military and civil purposes, the second part presents the results of a focus group discussion and the job descriptions and specifications of civil and military UAS operators alike. Finally, future recommendations for the defence system of the Republic of Serbia are given.

2. Literature review on knowledge, skills, and abilities needed for UAS operators

Every job position is defined by its *job description*, which could be defined as a list of job's duties, responsibilities, reporting relationships, working conditions, and supervisory responsibilities and its job specification (required knowledge, skills, and abilities). A list of responsibilities, chain of accountability, job conditions, etc. is often called *job description* in its narrow sense. A list of a job's "human requirements," that is, the necessary education, skills, and personality is often termed *job specification* (Dessler, 2013). Both categories are products of a process called job analysis (Siddique, 2004; Prien, et al. 2009). It can be stated that the process of job analysis is a foundation of all future human resources management processes. Development of KSAO's (knowledge, skills, abilities and other characteristics) is also occasionally defined in scientific and professional research as competency modelling, but with an addition to job analysis – inclusion and accentuation of job performance (Campion, et al. 2011).

Knowledge, skills, and abilities requirements for military UAS operators have to be developed in a more complex manner because their responsibilities include, not only drone operating knowledge, skills, and abilities, but military skills, too - firearms operating skills, military tactics knowledge, etc. (Žnidaršič, et al. 2020). In developing job descriptions for military UAS operators, one of the crucial factors that should be taken into the account is psychological dimension, which is to perform under combat circumstances and the ability to manage psychological effects of loss of lives (Chappelle, 2014; Hijazi, et al. 2019; Saini, et al. 2021; Voice, 2022; Richardson, 2022). Kirkpatrick, (2015) analyzed risk management and courage of operators of combat UAS.

Schmidt, et al. 2022, emphasised development of UAS operators' competencies and the importance of training programs for achieving required level of competencies. Some authors propose training programs for developing future drone operating skills through gamification, using various web and other IT based platforms and virtual reality, both for military and civil UAS operators that can be offered through higher, and even secondary STEM education (Bartholomew & Mayo, 2018; Cardona Reyes, et al. 2021). Lamb, et al. (2022) emphasized perception of risk of UAS operators as an important competence and Pena (2014) stressed out the accountability as a key factor of UAS operators' competencies. Adams (2020) focused on UAS operators' skills in online journalism as a specific category of UAS operating, similarly Borowik, et al. (2022) paid attention to the skills of UAS operators needed for filming.

3. Development of set of knowledge, skills and abilities needed for UAS operators

One of the most important components of UAS operations are their operators' qualifications (Marshall, et al. 2012). Development of job descriptions for military and commercial UAS operators is a multifaceted process that is different for each of these groups, so both processes should be approached with special thoughtfulness. As there are not a significant number of UAS operators in the Republic of Serbia, a focus group is organized instead of research through survey and statistical analysis. Expert focus groups as a method of a qualitative study are common research method. Focus groups are often defined as a group interview with a moderator, usually consisted of experts (Albanesi, 2014). The

academics and experts in a certain field debate on a defined issue following questions set by semi-structured interviews (Van Audenhove, Donders, 2019; Li, 2019). In newer studies, focus grpup interview is considered very informative and important method of researching many subjects in varipus social sciences (Van Soest, 2022).

The focus group included the experts in security, risk management, strategic management, environmental studies and a UAS operator. A Zoom focus group session is organized on September 10, 2022. The author was a moderator, and a transcriber of the answers. This focus group was organized as an unstructured discussion on wide range of subjects related to development of knowledge, skills, and abilities of military and civil UAS operators.

Table 1. Expert focus group composition (Source: author)

Code	Field	Expertise	Position
Expert 1	Higher education	Security and military studies	Full professor
Expert 2	Higher education	Strategic management	Research fellow
Expert 3	Higher education	Human resources management	Associate professor
Expert 4	Information technologies	Information technologies	Project manager
Expert 5	Risk management	UAS operations	UAS operator
Expert 6	Higher education	Environmental studies	Research fellow

4. Results

In a discussion, several main topics emerged. Expert 1 emphasized the importance of various combat skills needed for military UAS operators, which has not any significance for civil UAS operators, nevertheless, future military UAS operators can be recruited from the pool of civil operators and UAS enthusiasts and could receive proper military training through military academy or other forms of military training. Expert 4 stressed out the importance of information technologies education and constant learning of the students who engage in operating civil UAS who in the future would participate in various activities that require the involvement of UAS, expert 1 added that it is the basis for both, military and civil operators.

Expert 2 emphasized the importance of development of government strategy on UAS implementation in various fields and the inclusion of UAS in local governments' strategy on the adoption of smart cities, especially for the city of Belgrade. Those strategies would be a framework of the process of development of competencies needed for UAS operators. Expert 6 gave emphasis on the promoting the awareness of various fields in which UAS can already be involved (environmental protection, firefighting, flooding prevention and monitoring, deforestation monitoring, agriculture, etc.).

Expert 3 highlighted the importance of multi-team cooperation in development of knowledge, skills, and abilities for UAS operators that would include expert UAS operators, experts in human resources with the expertise in job analysis and in development of job descriptions and job specifications. Expert 5 stated the importance of continual updating of existing job descriptions and job specifications because of fast changes in the field of UAS operations and their application.

According to the literature review and the focus group discussion results, following job descriptions and job specification for military and civil UAS operators can be proposed:

a. Military UAS operators

Job description

- General UAS operations performance (Technical skill, take-off, climb, cruise, landing and recovery, emergency disposal);
- Following appropriate safety procedures;
- Implementing appropriate operations procedures;
- Mission planning;
- Instruments monitoring;

- Map reading;
- Risk estimation;
- Emergency procedures performing;
- Specific UAS operations performance (combat performance).

Job specification

- Knowledge of UAS components;
- Knowledge of ergonomics;
- Visual ability (high level);
- Attention to detail;
- Hand-eye coordination;
- Motor skills;
- Spatial orientation;
- Information technologies proficiency;
- Teamwork skills;
- Independent thinking skills;
- Leadership skills;
- Communication skills;
- English language proficiency;
- Knowledge of UAS regulation;
- Analytical skills;
- Problem solving kills;
- Active listening skills;
- Prioritization skills;
- Multitasking skills;
- Risk management skills;
- Time management skills;
- The ability of performance under extreme stress;
- The ability to perform under extreme pressure;
- Judgement and decision making skills;
- Knowledge of military strategies and tactics;
- Combat capabilities.

b. Commercial UAS operators

Job description

- General UAS operations performance (take-off, climb, cruise, landing and recovery, emergency disposal);
- Specific UAS operations performance (3D mapping; photogrammetry and remote sensing; delivery and transport, firefighting; crops spraying; scientific research; etc.);
- Following appropriate safety procedures;
- Mission planning;
- Instruments monitoring;
- Map reading;
- Risk estimation;
- Emergency procedures performing;
- Implementing appropriate operations procedures

Job specification

- Knowledge of UAS components;
- Knowledge of ergonomics;
- Visual ability (high level);
- Attention to detail;
- Hand-eye coordination;
- Motor skills;
- Spatial orientation;
- Information technologies proficiency;

- Communication skills;
- Teamwork skills;
- Independent thinking skills;
- Leadership skills;
- English language proficiency;
- Knowledge of UAS regulation;
- Analytical skills;
- Problem solving kills;
- Active listening skills;
- Prioritization skills;
- Multitasking skills;
- Risk management skills;
- Time management skills;
- Stress management skills;
- Judgement and decision making skills;
- General knowledge of a particular field (archaeology, traffic, transportation, agriculture, entertainment industry, etc.).

5. Recommendations for the defence system of the Republic of Serbia

The first recommendation is to develop more STEM programs and awareness of STEM sciences significance, not only through secondary and higher education, but to begin with the programs in elementary education through courses and workshops that include programs adjusted to the younger population and appropriate educational levels. One of the prerequisites of developing future UAS operators is development secondary and higher education programs in: maths, physics, engineering, computer science, programming, data analytics, data visualisation, data mapping, etc. (Hoagland, 2013). The second recommendation is to include gamification as a tool for developing future UAS operators (both civilian and military).

It is important to understand that both civil and military UAS operators are needed in the future job market, because there is often not a clear line between the need for engagement of civil or military UAS operators, for example in cases of ecological or man-made accidents, disasters (fires, earthquakes, floods, etc.), when knowledge, skills, and abilities of both civil and military UAS operators would be of crucial importance.

6. Limitations and further study

As technologies' development is very rapid, research of knowledge, skills, and abilities required of any job position that includes fast changing information technologies needs to be instigated on regular basis, because some of the conclusions may become obsolete very quickly. Future studies should be focused on further development of UAS technologies and changes in requirements for UAS operators both in military and civil sector.

7. Conclusion

The aim of this paper was to analyse the knowledge, skills and abilities for UAS operators, both military and civilian. Based on the analysis of the literature and the results of the focus group discussion, the job descriptions and job specifications for military and civilian UAS operators were proposed, along with recommendations for the future development of UAS operators in the Republic of Serbia. The most important step would be promotion of STEM sciences, especially information technologies and education of generations that could be educated for military and civil UAS operators.

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Sektor neformalne reciklaže u Srbiji kroz perspektivu zdravlja

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Apstrakt: Iako su reciklaža, spaljivanje i druge metode tretmana otpada dostupne, deponije i dalje dominiraju odlaganjem otpada u Srbiji. Bez pravilnog upravljanja, brojne deponije predstavljaju ozbiljnu opasnost, kao što je primer požara na više deponija u Srbiji u avgustu 2021. Pored formalnih sistema za reciklažu otpada, oko 15 miliona ljudi učestvuje u neformalnoj reciklaži otpada, pre svega plastike, metala, stakla i papira, dok u Srbiji, prema procenama, učestvuje između 30 i 50 hiljada. Ovaj rad analizira nova pitanja javnog zdravlja, posebno povezana sa neformalnim sektorom reciklaže otpada u Srbiji. Iako neformalni recikleri doprinose reciklaži i ponovnoj upotrebi otpada, relativno rudimentarne tehnike koje koriste, u sprezi sa nepravilnim upravljanjem sekundarnim zagađivačima, pogoršavaju zagađenje vazduha, zemljišta i vode u životnoj sredini. Što je još gore, neadekvatne mere zaštite na radu izlažu radnike koji rade na otpadu u neformalnom sektoru raznim zagađivačima, povredama, respiratornim i dermatološkim stanjima, infekcijama i drugim značajnim zdravstvenim problemima koji doprinose niskom životnom veku. Integracija neformalnog sektora sa njegovim formalnim pandanima mogla bi poboljšati upravljanje otpadom, a istovremeno bi se bavila ovim ozbiljnim zdravstvenim i životnim pitanjima.

Ključne reči: upravljanje otpadom, zdravstveni rizici, odlagališta, deponije

Informal Recycling Sector in Serbia through a Health Perspective

Abstract: Even though recycling, incineration, and other waste treatment methods are available, landfills continue to dominate waste disposal in Serbia. Without proper management, numerous landfills pose grave dangers, as exemplified by the August 2021 fires at multiple landfills in Serbia. In addition to formal waste recycling systems, approximately 15 million people participate in informal waste recycling, primarily for plastics, metals, glass, and paper, while this figure in Serbia is estimated to be between 30 and 50 thousand. This review analyses emerging public health issues, particularly associated with the informal waste recycling sector in Serbia. Although informal recyclers contribute to waste recycling and reuse, the relatively rudimentary techniques they employ, in conjunction with improper management of secondary pollutants, exacerbate environmental pollution of air, soil, and water. Even worse, inadequate occupational health measures expose informal waste workers to a variety of pollutants, injuries, respiratory and dermatological conditions, infections, and other significant health problems that contribute to a low life expectancy. Integration of the informal sector with its formal counterparts could enhance waste management while simultaneously addressing these grave health and livelihood issues.

Keywords: waste management, health hazards, dumpsites, landfills

1. Introduction

With rapidly growing populations and unprecedented urbanization rates, waste generation is accelerating, notably in cities and in low- and middle-income nations (Plevris, 2019). Effective waste management, particularly of toxic materials, is a significant challenge for sustainable development on a global scale. There are numerous options for waste disposal and treatment, including landfilling, incineration, decomposition, and recycling (Latinović, 2018; Marković & Tomašević, 2022; Latinović, Al Dhaheri & Alhudaili, 2022, Nikolić, 2022). Due to its minimal cost, landfill disposal continues to be

the method of choice in Serbia (Tošić & Vasović, 2020), as well as other low- and middle-income nations. However, improper management can cause significant health and environmental issues (Ketin & Kostić, 2022). Particularly emerging risks include hazardous, inadequately managed landfill slides (Huang & Cheng, 2017). For instance, management failures led to the collapse of a landfill in Shenzhen, China on December 20, 2015, resulting in the deaths of 73 individuals (Gao, Yin, Li et al., 2019). A comparable collapse claimed 140 lives in Bandung, Java, Indonesia, in February 2005 (Lavigne et al., 2014).

In Serbia, in 2015 there were large fires in landfills of the city of Kragujevac and the city of Paraćin, while August 2021 was marked by fires in two of the largest landfills in Serbia, the capital city of Belgrade and the second largest city in Serbia, Novi Sad (Ilić, Ilić-Kosanović & Najdić, 2022). In high-income countries, the formal, government-funded sector is responsible for the majority of refuse collection and treatment services. However, in many low- and middle-income countries, limited resources prevent the formal sector from keeping up with the rapid increase in refuse production. As a result, the informal sector (so-called refuse pickers and scavengers in some countries) has expanded (Gbedemah & Zaneti, 2021). In almost all low-income and middle-income countries, informal recyclers collect, transport, and trade refuse (Bermudez, Montoya-Ruiz & Saldarriaga, 2019). It is estimated that more than 15 million people globally are supported by the informal waste sector (Medina, 2008; Binion & Gutberlet, 2012), while in Serbia, the number of those who direclty deal with waste is estimated to be between 30 and 50 thousand people, while the number of those who are supported by this economy is substantially bigger (EKOlist, 2020).

Informal waste recyclers are subsistence workers who use primitive technologies to process and recycle a wide range of refuse materials, including plastics, food waste, cardboard, steel, copper and other metals. For example, in an unhygienic Roma settlement, in Vuka Vrcevica street, 2 kilometres from the centre of Belgrade, waste car tires or waste furniture is burned in a bonfire for the recovery of different metallic materials (Figure 1), which are then sold at a nearby purchase point for secondary raw materials. This is always accompanied by poisonous smoke that spreads over the densely populated, urban area of Belgrade. Although there are more sophisticated, almost non-hazardous, but still, simple techniques for recycling automotive tires, such as pyrolysis, in which, in addition to steel, gasoline and diesel fractions are also recovered (Latinović, 2019; Latinović, Jurčić, Al Marhouba, 2022), in lack of education and resources, informal recyclers in the aforementioned case recover only steel with a large environmental and health cost.

Figure 1. Unhygienic Roma settlement, in Vuka Vrcevica street, 2 kilometres from the centre of Belgrade, with the exact GPS coordinates. Armchair is being burned while children are playing with marbles right next to it. Source: author.

These informal recyclers indeed, can play a crucial role in the recycling of materials, but insufficient regulation frequently results in an increase in environmental pollution due to the discharge of a variety of secondary pollutants (Tong, Huynh & Khong, 2021). Moreover, these people are exposed to a number of health-damaging factors due to insufficient occupational health. With rapid urbanisation and the diversification of waste, particularly refuse electrical and electronic equipment (WEEE), the toxin-

related health risks for informal waste recyclers are growing (Vaccari, Vinti, Cesaro et al., 2019). In Guiyu, e.g., South China, the so-called "electronics graveyard of the world," laborers in the waste industry are experiencing a rise in novel health-related issues. Several studies on informal waste recyclers and WEEE have been conducted, whereas plastic waste pollution, especially microplastics, has received more attention in recent years (Kirby, 2019). This study focuses on emerging public health challenges confronting informal recyclers, particularly in Serbia. In addition, it describes the future challenges facing the informal refuse sector.

1.2 Increasing waste generation with expanding urbanization and increasing populations

Human activities continually generate waste. Sources of solid waste include the industrial, construction, commercial, service, and residential sectors, as well as individual households. In response to the prevalent human activities taking place, the waste generated will vary from location to location and over time in terms of its composition. Globally, approximately 2.3 to 3.1 billion tonnes of municipal waste, and more than 11 billion of solid waste were produced in 2021 (Maalouf & Mavropoulos, 2022). Increasing populations, rapid urbanization, and economic development in low- and middle-income countries have led to an unprecedented increase in refuse production. China and India are the most populous nations, and their urban and periurban waste problems are among the most severe. Municipal solid waste frequently exceeds the capacity of society to manage it safely. Expanding urban infrastructure, such as roads, bridges, and rapid transit systems, generates a rise in construction and demolition waste (CDW). Similar trend is recorded in Serbia in 2021. As a result of the rapid development of information and communications technology, WEEE is one of the fastest-growing pollutants worldwide (Vaccari et al., 2019). In 2019, approximately 53.6 million tonnes of WEEE were generated globally (Ghimire & Ariya, 2020) while in 2021 this number is estimated at 57.4 million tonnes (WEEE Forum, 2021). It is estimated that about 7 kilograms of electronic waste per inhabitant is generated in Serbia (Radovanović, Đorđević, Radić & Redžić, 2021). This is almost five times more than Romania, a member of the European Union, but it is slightly less than the European average, which is near 10.5 kg (Baldé, D'Angelo, Luda, Deubzer & Kuehr, 2022). While the global population is projected to increase by approximately 8% between 2021 and 2030, the total and per capita WEEE generation are expected to increase by approximately 47% and 34%, respectively (Guo & Zhong, 2021).

Globally, both governments and the general public are alarmed by the severity of problems associated with WEEE disposal. A further concern is the excessive use of plastics and the resulting plastic waste. Since the 1990s, global plastics and polymer consumption has increased by an average of 10% per year. Economies with low and moderate incomes experience the greatest growth rates (Farrelly & Green, 2020). In 2021, approximately 390.7 million tonnes of plastic waste were generated in the world while more than 15 million tonnes are estimated to have entered the ocean in the same year (Peng, Wu, Schartup & Zhang, 2021). Without improvements in refuse management, plastic waste production is projected to increase by a factor of ten by 2025. Researchers and the general public are becoming increasingly concerned about the threats posed by plastic refuse, particularly microplastics (plastic debris up to 5 mm in diameter), to marine life and human health.

3. Informal waste recycling

In the swiftly expanding cities of many low-income and middle-income countries, a lack of funding has led to extensive informal waste recycling (Esae, Sarah & Mofe, 2020). In contrast to the formal sector, informal waste recycling is conducted without government funding and may not be recognized as providing a valuable service by the general public. Similarly to formal waste management, the informal sector includes players at various phases of waste recycling. For instance, waste collectors select and collect valuable items from domestic, commercial, and industrial waste sourced locally or from waste imported from abroad. These scavengers constitute the foundation of the informal waste sector and are typically members of disadvantaged, vulnerable, or marginalized social groups. They are characterized by low levels of organisation, technology, and capital, in addition to noncompliance with tax, minimum wage, worker safety, and environmental protection regulations. In spite of the fact that informal waste recycling is typically not recognized as a legal occupation in many nations, it offers substantial societal benefits in terms of waste management and reducing the pressure on the resources used in the production of material products. The majority of the estimated >15 million individuals involved in

informal waste recycling reside in low- and middle-income nations (Medina, 2008), while in Serbia, according to estimations, their number is near 50 thousand (EKOlist, 2020).

3.1 Scope of materials recycled by the informal sector

Paper and cardboard, discarded metal (especially aluminium, steel, and tin), glass, plastic (polyethylene terephthalate (PET)) bottles, rubber, wood, textiles, and food waste are the materials recycled most frequently by the informal sector, although there are regional and national variations (Latinović, 2018; Latinović, Al Dhaheri & Alhudaili, 2022). Due to their high recycling potential and lengthy lifespans, metal, paper, and PET are typically favoured. The informal sector recycles an increasing amount of WEEE due to the potentially high value of the materials that can be recovered. Nonetheless, WEEE poses some of the greatest health dangers to informal recyclers due to recycling techniques and poor occupational health. The informal recycling of WEEE is widespread and practiced in many parts of the globe, despite the fact that toxic exposure patterns vary according to recycling methods and processes.

Aforementioned Guiyu, e.g., an agglomeration of four villages in Guangdong, South China, is a notorious global example of non-formal WEEE recycling. Since 1995, approximately 6000 family enterprises have annually processed approximately 1,6 million tonnes of WEEE (Kirby, 2019). Guiyu has become the largest WEEE dismantling and recycling facility in the globe. Workers painstakingly disassembling and stripping electronic components for reuse, including chips and valuable metals. Workers 'cook' circuit boards to remove chips and burn cables and other plastics to liberate metals like copper. Along the riverbanks, extremely hazardous acid solutions are used to extract gold from microchips. However, in Serbia, the majority of informally recycled materials are metals, paper and plastics. Informal recyclers can readily collect and sell plastic, primarily bottles. In many cities, such as Belgrade and Novi Sad, waste plastic commerce is well-established and supported by numerous processing facilities. However, the majority of this plastic is recycled crudely by informal organizations. Heavy metals, bromine, and antimony are added as pigments, additives, UV stabilisers, and flame retardants to polymers (Rodrigues, Abrantes, Gonçalves et al., 2019). The improper recycling of plastic waste risks contaminating these substances.

3.2 Environmental hazards of informal recycling sector

Methods that do not adequately protect the environment can generate secondary pollutants. Air, water, and soil are contaminated by the various toxicants and levels of exposure resulting from informal waste recycling. Near informal recycling sites, contamination is widespread and can reach exceedingly high concentrations (Fujimori et al., 2012).

3.3 Health risks

Those who work in the informal waste sector face a vast array of health concerns. Working on garbage dumps and landfill sites is inherently hazardous, and accidents, such as fires, explosions, and debris slides, such in Shenzhen, occur frequently. Due to the relatively high cost and lack of risk awareness, the majority of informal refuse recyclers do not wear protective gear such as gloves and boots. Even in the industry sector, with protective measures, workers get sick when exposed to certain toxic substances (Latinović & Marjanović, 2021). In the informal sector it is much more pronounced. For greater tactility, many recyclers prefer to work barehanded, but they run the risk of sharp injuries, particularly from glass and medical waste containing syringes (Cunningham, Simpson & Keifer, 2012).

Scavengers frequently come into contact with toxic substances and human/animal refuse. Particular attention has been paid to the health hazards associated with heavy metals for informal waste workers and their families. Recyclers who labour in landfills have elevated lead levels in their blood. Higher concentrations of lead and dioxin-related compounds have been found in the breast milk of female waste recyclers (Alam, Ang & Bondoc, 2018). Children and developing foetuses are especially susceptible to the effects of heavy metals (Soomro et al., 2019). For instance, the stillbirth rate in the aforementioned Guiyu, for which there are available data, was 4.6 times that of control sites, whereas blood lead concentrations in newborns were 4.8 times those of control sites (Xu et al., 2012). For Serbia, unfortunately, such data are still not available.

Nevertheless, exposure to hazardous plastic additives, such as brominated flame retardants (BFRs) and heavy metals, has been linked to problems with the nervous and reproductive systems, alterations in behaviour, and cancer (Park et al., 2012; AbouDonia, 2016). Informal waste laborers are also susceptible to inhaling gaseous emissions, bioaerosols, and microorganisms (e.g., car exhaust, dust, and fungus spores). In landfills, waste collectors may be exposed to gas emissions such as methane (CH_4) and hydrogen sulphide (H_2S), as well as vehicular emissions, which can cause respiratory, dermatological, and ocular issues (Wachinou et al., 2022). They are also more susceptible to prevalent illnesses (such as influenza, bronchitis, and ulcers), musculoskeletal issues, and diseases transmitted by vermin.

Due to unhygienic working conditions and a lack of washing facilities, informal waste recyclers may transport toxins to their residences and families. Landfills and garbage sites are breeding grounds for pathogenic organisms that cause dengue, leishmaniasis, diarrhoea, typhoid, anthrax, cholera, malaria, and a variety of skin disorders (Nicholas, 2017; Tadzhibaev, Murtazoev & Pulotov, 2019; Sahdev & Kumar, 2020). Moreover, the majority of informal waste laborers and their families are marginalized and socially excluded. Combined with financial insecurity, perceived shame, and humiliation, this can result in severe psychological harm that has far-reaching consequences for local communities (Yadav, 2021).

Table 1. Principal health risks for informal recyclers. Adopted from (Binion & Gutberlet, 2012; Yohannessen, et al., 2019; Wittmer, 2021; Dong et al., 2021; Gbedemah & Zaneti, 2021; Singhal, Lyngdoh & Prabhakaran, 2021)

Health risk	**Overview**
Chemical	Toxic substances, such as heavy metals and brominated flame retardants.
Hygienic	Lack of hand-washing facilities or adequate restrooms.
Disease	Headache, respiratory issues, dermatological problems, eye infections, influenza, bronchitis, ulcers, high blood pressure, musculoskeletal injuries (ie, chronic back ache and soreness in arms, legs and shoulders), typhoid fever, tuberculosis, dysentery, poliomyelitis, malaria, dengue, leishmaniasis, diarrhoea, anthrax, cholera
Accident	Accidental falls and other incidents resulting in lacerations and bone fractures, waste-related fires, explosions, landfill slides, needle pricks, and lacerations.
Psychological	insecurity, perceived embarrassment, and humiliation

3.4 Measures of improvement of the informal waste recyclers' welfare

A number of policy, economic, and industrial hygiene measures can enhance the health of informal recyclers. Green chemistry, enhanced product recyclability, and the elimination of toxic substances prior to recycling are of fundamental importance. It is essential to alleviate poverty by adequately financing the services provided by informal recyclers. Therefore, modernizing waste management systems will need to incorporate informal waste systems more and more. To prevent scavengers from entering toxic waste sites, proper management of landfills is crucial. In addition, the informal sector must implement new low-cost technologies designed to minimize health risks during waste recycling. Using pyrolysis instead of open flame scrap tire burning is one of the examples (Latinović, 2018).

Governmental or non-profit funding can provide apparatus like battery-powered handcarts, hand tools, protective clothing, and uniforms. Uniforms and identification cards formalize the appearance of informal workers, fostering an improved relationship with the public that can boost the self-esteem and confidence of informal workers. Government training of informal sector employees can impart more professional recycling knowledge, such as standardised classification and processing methods for various waste, recycling laws and regulations, and system development plans. The strengthening of these cooperatives and group networks can facilitate the transfer of knowledge regarding appropriate waste management and processing, relevant regulations and laws, environmental protection, sanitation, and hygiene. Such cooperatives also legitimize the work as a public service, making it possible to finance social programs like extended healthcare and child care. In some nations, cooperatives have merged to form larger regional or national movements. Solid Waste Collection and Handling, a

cooperative of roughly 1,500 waste collectors serving 200,000 households in Pune, India (Shankar & Sahni, 2018).

3.5 Collaboration between informal and formal sectors

Effective integration can enhance recycling rates, livelihoods, occupational and environmental health, and reduce waste management costs (Gerdes & Gunsilius, 2010). According to research conducted in Brazil, Egypt, and India, integration can increase informal sector revenues and decrease formal sector total waste system costs. A study of the cutting-edge 'InteRa' model for integrating the informal sector into waste management systems in low- and middle-income countries discovered similar win-win outcomes. Beyond the formal and informal waste management sectors, the successful development of integrated systems requires the participation of numerous stakeholders, such as the state, and local governments, environment/development agencies and non-governmental organizations (NGOs), academicians, and financiers.

9. Challenges and future research

Improving the health of informal waste sector workers is a significant challenge. International cooperation, such as through the Sustainable Development Goals (SDGs), will be essential for enhancing waste management, including addressing environmental contamination issues, and for enhancing the welfare of informal waste recyclers. Several relevant documents and guidelines have been adopted in Serbia. A Roadmap for circular economy in Serbia is intended to get to know, promote and put together the recognized stakeholders able to contribute by their knowledge, innovativeness and creativity to a faster transition to circular economy. This document is also a guidance for transition to a model of circular economy focusing, apart from the profit, to the protection of the environment and preservation of resources while focusing on the economic, social and ecological dimension as equally valuable. Although this is an initial document to start a dialogue between the decision-makers and representatives of industry, academic sector and civil society, it is a step towards defining future actions and a time framework for the transition. Furthermore, European Union has adopted a set of documents that provide guidance to the member states for a transition from the linear to circular economy.

The Green Deal and The Action Plan for Circular Economy are the last in this set. Since the Republic of Serbia is a country candidate for the EU membership, these documents will be complying with the recommendations in this regard in the forthcoming period, involving a series of activities including, among others, a draw-up of the Roadmap 2.0 for circular economy. In spite of the fact that there are optimistic plans for integrating the informal sector with formal waste management, these initiatives are still in their infancy in Serbia. Increasing awareness of the issues confronting the informal sector and altering attitudes toward waste pickers in Serbian culture is likely the greatest obstacle. Government and the media must recognize the often-crucial role that the informal sector plays in waste recycling.

Changed attitudes would contribute to the establishment of worker support programs, improved integration of informal employees into waste management, and the establishment of professional informal sector recycling businesses. Current regulatory trends and capital expenditures facilitate the operation of large recycling companies. Small companies are consequently excluded from the industry. Increasing pressure for automation and modernized sorting techniques make it much harder for small businesses to compete, and informal employees are excluded from waste sites. There are undeniable health and safety benefits, but displaced informal employees must either be integrated into new business schemes or compensated to alleviate poverty. Decisions regarding waste management should also consider who would gain the most from the sale of recyclables and how to enhance the disposal of non-recyclable, frequently toxic, material. High market prices can increase the incentives for informal recycling and the accumulation rates of recyclable materials, while also benefiting the livelihoods of numerous individuals through the creation of jobs. In contrast, low prices present difficulties for informal waste recyclers.

10. Conclusion

With growing populations and economic development, the amount of refuse produced is rapidly increasing, posing a variety of management and environmental challenges. Due to insufficient

financing for the formal waste sector in many low- and middle-income countries, approximately 35-50 thousand people in Serbia sort, collect, transport, and trade waste. This informal sector contributes significantly to refuse recycling and reuse. Metals, plastic, and paper are the primary materials recycled by informal waste recyclers. Unfortunately, relatively rudimentary recycling methods are the cause of significant environmental pollution and human health issues. Some efforts have been made to integrate the informal refuse sector with the formal sector. Despite the services it provides, the informal sector is still considered objectionable and a nuisance in many countries, as well as in Serbia. It is necessary to increase public awareness of the informal sector's contributions and alter public attitudes toward those involved. Improving waste management and the well-being of those involved in informal waste recycling will necessitate international collaboration, such as through the SDGs.

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Covid-19 i diskriminacija starijih - istina ili zabluda?

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Apstrakt: Diskriminacija starijih osoba je realnost u Republici Srbiji, ali i ostalim državama na evropskom kontinentu. Stavovi u razvijenim društvima su prepuni predrasuda, a starije osobe su žrtve diskriminacije, naročito žene koje su dvostruko diskriminisane, po osnovu starosti i po osnovu pola. Institucije države neretko smatraju da su starije odrasle osobe pre teret nego integralni segment stanovništva kojima mora da se pruži adekvatna podrška. U patrijarharnim društvima kao što je društvo u Srbiji, starije osobe retko imaju priliku da se izjasne o bitnim životnim pitanjima niti imaju priliku da donose odluke. Zdravstveni sistem u Republici Srbiji se relativno dobro prilagodio na krizu javnog zdravlja pojavom nepoznatog virusa COVID-19, ali na osnovu iskustava tokom pandemije ipak su starije osobe bile značajno ugroženije u odnosu na ostalu populaciju. Već ionako težak položaj starijih osoba je dodatno pogoršan tokom pandemije COVID-19. Život starijih osoba se nedovoljno vrednuje i pogoršava se odnos prema njima u porodici, društvu, pristupu zdravstvenim ustanovama i ostalim servisima od interesa za njihov opstanak. Tema ovog rada je analiza stanja starijih osoba za vreme COVID-19 pandemije.

Ključne reči: starije osobe, diskriminacija, nasilje, ejdžizam, COVID-19

Covid-19 and Older Adults Discrimination - Truth or False?

Abstract: Discrimination against older adults is a reality in the Republic of Serbia and other countries on the European continent. Attitudes in developed societies are full of prejudices, and older people are victims of discrimination, especially women who are double discriminated against based on age and gender. State institutions often consider older adults a burden rather than an integral segment of the population that must be provided with adequate support. In patriarchal societies such as the one in Serbia, older adults rarely have the opportunity to express themselves on critical life issues, nor do they have the chance to make decisions. The healthcare system in the Republic of Serbia adapted relatively well to the public health crisis caused by the appearance of the unknown virus COVID-19. However, based on the experience during the pandemic, older people were still significantly more vulnerable than the rest. The already difficult situation of older adults has been further aggravated during the COVID-19 pandemic. Older adults' lives are undervalued, and the attitude towards them worsens in the family, society, and access to healthcare facilities and other services of interest to their survival. This paper's topic is analysing the condition of older adults during the COVID-19 pandemic.

Keywords: older adults, discrimination, violence, ageism, COVID-19

1. Introduction

In mid-November 2019, rumours of a "mysterious pneumonia" existed in Wuhan, China. On 31 December, the World Health Organization (WHO) was notified of the disease, and in the first days of January 2020, several researchers worldwide completed the RNA sequencing of the virus. There was no doubt: a new virus of the coronavirus family, SARS-CoV-2, and the respiratory disease caused by it, COVID-19, had been discovered. Subsequently, on 27 January 2020, three events prompted the WHO to change the global COVID-19 risk from moderate to high. First, confirmation that the disease can be transmitted from human to human sustainably (WHO). Second, on 11 January, the first death from COVID-19 in China was recorded. (https://www.nytimes.com/article/coronavirus-timeline.html) Finally, the disease is reaching other countries. On 30 January, the World Health Organization declared a public health emergency of international concern. On 11 March, the organisation updated the status of COVID-19 to a pandemic, meaning the virus was circulating on all continents.

The WHO declaration invited countries to prepare their national mechanisms for managing and responding to this biological disaster. Although the COVID-19 pandemic was not the first of this century, the contamination curve is still increasing in some countries, and it has caused unprecedented impacts on society (Rodrigues, Carpes, Raffagnato, 2020). The COVID-19 virus has been declared a threat to public health worldwide, and the World Health Organization has declared it a global pandemic, which has raised many questions and problems in almost all areas of social life. This global threat to health security has accelerated the need to improve warning systems for global health risks and reduce and manage such risks.

The pandemic has exposed many issues concerning and responding to health emergencies such as COVID-19. That being said, the waning immunological vigour of older persons and presence of risk factors (“co-morbidity”) often accompanying older age (hypertension, increased BMI, diabetes, chronic lung disease, immunomodulation-immunosuppression, smoking, ischemic heart disease and cerebrovascular disease, etc.) make the disease a much more serious event for many older people (Clarfield, Jotkowitz, 2020). During the past two years, operational guidance from well-recognized organizations in emergency management and public health has called for regional planning operations in disaster. The regionalization efforts in preparedness coincide with parallel efforts in regionalization of general public health service provision (Stanley, 2010).

Even before the COVID-19 epidemic outbreak in March 2020, the healthcare system of the Republic of Serbia faced severe challenges regarding organisation financing and provision of services. But, despite that, the system has shown resilience and adaptability to this emergency from the beginning (Strbac et al., 2022). As part of the observed problems, it was noted that there was significant discrimination against older adults in such emergencies. Too often, the lives of older people are weighed less than others: they should simply be isolated because they are the most vulnerable; they have lived their lives and have had their chance at living a fulfilling life; they are, in any case, amongst those who are going to die soon. These and similar arguments can be found in everyday discussions as well as in the opinions of experts and ethicists (Ehni, Wahl, 2020). The article examines discrimination against older adults, which, due to the unpreparedness of society for an emergency during the pandemic, made this discrimination even more prominent. Older adults in Serbia are the biggest victims of the state of emergency and the unpreparedness of society for the massive, urgent needs of the population. Apart from the unpreparedness of the community for emergencies, violence against older adults on various grounds is increasingly visible in the public eye.

2. Who are older adults?

Older adults are people above a specific age limit, and the United Nations described older adults as over 60 (United Nations, 2013); for example, the World Health Organization set this limit at 65+ years. However, according to Devedžić and Stojilković (2012), the ageing process of the population is, among other things, the result of human changes, that is, the reduction of the mortality of older adults and their longer average life. Older adults are associated with poorer physical and mental health, increased social isolation and loneliness, greater financial insecurity, and reduced quality of life. (World Health Organization, 2021). Globally, the number of older adults (aged 60 and over) is expected to more than double, from 841 million people in 2013 to more than 2 billion in 2050, while the number of people aged 80 and over will be almost four times larger. Predictions say that older adults will outnumber children for the first time in 2047.

About two-thirds of older adults live in developing countries, as this population in less developed regions is growing faster than in more developed areas. Projections show that older adults will be increasingly concentrated in less developed parts of the world. By 2050, almost 8 out of 10 older adults will live in less developed regions (United Nations, 2017). At the beginning of 2019, 90.51 million people over 65 lived in the European Union (EU), almost a fifth of the total population. And in the next three decades, an upward trajectory is projected to reach 129.8 million inhabitants or approximately one-third of the total population. The average age of men is expected to increase from 76 years in 2008 to 84.5 years, and for women from 82.1 years to 89 years by 2050 (European Union, 2020: 8). The population of Serbia is also getting older, the birth rate is meagre, and other reasons contribute, such as migration from villages to cities, other countries and depopulation. Every fifth citizen of Serbia (21.3%), i.e. more than 1,400,000 inhabitants, is over 65 years old.

Table 1.: Population 65+ by gender with the total population in Serbia in 2019

Age group	Total %	Men %	Women%
65+	20,7	18,21	23,06
75+	8,23	6,7	9,69
80+	4,63	3,46	5,58
85+	1.91	1,45	2,35

(Source: Statistical Yearbook 2022, Republic Statistical Office)

The percentage of people over 65 will be at least 22% by 2030, which is almost every fourth inhabitant. (Republican Bureau of Statistics, 2022) The main feature of the age-sex structure of the Republic of Serbia today is the numerical dominance of men among the young population, that is, the dominance of women among the middle-aged and old population. The gender aspects of ageing are not only in the numerical composition of women and men in that category, but that is the most visible data. "The oldest" is the region of Southern and Eastern Serbia, where even 25% of the population is over 60 years old. (Republican Bureau of Statistics, 2022) At the same time, the position of older adults in Serbia, on the European continent and in many societies globally is complex. According to the data presented in the Third National Report on Social Inclusion, the position of older adults, primarily in rural areas, is unfavourable. There is no uniform and thoroughly institutionalised system of services for older adults which is financially sustainable and puts older adults at risk of social isolation. These are difficulties in accessing social and health services, transport services, and employment opportunities, not to mention participation in political and public life. Moreover, out of 19.5 per cent of recipients of cash social assistance, older adults are represented almost four times less or 5.6 per cent, which caused barriers that reduce accessibility for older adults (land maximum, insufficient information, administrative illiteracy).[1] The already difficult situation of older adults was made even more difficult by the Covid-19 pandemic when it was difficult for them to access health institutions.

3. What is discrimination against older adults?

Ageism can be defined as "an alteration in feeling, belief or behaviours in response to an individual's or group's perceived chronological age". (Comincioli et al., 2022) Every person who gets older is likely to be a target of ageism at some point. Ageism as a specific form of discrimination is very different from other types of discrimination, which are unlikely to affect everyone. So the scope and breadth of ageism are enormous. The social image of older people as vulnerable or incompetent affects their performance, health, and well-being. Ageism has an impact on the course of life. (García-Soler et al., 2020) When discussing legal regulations in the Republic of Serbia, older people are identified as a group at increased risk of discrimination. To improve the general social position of particularly vulnerable groups, which include women, older women, rural women, and women with disabilities, the Strategy for Prevention and Protection from Discrimination from 2014 to 2018, and then the Strategy for Prevention and Protection from Discrimination from 2022 to 2030, were adopted.

As previously stated, a significant share of the population of Serbia comprises older adults, and all the adopted documents greatly influenced the initiation and visibility of many issues, including discrimination against older adults. Although, at first glance, there may not be significant gender

[1]Government of the Republic of Serbia, National report on social inclusion and poverty reduction in the Republic of Serbia for the period 2014-2017., Belgrade, 2018

differences among older adults, older men inevitably have more autonomy and control over their lives, property and family matters than older women. They are less often exposed to domestic violence than women of a similar age, have better financial situations, have a higher pension, and often own valuable immovable property (Commissioner for the Protection of Equality, 2019). There is also a significant gender gap in older women's activity and employment rates. Many older women, especially those who live in the countryside, are discriminated against by being excluded from decision-making, even in their own families, they rarely own property, and most often, they are without a pension or other income (Amity, 2018). Almost half of the citizens of Serbia, who are 75 and older, are denied the satisfaction of material needs, which is a significantly higher percentage than in the EU. While in the EU, the population's material deprivation rate, especially women, decreases with age, in Serbia, it increases. Many older adults, especially women, did not meet their health needs, so they did not visit a doctor when necessary or receive appropriate diagnostics or therapy (Belgrade Center for Human Rights, 2019). The pandemic has made the already complex discrimination policy towards older adults in all segments of society even more difficult.

4. Ageism during the Covid-19 pandemic

The risk mitigation measures adopted in most states, such as physical distancing and the severe reduction of social contact disproportionately affected older adults and their well-being (Voinea, et al, 2022). In the Republic of Serbia the key measure was the ban on the movement of persons 65+, introduced on 18 March 2020, who live in settlements with more than 5,000 inhabitants and persons 70+ in settlements with up to 5,000 inhabitants. After three days, on 21 March 2020, this measure was changed in terms of the permission to move from 4 to 7 a.m. on Saturdays, and the very next day, 22 March 2020, on Saturdays from 3 to 8 a.m., and from 21 April 2020, on Fridays from 4 to 7 a.m., to buy groceries, as well as on Tuesdays, Fridays and Sundays from 6 p.m. to 1 a.m., for 30 minutes, within a radius of up to 600 meters from the place of residence (residence or residence). With the latest changes on 25 April 2020, movement is allowed from 6 p.m. to 1 a.m. every day, for a duration of 50 minutes, and with the Decision to ease the measure of movement restrictions during the state of emergency, older adults are also allowed to move on Friday, 1 May 2020, in lasting twice for 60 minutes, in a diameter of up to 600 meters from the place of residence (place of residence or residence). In the media, government representatives informally justified this measure by the need for older adults to be protected as a particularly vulnerable category, where the mortality rate due to COVID-19 is extremely high. The measure prohibiting the movement of elderly persons, which until 21 April 2020 meant going out only once a week, and in the night hours, represented a restriction of freedom of movement and had a causal impact on the mental and physical health of older adults. In this regard, the Commissioner for the Protection of Equality recommended to the Government of the Republic of Serbia to review the adequacy and frequency of the dates specified for the movement of older adults to mitigate this measure.

At the beginning of the pandemic, strict measures were implemented worldwide to prevent the spread of COVID-19, such as avoiding social activities, physical distancing, and isolation, which further increased mental health concerns among older adults. Certainly, these social measures contributed positively to the effectiveness of disease prevention and prevention of spread. Now it is very important to protect elderly people from infection, but also it is important to respect them and to support them in this complex situation. There is a great risk of “ageism”. The higher vulnerability of old adults to infection increases the risk of “ageism” and the active role that elderly people are having during outbreak reduces the risk of “ageism”. There could be also an increasing risk that age could represent a negative factor when the acute phase of the pandemic puts high pressure on the healthcare system and the availability of resources is not enough to cope with all the needs (Petretto, Pili, 2020). However, the mental health of older adults requires more attention and care, as they are the demographic group that experiences social isolation the most. In addition, as previous studies of older adults have shown that social isolation is a "serious public health problem" that increases the risk of cardiovascular, autoimmune, neurological, and mental health problems, the mental health problems of the elderly caused by COVID-19 should be more carefully considered and to be treated as a public health crisis. (Lee, et al. 2020).

While restrictions may aim to be protective, such policies have often translated into patronising public communication depicting all older adults as ‘’vulnerable’’ members of society (Fraser, et al. 2020) Discrimination was especially evident with the adoption of the Order on the ban on visits and restriction of movement in the institutions' facilities for older adults from 14 March 2020. By that

Order, visits to all social welfare institutions for the accommodation of older adults were prohibited, and the users of the institutions were forbidden to leave the institutions. Reception of new users of the accommodation service in institutions was allowed only with health documentation confirming that the person was not infected with the virus. Each newly admitted user was preventively ordered to be isolated for 14 days within the institution. The establishment of discriminatory triage practices for not referring older adults from nursing homes to hospitals to avoid the saturation of health resources at the beginning of a health crisis and restrictive legislation for forced isolation in nursing homes could be linked to socially accepted stereotypes and discriminatory practices at different levels. Ultimately, this could be related to the high mortality rate and physical, social, and emotional consequences of older adults living in nursing homes (Álvaro García-Soler, Penélope Castejón, Sara Marsillas, Elena del Barrio, Lori Thompson, Pura Díaz-Veiga, 2020). Apart from older adults in nursing homes who were discriminated against multiple times, the burden of isolation also fell on older women in many nursing homes.

In Serbia, women comprise 51.3% of the total number and predominate in the middle-aged and old population. Also, significantly more women live in single households, 60% than men, 40% (Republican Biro of Statistics, 2019), which also leads to the conclusion that the choice of measures and how they were communicated and implemented encouraged and deepened the generational gap, instead of intergenerational solidarity (Pajvančić et al., 2020). As the pandemic continued, it became clear that most segments of society were ill-prepared for this kind of emergency, especially for different categories of older women and everyone else who requires a certain type of health service. Corona vaccines that became available to the general public in 2021 have brought optimism among older adults. However, although two years have passed since the beginning of the pandemic, there are still no answers regarding the normalisation of the functioning of the health system, which is of existential importance for older women whose health, social and emotional condition is still at risk. There is concern that a prolonged pandemic may cause physical damage to individuals and a collective form of intense stress. Witnessing or experiencing a disaster causes mental shock, such as anxiety and depression, spreads tension and fear among individuals like an infection and collectively affects society (Lee, Jeong, Yim, 2020). It is essential that the recommendations uphold the principle of the equality of all human beings and avoid discrimination against the vulnerable among them. When the pandemic subsides, countries will have an opportunity to reflect on what would have transpired and on how they dealt with the tragedy (de Castro-Hamoy, de Castro, 2020).

5. Abuse and violence against older adults - a specific form

Ageism and negative age stereotypes can be expressed unconsciously and consciously through microaggressions in interpersonal interactions, through social and cultural institutional messaging, and through exposure to and encounters with systems of law, government, employment and healthcare. The negative impact of age stereotypes on older adults has been well documented, yet the experience of older adults and ageism within the family has been understudied (Gordon, 2020).Violence against older adults is the most hidden form of violence in families and institutions in many societies. Abuse of older adults is a special type of violence, mentioned for the first time in Great Britain in the seventies of the last century when the term "granny battering" was coined (Janković, Todorović, Vračević, 2015). Recently, violence against older adults has become more frequent, and the victims usually do not report the perpetrators because they are family members. In contrast to the abundance of evidence of the positive impact of family support for older adults, very little attention has been given to the issue of ageism and age discrimination in families (Gordon, 2020). Older adults who become victims of violence are often burdened with shame, the feeling that they are to blame for the violence, fear because of the abuser, and mistrust in the appropriate instances of the system. Furthermore, among the emotional obstacles to reporting violence is the syndrome of learned helplessness, the feeling of powerlessness and the desire to protect the family "from shame", including the abuser.

Older adults (among them even more invisible older women), although they make up a significant part of the population in the Republic of Serbia, are not sufficiently identified in society as a particularly vulnerable category of the population. It is essential that the recommendations uphold the principle of the equality of all human beings and avoid discrimination against the vulnerable among them (de Castro-Hamoy, de Castro, 2020). Population ageing has become a global policy concern and expected to have a far-reaching effect in developing countries as they have been slower to adopt requisite policy measures. Despite this demographic transition, there is also a concern of epidemiologic transition, which raises challenges for a healthy and long life. This combined demographic and epidemiologic

transition may significantly challenge the ageing population, especially for older adults who are not healthy and without a proper support system. Compared to developed countries, developing countries are experiencing a faster ageing transition and are noted for inadequate funding, human resources (HR), and lack of healthcare infrastructure.

Evidence indicates that adequate interventions from health and non-health sectors required for a healthy ageing society (Irshad, et al. 2023). Older people in Serbia still have difficulty realising their health and social protection rights, pension insurance, the right to information and financial independence, and protection from abuse and violence. As a general normative concept, human dignity protects persons from humiliating and degrading treatments including the prohibition of treating persons merely as a means or as if they morally count for less or nothing at all. It does these works for older people as well. But the exact content of these normative functions ought to be articulated in accordance with what it means for older persons to live well and lead a life of dignity and authority (Gebremariam, Sadana, 2019). The most common problems faced by older adults in Serbia are poverty and neglect within the family, including disposal of property without their consent, dissatisfaction with exercising the right to material support, when they find themselves in a difficult financial and life situation due to a lack of income or an insufficient amount of income, and when poor health condition, it is difficult to exercise the right to help and care of another person.

Many users of homes for older adults are placed in homes without their consent, with the consent/pressure of their children or closest relatives. There are no rare cases of placement in a home when that person can no longer do housework and take care of others or when the room they use is "more needed" by other family members. The problem is that there are still illegal homes for older adults, whose unprofessional and uncontrolled work massively violates the guaranteed rights of older adults in such institutions (Ombudsman, 2019). In the Republic of Serbia, according to the Ministry of Labour, Employment, Veterans and Social Affairs data, 283 licensed nursing homes are registered. However, that number is higher since there are nursing homes that do not have a license. Older adults with a lower level of social activities, who are functionally dependent, chronically ill, and older persons with disabilities diagnosed with dementia, are more exposed to all forms of abuse. Abuse of older adults can be in the form of intentional or negligent neglect by the care provider (person in charge of care). Abuse can also take the form of neglect through failure to provide basic needs, food, water, clothing or adequate housing, failure to assist in maintaining personal hygiene or providing health care.[2]

The health care system must be prepared to respond effectively to the problems caused among older adults (Moghadasi, et al 2022).The results of research on violence against older adults (Petrušić, Todorović, Vračević, 2012) show that among the prosecuted acts of domestic violence, about 10% were committed against older family members. This data only confirms that violence against the elderly is less reported and more difficult to detect than violence against younger family members and is by no means an indicator of a lower prevalence. Violence against older adults is most often committed in the victim's and perpetrator's family homes (90%). Violence against older adults is less often committed in a public place than violence against other family members, which is one of the specifics of violence against older adults, contributing to its more difficult detection. Also, no research has ever been done on the number, type, and forms of abuse against older adults in nursing homes, given that researchers do not have access to those people, which was more pronounced during the pandemic. In the past, we have witnessed that inscriptions appear sporadically in the media, and the reaction of the competent institutions is also sporadic. There is no systematic care and control of the institutions where older adults reside, and the forms and number of abuses are in the domain of the hypothesis.

Apart from a few researchers and independent and specialised state bodies, almost no one deals with such criminal acts. Violence against older adults in the family context is most often perpetrated by their children and grandchildren, in contrast to violence against other family members, where the dominant form is partner violence - violence against a married, cohabiting, or ex-spouse. Violence against older women by their spouses is often just a continuation of the continuous violence they have been exposed to. As in any other type of violence, the solution is not to "keep silent" and "run away from the problem", with the justification that it is a private family matter. An effective response by society to the

[2] https://www.danas.rs/vesti/drustvo/todorovic-zlostavljanje-starijih-je-cesto-skriveno-potrebne-brze-parnice-ako-do-prijave-dodje/

problem of abuse of older adults is practically impossible if there is no formally defined coordination of the institutions of the system but also the wider local community when abuse has already occurred (Janković, Todorović, Vračević, 2015). Family relationships are a key part of social support for older adults because a protective environment is important. Therefore, family support and relationships can protect older adults' psychological and mental health in all situations. Research has shown that older adults in low-functioning families with weak solidarity feel more depressed and lonelier (Lee, Jeong, Yim, 2020). The life course approach is invoked to underscore inequalities among older people; to argue that these arise from the cumulative impact of advantage and disadvantage across people's lives; and to label as inequities those differences that are unjust and must be addressed (Keating, 2023).

According to data from the Ministry of the Interior, during the COVID-19 pandemic, domestic violence was on the rise, but there is no data on the types of domestic violence, so it is expected that violence against older adults was also increasing. In an emergency, alerting society's institutions to reduce the pandemic's negative effects is necessary. COVID-19 needs to be understood as a wake-up call to ensure adequate nursing care for the elderly based on evidence, the requirements of an aging population, responsibility, and social welfare. A strong public health response in the form of urgent and joint action is needed to generate (global) preparedness and to protect this at-risk group (Fischer, et al. 2020).

6. Possible ways to improve the current situation

The Covid-19 pandemic has affected different populations in different ways, and one of the particularly vulnerable groups is older adults. Older individuals are more susceptible to the virus due to their weakened immune systems and have experienced discrimination and neglect in various forms throughout the pandemic. One of the most prominent forms of discrimination against older adults during the pandemic has been implementing policies that prioritise younger patients over older ones regarding medical care. Discrimination was especially problematic in the early stages of the pandemic when there were shortages of medical resources, but it has continued to be an issue in some places even as the situation has improved. The pandemic has also increased social isolation and loneliness among older adults, further contributing to their vulnerability. Social distancing measures and lockdowns have meant that many older individuals cannot see their loved ones, attend social events, or even leave their homes. Social distancing has significantly impacted their mental and physical health, well-being, and health since social isolation has been linked to various adverse health outcomes.

Moreover, older individuals have also been disproportionately affected by the economic consequences of the pandemic. Many have lost their jobs or have seen their retirement savings diminish, leaving them in precarious financial situations. The economic situation has been especially problematic for those who rely on pensions or other forms of fixed income, as the cost of living has increased while their income has decreased. In addition to these challenges, older individuals have experienced discrimination in other forms, such as age-based stigmatisation and negative stereotyping. For example, some younger individuals have blamed older people for spreading the virus, even though research has shown that younger people are also responsible for transmission. This type of ageism can significantly impact older individuals' mental health and well-being, further exacerbating their vulnerability.

The Covid-19 pandemic has exposed and exacerbated the discrimination and neglect experienced by older adults in various forms. From healthcare policies prioritising younger patients to social isolation and economic hardship, older individuals have faced numerous challenges during the pandemic. Addressing these issues will require a concerted effort by policymakers, healthcare professionals, and society to recognise and address the needs and vulnerabilities of this population. The key factors include an increase in coordinated, cooperative, and collaborative collective action early on in the pandemic. The main driver seems to be a common sense of urgency and a shared cognition based on reliable information. Both of these will prove crucial to tackling similar challenges in the future (Hattke, Martin, 2020) The National Strategy on Aging in Serbia 2006 - 2015 provided good foundations for activities to improve the position of older adults in Serbia in the form of the principles of lifelong development of the individual, promotion and protection of all human rights and fundamental freedoms, ensuring economic and social security and quality of life in old age; enabling full integration and participation of older persons in the community; elimination of all forms of social neglect due to the decline of functional abilities in old age and disability; involvement in achieving gender equality; respecting diversity and consequently different needs among the elderly population;

promoting intergenerational and intragenerational transfer; solidarity and dialogue; establishing partnerships at all levels.

The key areas in which the situation needs to be improved are improving institutional mechanisms for monitoring the living conditions of older adults, monitoring the implementation of policies and measures, and evaluating their effects, improving social and health care services, improving the digital inclusion of older adults, as well as reducing the gender gap among older adults through strengthening the protection of older women. In addition to the social protection system (respite services, daycare services for older adults, help at home, training of informal caregivers with a particular emphasis on the care of people with dementia) and health care (screenings, detection and services for victims of abuse), which are most often thought of when is this topic in question, the participation of the police (informing the police in working with the elderly and recognising different forms of abuse of older adults), but also of the judicial system (through the legislative framework that identifies this phenomenon and defines the framework of protection in cases of abuse), is of crucial importance. Education system (raising awareness of issues related to ageing and developing intergenerational solidarity) and the financial sector (Janković, Todorović, Vračević, 2015).

It is necessary to spread a positive image of ageing, the attitude towards older adults, and their enormous contribution to society and their role today (Commissioner for the Protection of Equality, 2019). That is why it is necessary to introduce a teaching unit on education, which refers to intergenerational solidarity and a good upbringing of children with older adults in the circle of families by personal example. Preventing discrimination against the oldest citizens must be a moral imperative in a society facing deep demographic ageing. It is everyone's moral obligation not to turn a blind eye to anyone's discriminatory performances but rather to suppress discrimination against older adults and invest in our own better old age. Bearing in mind above all the demographic picture characterised by demographic ageing and high average age of the population, along with further migration and departure of young people, special attention should be paid to the implementation of measures and activities aimed at reducing poverty, encouraging rural development, as well as achieving full equality of men and women, especially vulnerable and marginalised social groups, taking special care of the poverty of older citizens. (Commissioner for the Protection of Equality, 2021) Also, in public opinion, the dominant approach to ageing as a problem must be changed. The pandemic, as the biggest health challenge, showed all the weaknesses of care for older people that did not disappear when the end of the pandemic was declared. Their problems in all social areas remained unsolved, with no indication that they would begin to be solved.

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Upotreba sondi cink dioksida za praćenje biološke i hemijske kontaminacije vode u civilne i vojne svrhe

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Apstrakt: Glavni organski zagađivači, i njihova nasumična široka primena ugrožava ljudsko zdravlje i ekosisteme. Jasno je da detoksikacija toksičnih insekticida iz vodenog sistema ostaje globalni prioritet. U ovoj studiji sintetisan je nanokatalizator cink oksida sa odgovarajućim svojstvima da bi se postigla potpuna degradacija nekih insekticida iz vodenih medija. ZnO katalizator je korišćen u normalnoj i nano veličini kao deo naprednog procesa oksidacije u prisustvu H2O2 i UV zraka. Potpuna detoksikacija testiranih pesticida nakon tretmana najefikasnijim procesom (ZnO(s)/H2O2/UV) je zatim ispitana istraživanjem biohemijskim tretmanom. Takođe je istražen uticaj tretmana vode ZnO. Zanimljivo je da je ova studija izvestila da su stope degradacije istraživanih insekticida bile brže korišćenjem ZnO katalizatora nano veličine nego običnog ZnO katalizatora kao i sondi cink dioksida. U tom smislu, potpuna razgradnja ispitivanih insekticida (100%) u sistemu ZnO(s)/H2O2/UV postignuta je nakon 320 min ozračivanja. Tretman vode nanokatalizatorom cink oksida poboljšao je kvalitet parametara vode. Zajedno, napredni procesi oksidacije koji koriste ZnO nanokatalizator mogu se smatrati obećavajućom tehnologijom tretmana za potpunu detoksikaciju metomila i dimetoata u vodi. Međutim, dalja istraživanja su opravdana za identifikaciju potencijalnih proizvoda raspada.

Ključne reči: Cink dioksid, monitoring, hemijska voda

Use of Zinc Dioxide Probes to Monitor Biological and Chemical Contamination of Water for Civil and Military Purposes

Abstract: Mainly organic pollutants, and their random wide application threatens human health and ecosystems. It is clear that detoxifying toxic insecticides from aquatic systems remains a global priority. In this study, a zinc oxide nanocatalyst with suitable properties was synthesized to achieve complete degradation of some insecticides from aqueous media. ZnO catalyst was used in normal and nano size as part of an advanced oxidation process in the presence of H2O2 and UV rays. The complete detoxification of the tested pesticides after treatment with the most effective process (ZnO(s)/H2O2/UV) was then investigated by biochemical treatment research. The effect of ZnO water treatment was also investigated. Interestingly, this study reported that the degradation rates of the investigated insecticides were faster using nano-sized ZnO catalysts than plain ZnO catalysts as well as zinc dioxide probes. In this sense, complete decomposition of the investigated insecticides (100%) in the ZnO(s)/H2O2/UV system was achieved after 320 min of irradiation. Water treatment with zinc oxide nanocatalyst improved the quality of water parameters. Together, the advanced oxidation processes using ZnO nanocatalyst can be considered as a promising treatment technology for the complete detoxification of methomyl and dimethoate in water. However, further research is warranted to identify potential breakdown products.

Keywords: Zinc dioxide, monitoring, chemical water

1. Introduction

Characterization of Commercial and Fabricated ZnO Figure 1 shows typical scanning electron images of synthesized and commercial ZnO. The results show that the shape of the synthesized ZnO is spherical with a diameter in the range of 30–49 nm. Commercial ZnO appears as randomly oriented

hexagonal prisms with diameters ranging from 34 to 119 nm and lengths ranging from 169 to 399 nm. Additional studies on the structures of synthesized and commercial ZnO were conducted using transmission electron microscopy.

The diameter of the synthesized ZnO(s) lies in the range of 12.48–26.12 nm. It reflects the shape of commercial ZnO which appears as a (nanowire) with a hexagonal diameter in the range of 30–83.87 nm with a length in the range of 70.96–406.45 nm. XRD diffraction pattern of ZnO nanoparticles. The peaks are indexed as 31.4° (100), 34.54° (002), 35.90° (101), 56.27° (110), 62.54° (103), and 67.64° (112). All the diffraction peaks of the sample correspond to the characteristic hexagonal virzite structure of ZnO nanoparticles; diffraction data file. The average particle size of ZnO nanoparticles was found to be in the range of 34–39.7 nm using the Scherrer equation. Diffraction patterns were found to be absent, corresponding to impurities. This proves that pure ZnO nanoparticles have been synthesized. However, the XRD patterns of nanoparticles are greatly extended due to the very small size of these particles. Strong and narrow diffraction peaks indicated that the product had good crystallinity. Particle size calculations using the Debie–Sheerer equation revealed that the average of commercial ZnO ranges from 61.66 to 75.8 nm. Figures 4A,B show the FTIR spectra of the synthesized ZnO (NPs). Infrared studies were conducted in order to determine the purity and nature of the metal nanoparticles. Metal oxides generally give absorption bands in the fingerprint region, i.e. below 1,000 cm−1, which results from interatomic vibrations. The peaks observed in Figure 4A at 3455 and 1.083 cm−1 may be due to O-H stretching and strain, respectively, attributed to water adsorption on the metal surface. The peaks at 1634 and 537 cm−1 correspond to stretching and straining Zn-O vibrations, respectively. The metal-oxygen frequencies observed for the corresponding metal oxides are in agreement with the literature values.

The figure shows the observed peaks of the received commercial ZnO (nanoparticles); two peaks at 3441 and 1.089 cm−1 may be due to O-H stretching and strain, respectively, assigned to adsorbed water on the metal surface. The peaks at 1631 and 537 cm−1 correspond to Zn-O stretching and deformation vibrations, respectively.

Figure 1. SEM image and particle size distribution of synthesized (A) and commercial (B) ZnO.

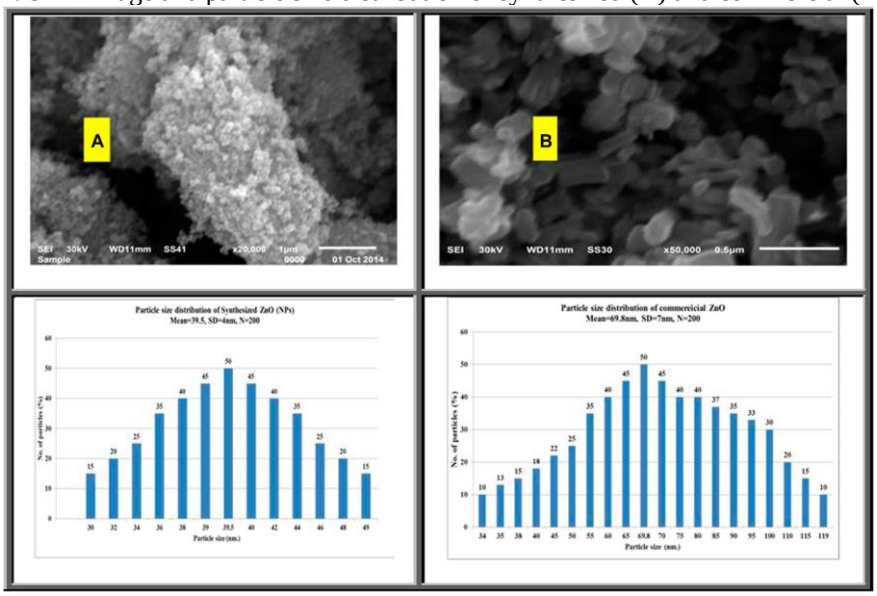


Figure 2. TEM image of synthesized (A) and commercial (B) Zn

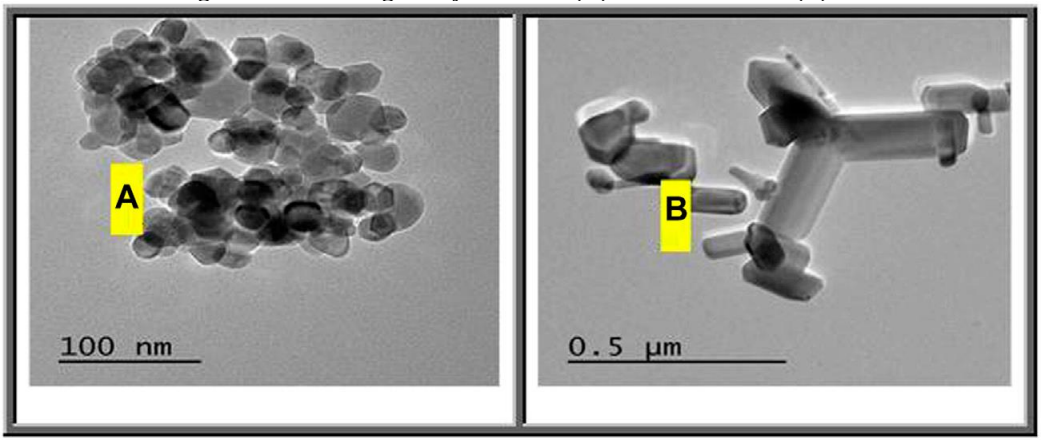
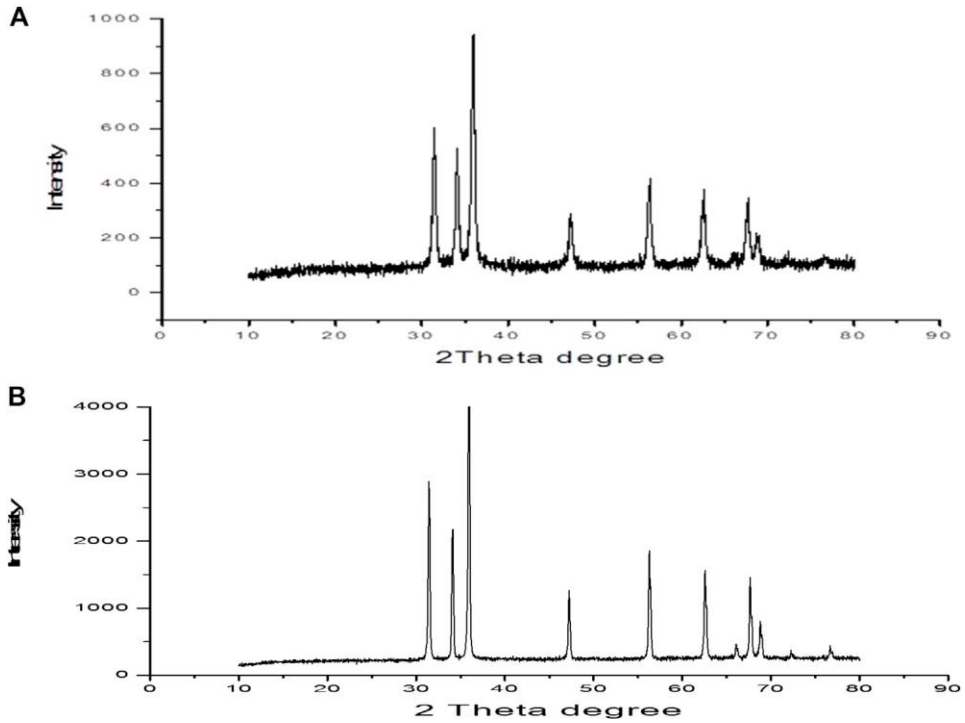


Figure 3. XRD samples of manufactured and commercial ZnO.



2. Intake of heavy metals through water

Soil is polluted by the presence of heavy metals in surface and groundwater, and pollution increases when mined ores are dumped on the surface of the soil for manual processing.

Due to deposition over the surface, the metals(Gnamuš A, Byrne AR, 2000) are exposed to air and rain, thus creating massive AMD. If the soil is polluted at that time, it enters the plant tissue and accumulates there. And when those plants are grazed by animals and water is used for drinking from polluted waters, these heavy metals enter the body through them. Also, marine life, which reproduces in contaminated water, also has the presence of heavy metals in their body tissues, if they are lactating then in their milk. As an overview, all organisms within a given ecosystem are contaminated by these pollutants (Atmos. Environ., 2005) through their food chains. When food is taken from these contaminated vegetables, the presence of heavy metals in those vegetables can lead to various chronic diseases. The toxic effects of these heavy metals usually depend on the amount of concentration and the oxidative state of certain heavy metals. Heavy metals have a very dangerous impact because they are non-degradable in nature, have a long biological (Hines ME., Faganeli J, 2006) half-life and have

the potential to accumulate in the body. Also, there are some heavy metals that are extremely toxic just because of their solubility. Smaller concentrations of heavy metals within the food chain also show serious effects because there is no specific procedure by which these heavy metal contaminants can be extracted from the organism's body. Today, the presence of these toxic heavy metals is everywhere due to their extreme industrial use. In the case of wastewater, it contains a huge concentration of heavy metals, which create various health problems.

2.1 Impact on the aquatic environment

Water from estuaries and fresh water has not been somewhat polluted so far, but even that water threatens to be polluted in the long term due to the deposition of metals due to human past activities. Water in rivers and lakes can be highly polluted depending on the volume (Jeran Z, Jaćimović R, 2002) of flow and the proximity of point sources. Due to human civilization, the content of elements in water has increased. Such elements are cadmium, lead, mercury, zinc and chromium. Unlike organic chemicals, there are metals that cannot be converted into less toxic compounds, and one of their characteristics is the loss of biodegradability. When heavy metals enter the water system, they redistribute through the column and accumulate in the sediments. Sediments represent a partial contribution to the pollution of natural phenomena due to their activity and metal remobilization process. Metal residues present in the contaminated environment have the flexibility to bioaccumulate in the aquatic environment. The growth of larvae and young fish is fast. But when these heavy metals enter, they can inhibit the growth rate. Fish grow in length and bulk when given the right conditions, such as a certain temperature and an acceptable amount of food. On the other hand, fish growth can be hindered in water contaminated with poisons, such as heavy metals. One of the most noticeable signs (Schood Jožef Stefan, 2010) of metal toxicity in larval fish is growth inhibition. As a result, fish length and mass are indicators of environmental conditions. Heavy metals are introduced in liquid form, and the ingredients of surface water (carbonate, sulfate, organic substances humic, fulvic and amino acids) cause the formation of insoluble salts or complexes. These salts and compounds are not expected to harm aquatic species. Some of them sink and accumulate in the sediments at the bottom. A decrease in the pH of water due to acid rain or any other acidic incident, due to the deposition of heavy metals in the water column, causes the aquatic biota to become toxic. Low levels of heavy metals can also cause chronic stress, as fish may not die, but may cause them to lose weight and become smaller, reducing their capacity to compete for food and habitat.

3. Conclusion

The results of measurements in different parts of the environment show that mercury is present in very high concentrations in soil and sediments. Active transport of inorganic mercury takes place. The expected decrease in the concentration of mercury in biota since the closure of the Mercury Mine was not observed. Mercury concentrations in bioindicators are elevated in the vicinity of Idrija, but not to the extent of causing noticeable adverse effects. However, it must be noted that a change in land use and water management (such as the construction of a new hydroelectric power plant on the Idrijca River) can seriously alter the reactivity and formation of MeHg. An optimized monitoring program should therefore be implemented using physical, chemical and biological methods, and in particular appropriate biomonitoring to detect changes in the mobility, reactivity and bioavailability of mercury.

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Strateška odbrana kao igra sajber bezbednosti

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Apstrakt: Trenutno se napadači i branioci bore za pristup i kontrolu informacija u političkoj, ekonomskoj, vojnoj i društvenoj sferi. Vojnim jezikom, podaci su postali virtuelna 'visoka tačka' sa koje se može uticati na bolje upućenog protivnika. Strateška odbrana je postala igra sajber bezbednosti. Međutim, uprkos brojnim tehnološkim rešenjima koja su uvedena za rešavanje ranjivosti sistema, ljudski faktor ostaje najveća pretnja bezbednosti sistema. Ovaj rad, na primeru ukrajinsko-ruskog konflikta, promoviše primenu strateških vojnih koncepata na sajber sukob u cilju boljeg rešavanja dinamičkog izazova kontinuirane interakcije između prilagodljivih i inteligentnih protivnika. Počinje zalaganjem za korisnost vojne paradigme u sajber prostoru, iako bez želje za militarizacijom sajber prostora. Zaključak je da je vojni način razmišljanja, koji je zasnovan na sukobu sa dinamičnim, prilagodljivim protivnicima, pouzdanija strategija od preovlađujuće paradigme „sajber higijene“. Opisano je pet nivoa strateške misli kako bi se povezali ciljevi sa politikom, strategijom, kampanjama i operacijama, taktikama i instrumentima. Svaki nivo strateške misli primenjen je na hipotetički scenario odbrane mreže. Konačno, rad je demonstrirao alternativu tehnološko-centričnim strategijama koje su nedovoljne za borbu protiv protivnika ugrađivanjem strateškog razmišljanja u digitalnu odbranu.

Ključne reči: sajber higijena, sajber ratovanje, konflikt, strateška misao, sajber odbrana

Strategic Defence as a Cyber Security Game

Abstract: Currently, both assaulters and perservers strive to be in a position of access to information, and also control in the field of economics, warfare, and society. Describe in military terms, data has become a virtual 'high ground' from which a more knowledgeable opponent can be influenced. Strategic defence became a cyber security game. However, despite the numerous technological solutions introduced to address system vulnerabilities, the human factor remains the greatest threat to system security. On the example of Ukraine-Russia conflict, this paper promotes the implementation of military strategy concepts to cyberconflict in order to better address the dynamical challenges of continual interaction between conformable and intelligent opponents. It begins by arguing for the adaptability of a military paradigm in cyberspace, though, without a desire for cyberspace's militarization. The conclusion is that the military mindset, which is predicated on clashes with dynamic, adaptable opponents, is a more dependable strategy than the prevalent cyber-hygiene paradigm. Five levels of strategic thought were described in order to connect objectives to policy, strategy, campaigns and operations, tactics, and instruments. Each level of strategic thinking was applied to a hypothetical defence script. Finally, the paper showed a substitute to technocentric strategies that are insufficient to combat the opponent by incorporating strategic thinking into digital defence.

Keywords: cyber hygiene, cyber warfare, conflict, strategic thought, cyber defence

1. Introduction

Beginning during the Second World War, the digitization of information has highly strengthened the association among humans (from the personal to the nation and state levels) and unstructured data, structured information, and intelligence (pieces of information with military or social value) (Unver, 2018). Each aspect of society has gained certain conveniences from information technologies, but it made us dependent on data, which our opponents accepted as a tool to be used *versus* us. Currently, both assaulters and perservers strive to be in a position of access to information, and also control in the field of economics, warfare, and society (Powers & Jablonski, 2015). In warfare terms, information has become an advantage from which a more knowledgeable opponent can be influenced. Currently, the Ukrainian Government is at a tactical drawback compared to Russian Federation, both on the conventional battlefield and in cyber battlefield. Nevertheless, cyber security, particularly at the nation-level, is a pastime of strategy, and Ukraine can invest in long-term which is sought to pay off. Practitioners, academics, policymakers, and the general public in Ukraine are perplexed, both on personal and collective level, by asking of how to protect information (Greminger & Vestner, 2022). Another hindrance is that the opponents do not have a single or even numerous attacking tactics since they can purloin, demolish, repudiate access to, or change information – as well as the systems that hoard, processing, and show it to its purported proprietors.

Digitized data is a man's creation that resides in devices projected and built by engineers. Thus, decision-makers look to the tech-community for solutions to such issues (Cai & Zhang, 2013). Technical proposals can take a variety of shapes. Some of them often show themselves in policymaking spheres, such as that we may abandon the internet as a hole, and replace it with some highly secured alternative. We could create 'impenetrable' software applications, through advanced technologies that make defence easier than wrongdoing (which is not the case at the moment); or we could transfer our security problems to outsourced companies. All of aforementioned concepts sound technically doable, still cannot be implemented on account of numerous reasons. Basically, it is risky to rely only on technological aspects to address fundamental issues (Hammes, 2021).

2. Limits of Tech-Driven Methodologies

Technological basis plays a crucial function in the protection of data. Intruders looking for simple prey can be thwarted by well-designed networks, higher-quality software, and nimble startups. Unfortunately, sometimes well-resourced, professional attackers are on a long-term mission to damage specific, valuable prey, whether for stealing the data or to manipulate (Ogun, 2015). They will persevere until their mission requirements change or they are successful in their mission. Digital perservers might only catch a view of the perpetrator, which is frequently far too late. In contrast to the casualty's point of view, which is typically limited and deficient, professional assailants are tenacious and know precisely what do they aim at (Pomranky, 2010). According to Libicki (2021), the average number of days a triumphant threat group was present on a victim's network before being detected in 2014 was more than two hundred. In one instance, an attacker kept unauthorized access for more than eight years. Even after detection, organizations may invest months attempting to eradicate the intruder.

The foreign hackers continued to plague the US State Department three months after the agency breach. This interrelation between security and cadence is essential for safeguarding cyber resources. Understanding the interaction between attackers and defenders requires an analysis of time intervals, but the security clique does not understand or respect the essence and consequences of this connection. A techno-centric look is preoccupied with still, disposable interactions betwixt assailant and perserver. This might not be a precise depiction of the reality, which is inhabited not by programming code, but by people who have a mind of their own and are able to adjust, grant resources, and create a dynamical resolution in order to achieve objectives (Schneider, 2015). A Digital perserver that ignores such realities does so by increasing risk. The interactive and time-dependent nature of network attack and defence encourages suboptimal security strategies.

The emphasis on 'cyber hygiene' is indicative. This mode encourages good visibility into your own network, slicing and dropping systems that don't have permissions, patching potential vulnerabilities, and improving settings to deter potential attackers from attacking. All of these defensive measures are obligatory and commendable. Nevertheless, they are not enough against adversaries who have the time and assets to adjust to the defences of the victim and overcome them. "Washing cyber hands" is

beneficial for preventing the unfurl of vacuous pathogens, but it is not as effective to more intelligent germs (Ratnaweera & Pivovarov, 2019).

3. Strategic Cyber Defence Ideas

This paper promotes the implementation of conventional warfare strategy concepts to cyberconflict in order to better adapt to the accelerating challenge of a constant interaction ratio between adaptive and intelligent opponents. Conventional combat has traditionally been characterized as a protracted grapple between tenacious opponents (Lucas, 2017). In the late XVIII and early XIX century, the emergence of large armies, modern weapons and clashes, elevated this concept to a higher level. Therefore, military strategists of the 20th century needed to consider far out of the conventional doublet of tactics and strategy. They coded numerous levels of skirmishes over time. In the 80s, the United States Army doctrine characterized several levels of war: strategical, and operation and tactic levels. From Napoleonic battles to Soviet military planning, these drew upon previous writings and lessons learned (Townshend, 2005). National objectives and policy were incorporated into doctrine, despite the fact where term 'strategy' frequently emerged in the prototype's as one of its most important constituents, which can be perplexing (Hoffman, 2016).

Figure 1. Steps in strategic thinking. Adapted from: (Johnson & Clack, 2015).

We contend that decision-makers must have a deeper understanding of the role of technology in strategic thinking; therefore, 'tools' is added as a new layer beneath the tactical layer. Undoubtedly, in physical warfare, 'weapons' are used to inflict kinetic damage. In the digital realm, models age explicitly. In the digital realm, the model demonstrates their strategic position. Too many professionals in digital security believe that tools are the sole focus of defensive action (Sambaluk, 2019). By placing tools at the bottom of the model, the author believes they appear in their correct location. In addition, the expression 'campaign' is included at the operational level in this model. Sometimes, 'campaigns' and 'operations' are used interchangeably, so both terms appear to reduce confusion (Drew, 2020).

This is illustrated in the Figure 1. The policies and objectives of an organization are broad statements that define the desired purpose of the strategic program. Strategy is a plana for how a group can use its resources to reach its goal and policy. Operation, grouped into "campaigns" in this schema, is a sequence of activities that are used to carry out strategies that are followed over days, weeks, months, or even years. (Christiano, 2022). Tactics are the things you do when you meet an opponent one-on-one. They are the basic building blocks of a campaign. Tools are the digital things an actor uses to put plans into action. All of these parts have to work together for success to happen (Roach, 2015). Before

explaining how these five levels can improve digital defence, it's important to mention that this paper does not propose to "militarize" cyberspace, which is a worry of numerous professionals. For instance, Chesterman (2011) wrote that the military had "prioritized one national security objective -- more espionage and the ability to carry out attacks - above all others." This question was seen by journalists as a question of "nonsensical militarization" of it, "active equipping with military forces and a different spectrum of defence means" or, say, "adaptation realized for the needs of military use." Although the author of the paper does not generally agree with these assumptions, there is a need to combine strategic thought with the goal of militarization. of today's actual computer intrusions.

4. Using the Strategic Model for Traditional Security

In today's digital age, where technology permeates every aspect of our lives, ensuring the security of our digital assets has become of utmost importance. Cybersecurity has emerged as a critical field to protect individuals, organizations, and nations from the ever-evolving threat landscape. To effectively address cybersecurity challenges, a strategic approach is necessary (Fielder, Panaousis, Malacaria et al., 2016). First it is needed to understand the Strategic Model: The strategic model is a systematic framework used to develop and implement effective strategies in various domains, including cybersecurity. It involves a holistic approach that encompasses analysis, planning, execution, and evaluation of security measures. The model aims to align security objectives with organizational goals and adapt to changing threat landscapes. Key Components of the Strategic Model in Cybersecurity are, at the first place a Risk Assessment. It is a crucial component of the strategic model is conducting a comprehensive risk assessment. This involves identifying and analysing potential threats, vulnerabilities, and potential impacts. By understanding the risks, organizations can prioritize their security efforts and allocate resources effectively. Furthermore, security policies and procedures: developing robust security policies and procedures is vital for protecting digital assets.

These policies define guidelines for access control, data protection, incident response, and other essential security measures (McGraw, Miques & West, 2013). By establishing clear protocols, organizations can ensure consistency and compliance in their security practices. Incident Response Planning: Being prepared for cyber incidents is essential in mitigating their impact. The strategic model emphasizes the development of an incident response plan, which outlines the necessary actions to be taken in the event of a security breach. This includes detection, containment, eradication, and recovery processes, along with communication and coordination strategies (Skarga-Bandurova, Kotsiuba & Velasco, 2021). People are often the weakest link in cybersecurity. Therefore, the strategic model emphasizes the importance of security awareness and training programs. By educating employees about potential threats, safe practices, and the significance of cybersecurity, organizations can enhance their overall security posture (ISACA, 2015).

The strategic model recognizes the dynamic nature of cybersecurity and the need for continuous monitoring and improvement. Organizations should regularly assess their security measures, monitor network activity, and implement necessary updates (Shumard, 2015). This proactive approach helps identify emerging threats and adapt security measures accordingly. The strategic model ensures that cybersecurity efforts align with broader organizational goals and objectives. By integrating security considerations into the overall business strategy, organizations can protect their critical assets and maintain business continuity (Kavyn, Bratsuk & Lytvynenko, 2021). By conducting risk assessments and prioritizing security efforts, the strategic model helps organizations allocate resources effectively.

This ensures that investments in cybersecurity are directed where they are most needed, maximizing the return on investment and minimizing potential losses. The strategic model's emphasis on incident response planning enables organizations to respond swiftly and effectively to security incidents (Caelli, 2012). With predefined protocols and clear roles and responsibilities, organizations can minimize the impact of breaches and swiftly restore normal operations. Through security awareness and training programs, the strategic model fosters a cybersecurity-conscious culture within organizations. This leads to increased vigilance, improved adherence to security practices, and better overall resilience against cyber threats. As cyber threats continue to evolve in complexity and scale, adopting a strategic model for traditional cybersecurity becomes increasingly critical (Yadron, 2014). By leveraging the components of risk assessment, security policies, incident response planning, security awareness, and continuous monitoring, organizations can develop a proactive and resilient cybersecurity posture. The strategic model provides a comprehensive framework that aligns security objectives with organizational goals, leading to improved protection of digital assets and enhanced overall

cybersecurity resilience (Rindell, Hyrynsalmi & Leppänen, 2018). However, information security research has been almost exclusively focused on technical problems, and efforts to enhance information security have been software- or hardware-centric (Bella, Curzon & Lenzini, 2015). There have been few attempts to resolve computer users, despite the fact that they are the greatest security vulnerability in information systems. Despite the numerous technological solutions introduced to address system vulnerabilities, the human factor remains the greatest threat to system security (Saflanu & Twum, 2016).

5. Cyber Security Lacking a Plan

It is extremely important to understand how the basic strategic principles of cyber security can be adapted and fully implemented in order to better protect important digital assets. Attacks by ruthless criminal groups and groups that represent threats to the national interests of the state greatly compromise numerous private organizations and seek to alienate their intellectual property, including various trade secrets, highly sensitive and confidential commercial data, as well as numerous other digital assets (Collins & McCombie, 2012). It should be pointed out that the traditional security model of 'tools and tactics' is undeniably characterized by extremely suboptimal communication and extremely poor coordination between different levels of management, the board of directors and members of the security team. The one under the direct management of the CISO, is more than determined to decisively confront the adversary.

Their first step involves taking decisive tangible actions, such as recruiting new staff, developing modern capabilities, adopting an entirely new strategy, or acquiring an entirely new software application (Justice & Sample, 2022). The CISO will develop an argument for and against based on an immediate ROI assessment that includes the very cost of the proposed initiative, the amount of money we should save (provided almost everything goes well) and the inevitable precise mathematical calculation of the total risk undertaken by the enterprise. If by any chance the CEO or the board expresses a desire to clarify the reasoning, the CISO will be obliged to provide information and will demonstrate an approach using various tools and tactics to save invested money and reduce the level of risk. Management has two options. They will either approve the proposal or ask the CISO to redesign the approach. This cycle in its original form requires that the budget be reviewed until management realizes that the more money, they spend on ROI needs and on network security itself, the more money they actually save later.

At the very end of the cycle, management comes to the conclusion that security is far more important in preventing losses than generating revenue, and they become extremely disengaged (and of course dissatisfied) with protecting their very important digital assets. In doing so, they admit that their organization is just one of many whose boards are not fully aware of current strategy and have never actually participated in an attempt to formulate a serious strategy.

6. Strategical Perspective of Security in Cyber Domain

Contrary to such a point of view, a strategic cyber security program in reality begins with the precise definition of one or more program objectives, rather than the tools or tactics themselves. First, from a strategic point of view, the CISO receives executive support for the realization of these goals. In order to achieve the stated goal, the CISO must in some way include all levels of strategic thinking, starting with the board itself and inevitably the CEO. Everyone must have an active participation. The CISO understands very well that security is an uncertain journey, not the final destination itself, and that the aforementioned relationship building is complex and requires the ability to translate two extremes, between technical and non-technical vocabularies (Subramanian, 2020). The CISO tries to regulate the objectives of the program as precisely as possible, and this primarily refers to the company's digital security programs. The CISO, Board and CEO agree by acclamation that the goal of this brand-new policy is to preserve and protect intellectual property, sensitive trade secrets, and valuable data and that the goal is to fully minimize loss due to a possible intrusion. Such a worded statement implies that everyone is able to recognize the impossibility of completely stopping all adversaries and almost all attacks, especially those when they are actually actors belonging to nation states and certain well-organized criminal organizations.

The immediate goal of this exercise is to inevitably reach a consensus on a non-technical, proclaimed program goal. Consensus can very easily be reached without any in-depth technical discussion, but it is

important to point out that the CISO must ensure that all set goals, chosen policies and chosen strategies are technically feasible. The CISO can practically confidently collaborate with his carefully selected security team to plan all important operations and campaigns and, if the need arises, acquire new security tools and create new strategies to facilitate their execution. Everyone makes a decision together with the aim of conducting a full network security monitoring operation, which is defined as collecting data and summarizing indications and warnings in order to immediately detect and respond to potential intruders (Fuentes-Garcia, Camacho & Macia-Fernandez, 2021). The security team has the authority to initiate a long-term, strategic process of looking for various complex hostile cyber-attack campaigns, which include all known to date as well as those future, unknown intrusion patterns.

The CISO, board, and CEO are tasked with agreeing that rapid detection, timely response, and decisive containment of cyber threats is that expected second goal of the program. This objective ensures that the threat is not defeated if the perimeter defences are breached. As long as they have the ability to react before the attacker completes his ultimate goal, the defenders can take the upper hand. Therefore, the security team will develop appropriate strategies for radical and rapid identification of various compromises, determining their real nature, attribution and, most importantly, have the ability to devise a plan to effectively prevent the attacker from trying to realize his mission.
At the immediate tactical level of inevitable one-on-one confrontations with an adversary—analogous to wartime battles—the security team will be forced to make a number of very important decisions, such as whether to expel the intruder immediately or to wisely and calmly observe the intruder for a while in order to gathered very valuable information about the nature and source of the attack (AlKadheeb, Bhattachariia & Perl, 2022). Some tactics necessarily incorporate the use of certain tools or techniques, which would be analogous to, say, the crew of the Star Trek franchise switching their handheld phasers between settings to different modes that include the "stun" and "kill" positions. It should be noted that the adversary has some say in what happens, but from the company's perspective, important program goals, key policies and set guidelines should be drawn up in order to regulate this entire very important process.

7. The Applicability of Campaigns

The campaign, which seems to be working successfully at the operational level itself, is essential to the overall concept and to the inevitable success of the strategic security program as a whole. It should be noted that the maturity of a security program can be carefully assessed by the immediate attention that the CISO and his or her security team devote to the immediate development of the campaign itself, as well as by a broad understanding of the level of progress and analysis of the campaign itself by superior senior management. When talking about specific campaigns themselves and evaluating them in terms of sheer sophistication and breadth of impact, careful discussions with other executives, the board, and other key stakeholders are crucial. The CEO should have the ability to talk in detail about the various threat actors behind the campaigns, including their means and motivations, as well as provide visual examples of each campaign and how the security team directly responded to them. In addition, the very important term 'campaign' fits more than well into existing non-technological business operations such as marketing and, say, sales campaigns.

Despite these efforts, it should be emphasized that the number of cyber-attacks is constantly increasing (Shandler & Gomez, 2022). Individual attacks implemented include ghost everything from say a suspicious TCP packet to a very unusual computer port, then some random suspicious SQL query and sinister 'phishing' email (Verma & Shri, 2022). A more in-depth discussion of individual attacks is of somewhat limited value. A legitimate question arises, how can one give oneself the right to imagine a fully credible programmatic goal to counter the dizzying number of several tens of billions of attacks (Verma & Shri, 2022)? The optimal strategy necessary to organize primary threats and immediate threat actors into logical campaigns actually lies somewhere in no man's land. This is potentially the most effective method for a business organization or nation-state to combat a highly cunning interactive and above all highly adaptive adversary.

8. Ukrainian Cybersecurity Strategies

The new Ukrainian government, which has extremely hostile relations with Russia and is involved in an especially long-lasting conflict, appears to be the target of numerous extensive and orchestrated cyber-attack campaigns. The only possible way to counter such a brutal offensive campaign, in the opinion of the author, is to equally conduct a determined and unwavering defensive campaign. In April

2015, the notorious security firm Looking Glass revealed a large-scale and well-orchestrated "Operation Armageddon", which it saw as a well-known pattern of cyber-espionage (activities going back to 2013) designed to give Russia a "tangible military advantage" in intends to target the Ukrainian government, then law enforcement and various military officials who appear to be of interest to the intelligence services (Jasper, 2020). As expected, the researchers found a direct correlation between large-scale digital attacks and the current ongoing conflict, as well as an almost alarming combination of all known forms of cyber-espionage, brutal physical warfare and geopolitics itself. Reports from reputable security firms such as Trend Micro and FireEie have exposed Russian campaigns dubbed "Operation Pawn Storm" and "APT28". According to FireEie, APT28 appears to have narrowly and cunningly targeted individuals associated in any way with European security organizations.

Organizations such as the North Atlantic Treaty Organization (NATO) and the Organization for Security and Cooperation in Europe (OSCE) stand out here. These are precisely those organizations that the Russian government has seen for many years as an existential threat to its security. It should also be noted that some Russian non-state actors such as CyberBerkut play an active role in the cyber fight against the NATO pact and targets of interest in Ukraine (Lilli, 2022). At the end of March 2014, the group launched extensive, highly sophisticated attacks involving so-called distributed denial-of-service (DDoS) attacks on the primary website of the NATO pact, the website of the CCD COE and the website of the NATO Parliamentary Assembly. In the same year, in October 2014, on the eve of the parliamentary elections in Ukraine, extensive and well-planned and coordinated DDoS attacks were launched on the website of the Central Election Commission of the country, into which election materials were poured from all parts of the country. The group also targeted US military structures operating in Ukraine, publishing highly classified documents concerning the secret transfer of Western military equipment to strengthen the country's defence power (Sakva, 2015).

The nature of national security requirements is above all strategic and they do not change very often. it should be emphasized the fact that what can to some extent be considered a legitimate problem of national security, states will dedicate enormous human and material resources in order to achieve their goals. At the same time, they will not hesitate to use a very wide range of methods and forms of attack. The country will most certainly not surrender after one or even after several dozen or even hundreds of disastrous tactical engagements. On the contrary, it will regroup and break through even the strongest defences. Nation-states differ greatly from individuals and even well-organized hacker groups such as the famous Anonymous, countries such as Russia also qualify as so-called advanced actors in terms of security threats (Kose, 2021). That designation "advanced" indicates the adversary's immediate ability to operate across the spectrum of different computer intrusions, both in terms of target and intensity.

Depending on the immediate location of the target, they can use well-known vulnerabilities, or they can try to improve their approach by continuously researching new vulnerabilities and developing tools that adapt to further exploitation (Iakoviv, 2018). it should be emphasized that every country, including Russia itself, has a key and very significant ability to adapt, and this is one of the very important reasons why close monitoring of threats is crucial at all levels of strategic thinking. This actually means that whenever a failed intrusion attempt is attributed to some so-called advanced actor, the security team can be more than sure that this seemingly defeated adversary will return with some new inventive technique and possibly a new, far more sophisticated campaign.

9. Conclusion

The Government of Ukraine is presently at a pitfall against Russian Federation, in the conventional battlefield as well as in the cyber area. Still, security in cyber space, particularly at the national level, is a game of strategy, and Kyiv can make long-term investments that will pay off. This paper has argued that digital defence requires strategic consideration. First, it argued for the implementation of a conventional militaristic paradigm in cyber area, even though they without wanting to militarize it. We argued that the military mindset, which is predicated on a dynamical clash, adaptable enemies, is far more well-grounded strategy compared to prevalent cyber hygienic paradigm. Furthermore, the paper recounts the 5 levels of strategy thinking, connecting objectives to policies, strategies, manoeuvres and activities. Every level of strategical thinking was applied to a hypothetic intertwining defence script. This paper showed a surrogate to techno-centric strategies, insufficient to combat the enemy by incorporating strategic thinking into digital defence. During a war, Ukraine is an obvious prey for many cyber attackers and initiatives. The only way to beat them is to take an equally aggressive defensive stance in cyberspace.

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

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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.

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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.

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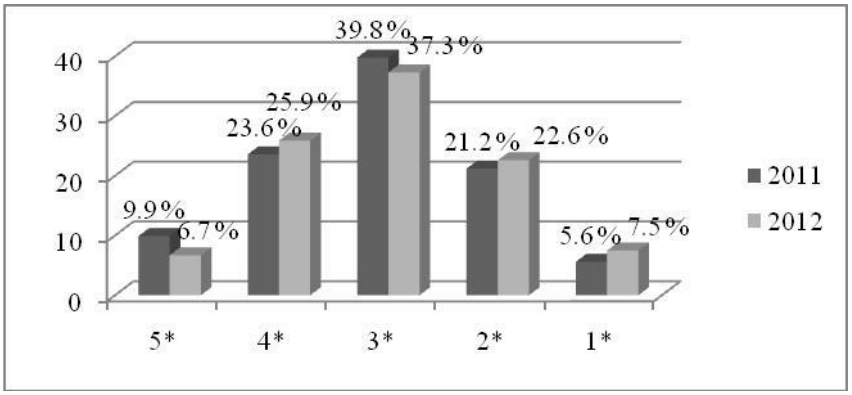
Figure 1: Accommodation units according to the structure of hotel capacities in 2011 and 2012, written in the form of percentage



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)

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

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

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Keywords: 3-5 keywords

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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.**

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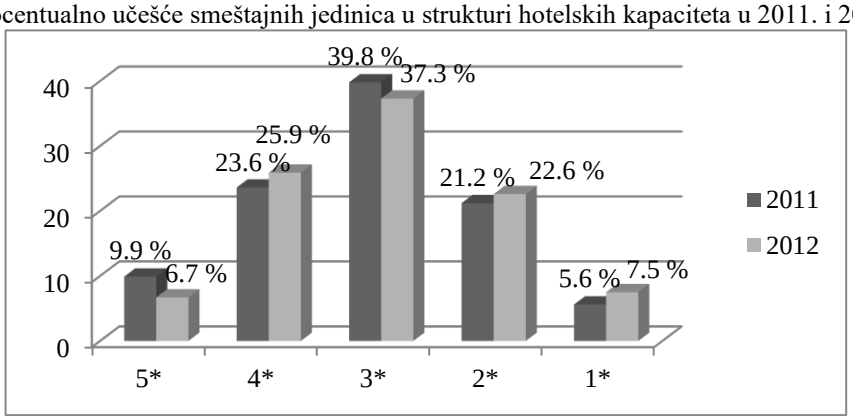
Sve ilustracije, bez obzira da li su dijagrami, fotografije, grafikoni nazivaju se slike. Naziv i broj slike treba prikazati na sredini reda iznad slike.

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).

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

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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

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