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ACCESS TO JUSTICE IN THE DIGITAL AGE

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Abstract

The paper focuses on the right to access to justice in the context of ongoing digitalisation. Access to justice enables individuals to utilise existing legal mechanisms to protect their rights, adhering to substantial standards of justice. Access to justice is essential for the rule of law and human rights. In the paper's first section, we analyse access to justice from a human rights perspective. Access to justice encompasses several core human rights, such as the right to a fair trial, and the right to an effective remedy. We then discuss the role of Artificial Intelligence (AI) in court and how it influences access to justice. We aim to determine whether digitisation and AI tools enhance access to justice and lead to more efficient legal processes. Can the online landscape and the implementation of AI address the shortcomings associated with accessing justice in traditional offline settings? Our initial hypothesis is that modern AI-based tools can facilitate the exercise of the right to access to justice. However, we also recognise that these tools face numerous challenges not typically encountered in the offline environement, which must be addressed to ensure proper access to justice. The author defines the normative and comparative methods as the framework for analysis.

Key words: access to justice, e-justice, AI, Law-chatbot.

ПРАВО НА ПРИСТУП ПРАВОСУЂУ У ДИГИТАЛНОМ ДОБУ

Апстракт

У фокусу рада је право на приступ правосуђу у контексту текуће дигитализације. Право на приступ правосуђу омогућава појединцима да искорите постојеће правне механизме за заштиту права, придржавајући се суштинских стандарда правде. Приступ правди је од кључног значаја за владавину права и људска права. У првом делу рада, анализирамо приступ правосуђу из перспективе људских права. Право на приступ правосуђу обухвата неколико основних људских права, попут права на правично суђење и права на ефикасан правни лек. Затим ћемо говорити о улози вештачке интелигенције у судовима и о томе како она утиче на приступ правосуђу. Наш циљ је да утврдимо да ли дигитализација и алати вештачке интелигенције побољшавају при-

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ступ правди и да ли доводе до ефикасних правних поступака. Да ли онлајн окружење и примена вештачке интелигенције могу решити недостатке повезане са приступом правосуђу у традиционалном офлајн окружењу? Наша полазна хипотеза је да употреба савремених алата заснованих на вештачкој интелигенцији може олакшати остваривање права на приступ правди. Међутим, истовремено препознајемо да коришћење ових алата покреће бројне изазове који нису карактеристични за офлајн окружење, а који се морају решити како би се обезбедио одговарајући приступ правди. Методолошки аспект за који се ауторка определила је нормативни и упоредноправни.

Кључне речи: приступ правосуђу, е-правосуђе, вештачка интелигенција, правни чет-бот.

INTRODUCTION

Access to justice is an essential component of any democratic state. It is imperative for upholding the rule of law and enabling its citizens to effectively exercise their human rights. It allows individuals to defend themselves against rights violations, remedy civil wrongs, hold executive power accountable and protect themselves in criminal proceedings (European Union Agency for Fundamental Rights, 2016, p.16). Access to justice is not a just right *per se*; it also empowers individuals to uphold their other rights within a specified legal framework. Recognised as a 'cross-cutting right', it should be understood and interpreted according to other principles, "such as equal recognition before the law" (Gutterman, 2022, p. 2). Access to justice empowers individuals to demand the protection of their rights, regardless of their economic, social, political, migratory, racial, or ethnic status, religious affiliation, gender identity, or sexual orientation (Lima, Homez, 2020, p. 2). The concept encompasses all phases of the 'chain of justice,' starting with awareness and access to information regarding rights within civil society, extends through the actions of law enforcement authorities, and culminates in the application of appropriate legal remedies. To facilitate access to justice, it is crucial to identify appropriate institutions within the justice system that can focus on citizens and their legal and justice concerns. The ability of individuals to fully engage within existing legal mechanisms to protect their rights and adhere to substantive legal standards is conventionally referred to as access to justice. Access to justice is an essential fundamental human right that is guaranteed at both the international and national levels (Tasić, 2020, p. 621).

The UN Human Rights Committee pioneered the concept of access to justice (Lima, Gomez, 2020). This right is enshrined in various UN instruments as well as in Article 6 of the ECHR and Article 47 of the EU Charter of Fundamental Rights. It encompasses the right to access courts in civil matters and includes guarantees related to court organisation and proceedings. The European Court of Human Rights has gradually developed this right, emphasising that access to court includes the ability to initiate proceedings and resolve disputes effectively. Although the right to

access a court is not absolute and may have limitations, these should not undermine its essence. The right to access to court must be effective by providing the individual with a clear, practical opportunity to challenge acts that interfere with their right[1]. According to the Court of Justice case law, the core of the fundamental right to an effective remedy and a fair trial within the EU's judicial protection system serves as a development tool in the EU legal framework, encouraging the progressive realisation of Charter rights (Gutman, 2019, p. 903).

THE DIGITAL TRANSFORMATION AND THE JUSTICE SYSTEM

The rapid advancement of information and communication technology (ICT) since the 1960s has significantly impacted various aspects of society, including human rights and legal protections. In the context of pervasive digitisation, access to justice has gained importance, with technology serving as a facilitator. While the judiciary is traditionally seen as conservative, recent technological developments show promise in addressing these challenges. The incorporation of ICT in the justice system can be divided into three stages, each reflecting differing levels of technological advancements (Kramer, Van Gelder, Themeli, 2018, p. 211). The initial electronic stage began in the 1980s when courts and lawyers started using computers for information storage and document creation (Velicogna, 2007, p. 131). The first phase is marked by using basic technologies. Computers were used for drafting and printing basic documents, using e-mail for informal communication and browsing the internet. However, it was only in the 1990s that several European governments began supplying the courts with equipment and office applications in a more structured manner.

The second phase is marked by the advent of smart hardware and software that actively process and deliver information, resulting in significant enhancements to the justice system. The transition from paper-based to electronic documentation has enabled the adoption of web-based services, online access to legislation and case law, e-filling, and the electronic exchange of legal documents. This enables virtual interactions between parties, with court users often contracting courts remotely via email, websites, or mobile apps. Regarding court litigation, ICT devices and programs are utilised as tools for organising litigations, courtroom technologies, and decision-making (Kramer *et al*, 2018, p. 212). Litigation organisational tools, used outside the courtroom, help facilitate proceedings and include information technology systems, evidence documentation applications, and various communication devices. In the courtroom, advancements such as audio and video recording systems, as well as remote communication tools for testimony, have been essential during hearings. The development

[1] ECtHR, *De Geouffre de la Pradelle v. France*, no. 12964/87, 16. 12. 1992, para. 35.

of digital technologies has enabled the establishment of a more interactive procedural framework, thereby enhancing the virtual aspects of traditional processes. To fully capitalise on these advancements, legal regulations must evolve in alignment with technological developments. Certain courtroom technologies require prior legal approval and the establishment of specific regulations for their use. Delays in regulation can hinder the effective implementation of these innovations in the legal system. Electronic systems of case file management, electronic proceedings, electronic applications, and a system of random allocation of cases to judges are the main achievements in this period.

Artificial intelligence (AI)[2] represents the third stage of ICT development, referring to machine-based systems designed to operate autonomously and adapt after deployment. AI systems infer outputs like predictions and decisions from user input, impacting physical and virtual environments.[3] The integration of AI is significantly transforming the roles of judges and lawyers, potentially undermining traditional court procedures. Decision-making tools powered by AI can facilitate expedited dispute resolution, reduce costs, and enhance the efficiency of court proceedings. The emergence of robot judges and algorithms for rendering underscores the application of AI in this domain. There are examples of testing the adoption of automated judgments in first-instance proceedings in civil law disputes, especially in disputes of small values (such as the 'robot-judge' project in Estonia) (Nenadić, Miljuš, 2022, p. 301). Considering the information provided, the robotic judges could have many advantages (Nakad-Westrate et al 2015, p. 63). The benefits associated with digital judges include speed, objectivity, and accuracy, as these systems exhibit reduced susceptibility to human error. Nonetheless, concerns persist regarding potential misunderstandings in the decision-making process and non-transparent algorithms, which may jeopardise fundamental rights. While fully automated judgments presents certain challenges, AI can effectively support judges in drafting decisions and identifying analogous cases, laws, regulations and court interpretations.

AI technologies are poised to deliver more benefits than other digital technologies, owing to their capacity to extract information from extensive textual data at a speed significantly surpassing that of humans. These ben-

[2] The scientific community has not accepted a single definition of AI, and it is commonly used as a term to refer to different computer applications that use different techniques and exhibit capabilities commonly associated with human intelligence. The European Commission proposes to establish a legal definition of 'AI system' in EU law, which is primarily based on a definition already used by the OECD. Article 3(1) of the draft AI ACT stated that an 'artificial intelligence system' means software that is developed with (specific) techniques and approaches and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with.

[3] Article 3, AI Act

efits stem from the ability of AI devices to extract information from a vast amount of text significantly faster than humans can. The capability to address legal questions based on this extracted information represents a significant advancement in aiding individuals with their tasks. Moreover, the potential for AI to retrieve arguments from documents positions these systems as viable alternatives for professionals in the justice sector. As legal text analytics and mining continue to develop, certain AI systems will not only be able to replicate arguments found in existing documents but also generate new arguments. This evolution will be advantageous for judges, lawyers, and government entities, as it can reduce the time spent constructing arguments, or save costs by using AI machines to replace humans (Kramer et al, 2018, p. 6).

One area where AI can be highly beneficial is in providing citizens with essential information on basic legal matters. The issue of legal literacy among citizens has been highlighted on various occasions. Many individuals lack awareness of fundamental rules and regulations; when they find themselves in situations requiring court intervention, they find the process overwhelming due to the associated costs and time commitments. Consequently, there is a pronounced need for accessible information that is presented in plain language, alongside clear answers to direct inquiries. These may include whether a specific law may apply to an individual's situation, what options are available to victims, or the likelihood of prevalling in a case under particular circumstances.

In recent years, numerous law tech companies have leveraged software and information technologies to enhance the productivity of judicial services. These companies focus on practical applications and more concrete practice than the 'robot judge' dream (Fernandes, Duvoisin, Horst, 2022, p. 213). Lawtech activities that utilise AI predominantly involve searching large volumes of documents, gathering procedural information, and reviewing decisions made by courts or judges. AI can also be employed to handle notary public routines that do not need judicial review. This eliminates delays in cases waiting for processing by a clerk.

Currently, attention is being drawn to the development and implementation of an innovative solution known as 'Law Chatbots,' which aims to revolutionise access to legal information and services. The Law Chatbot is an artificial intelligence-powered conversational agenda designed to address user queries across a wide spectrum of legal topics, including civil law, criminal law, contract law, and intellectual property rights (Misquita et al, 2024, p. 164). The assistance provided by such tools would be particularly valuable in areas such as the Right to Information and Consumer Rights Protection (Srivastava, 2023, p.33-34). The motivation behind the development of Law Chatbots stems from the urgent need to democratise access to legal expertise by addressing obstacles such as cost, complexity, and the restricted availability of legal professionals. Utilising AI and natu-

ral language processing, these chatbots provide instant and cost-effective legal advice, guidance, and resources to individuals and businesses, independent of time or geographic constraints. With a seamless inclusion into messaging platforms and web interfaces, the Law Chatbots offered 24/7 availability, enabling users to efficiently and confidently navigate complex legal issues. By enhancing legal literacy, promoting legal empowerment, and facilitating access to justice in the digital age, Law Chatbot represents "a transformative tool in bridging the gap between legal professionals and the general populace" (Misquita, Sawant, Shaikh, Patil, Narkar, 2024, p. 164). Rule-based chatbots utilise predefined sets of rules, logic, and patterns to interpret user queries and generate responses. They rely on structured knowledge bases that encompass legal rules, statutes, and frequently asked questions. Although these chatbots offer benefits like simplicity and transparency, they inevitably encounter significant limitations. These limitations include difficulties in managing complex queries, accommodating natural language variability, and facing persistent challenges in maintenance and adaptability. AI-based chatbots such as Amica, Adie, etc. have emerged as valuable tools in various legal fields across numerous countries (Srivastava, 2023, p. 33). Their widespread implementation is transforming the delivery of legal assistance, making it more accessible and efficient for everyone.

The development of ICT and AI has led to the development of predictive tools designed to forecast the likelihood of individuals becoming either perpetrators or victims of specific criminal acts, or behaviours associated with particular categories of crime. The concept of predictive justice first emerged in the United States in 2013, in the case of State v. Loomis (Spalević, Ilić, 2024, p. 2). Predictive justice tools have the potential to anticipate the outcomes of court proceedings or certain phases within those proceedings by utilising mathematical algorithms that analyse vast amounts of data, including previous judicial decisions. In this context, the application of AI requires the input of a substantial volume of data, including laws, regulations, judgments, and documentation from a wide array of court cases into a computer program. The program subsequently evaluates a particular court procedure by extracting essential elements (the verdict of the decision). Each specific case is interconnected with past decisions from cases with similar material and procedural characteristics. This methodology enables the program to predict the outcome of an entire dispute or a specific stage of the process, with the reliability of the model hiding on the quality of the input data and the selected machine learning technique (Toskić Cvetinović, Tošić, 2022, p. 319). On the other hand, AI has the capacity to make independent decisions, meaning its actions are not necessarily dependent on its creator or controllers. While it is not incorrect to say that AI exhibits elements of human-like thinking to some degree, its interference and decision-making processes often have a 'black box' effect.

This means that the stages of decision-making and the detection of biases within AI can be obscure, raising concerns about the procedural rights involved.

These issues motivated the adoption of the European Ethical Charter on the use of AI in judicial systems by the European Commission for the Efficiency of Justice (CEPEJ). This Charter, established in December 2018, was the first European framework outlining ethical principles regarding the use of AI in the judiciary. CEPEJ has identified the following core principles to be respected in the field of AI and justice: the principle of respect of fundamental rights[4], the principle of non-discrimination[5], the principle of quality and security[6], the principle of transparency, impartiality and fairness[7], and the principle 'under user control.'[8] Individuals should not be subject to decisions that are based entirely on automated processing, such as algorithms, particularly when these decisions have legally binding implications or significantly affect their circumstances. However, such decisions must safeguard the individual's rights, freedoms, and legitimate interests by incorporating suitable safeguards. In situations where decisions are not grounded in legal requirements, individuals must be informed of the following (i) the ratio behind the decision-making process, (ii) their entitlement to seek human intervention, (iii) the potential ramifications of the processing, and (iv) their right to challenge the decision.[9]

E-JUSTICE

Developing e-justice is essential for modernising the justice system and enhancing access to justice. New technologies offer solutions to improve this access, making it a central focus of cyber justice research. Technology reduces costs and delays and integrates electronically managed court proceedings, all of which support fair judicial processes. E-justice promotes the key components of a fair trial, including fairness of proceed-

[4] Ensuring that the design and implementation of Ai tools and services are compatible with fundamental rights;

[5] Specifically preventing the development or intensification of any discrimination between individuals or groups of individuals;

[6] About the processing of judicial decisions and data, using certified sources and intangible data with models conceived in a multi-disciplinary manner, in a secure technological environment;

[7] Making data processing methods accessible and understandable, authorising external audits;

[8] Precluding a prescriptive approach and ensuring judicial decisions and data by algorithms and in the use made of them;

[9] https://commission.europa.eu/law/law-topic/data-protection/reform/rules-business-and-organisations/dealing-citizens/are-there-restrictions-use-automated-decision-making_en#example;

ings, public hearings, and reasonable case durations. It significantly benefits individuals and businesses, particularly in remote areas, by providing online resources for filing documents and participating in legal processes. Tools like online dispute resolution (ODR) expedite disputes without costly legal representation and improve transparency by allowing easy access to court records. Furthermore, e-justice serves to harmonise legal systems across jurisdictions, which is vital for cross-border trade, while also offering efficient, low-cost solutions for small claims. The development of e-justice upholds core values such as judicial independence, equality of access, and procedural transparency, ultimately enhancing human rights and justice accessibility across civil and criminal matters using similar digital tools.

The digitisation of justice has far-reaching implications across social, governmental, and economic domains. While it provides considerable societal value, it is pivotal to provide that all individuals have access to these advancements, as gaps in managerial power and knowledge can affect social cohesion. Inclusivity is crucial, particularly for diverse cultures and marginalised groups (Kramer et al, 2018, p. 214).

In the context of e-justice, the rights to a fair trial and effective remedy must be maintained. Access to justice relies on these principles, and therefore, it is vital to examine the implications of modern IT on fair procedures and judicial governance. Ensuring fairness within digital processes is a key concern, which requires the constant alignment of IT and procedural laws to adapt to technological changes.

When evaluating e-justice systems, seven values must be considered: independence, accountability, impartiality, equal access, transparency, privacy, and legal validity. Judicial independence is essential, as it separates courts from the executive and legislative branches. Evaluations should focus on whether e-justice systems, particularly case management tools, negatively impact this independence. Additional challenges may arise from outsourcing functionalities to private companies, which could compromise the independent functioning of e-justice systems. The nature of contracts established between public institutions and private entities plays a significant role in maintaining this independence.

When evaluating the e-justice system regarding accountability, two key areas must be considered judicial accountability and the accountability of the e-justice system itself. E-justice platforms can provide insights into judicial activities, efficiency, and compliance with norms, which should be part of the evaluation framework. Periodic assessments by internal and external organisations, including the Ministry of Justice, serve to uphold accountability and ensure transparency.

Impartiality is another critical value. The e-justice system should ensure equitable access to justice for all, regardless of gender, location, socio-economic status, or technological literacy. Nevertheless, privacy concerns may pose challenges to transparency, as integration of data might

raise security issues. Finally, legal validity is essential. Courts, lawyers, and judges must follow established rules and procedures to maintain a stable democracy. Evaluating e-justice requires the consideration of how technological digitisation impacts compliance with norms and user operations. E-filling systems must prevent identity fraud, ensuring beneficiaries recognise the system as legally valid. Legal validity in e-justice pertains, in equal measure, to citizens', lawyers', and judges' adherence to norms.

THE EU AND E-JUSTICE

The development of e-justice is essential for the effective operation of the judicial system in the EU. Since 2008, the EU Commission and Council have collaborated on various e-justice initiatives to create a pan-European judicial area that enhances legal certainty and the effectiveness of rights. The European e-justice Strategy was first introduced in May 2008, focusing on improving judicial cooperation and the use of ICT in administrative procedures. This was followed by the e-justice Strategy for 2009-2013, which emphasised the importance of ICT in legal processes. The most recent e-Justice Strategy for 2019-2023, approved in March 2019, aims to enhance access to legal information and streamline judicial operations. Key objectives include introducing new functions for the e-justice portal and improving access to courts, particularly small claims. Overall, the EU continues to prioritise the advancement of e-justice initiatives, aiming to enhance access to justice while simultaneously minimising costs and delays.

The EU's e-justice initiatives are closely connected to national developments in information technology, particularly within public administration and justice sectors. Following the establishment of a European framework for e-commerce in 2000, the European e-justice program was launched to simplify access to information and standard forms, facilitating electronic submissions among parties and courts. To enhance cross-border debt collection, the European Order for Payment Procedure and the European Small Claim Procedure were introduced, with the former starting on 12 December 2008, and the latter on 1 January 2009. These procedures aim to streamline small claims handling for consumers and small businesses, recommending written submissions to reduce costs and time. An oral hearing may occur if necessary, with technology enabling remote participation where appropriate. E-justice is prioritised under the EU's Digital Single Market strategy, aiming to improve access to justice. The European e-Justice Portal, launched in 2010, consolidated resources for legal professionals, EU citizens, and businesses, providing a wealth of information on EU and national law in multiple languages, along with interactive tools and access to CJEU case law.

As the process of digital transformation accelerates, it is essential for the EU to articulate how its core values and fundamental rights, which are relevant offline, should be effectively applied in the digital environ-

ment. The European Union is 'a union of values,' as enshrined in Article 2 of the Treaty of EU and in the Charter of Fundamental Rights, founded on respect for human dignity, freedom, democracy, equality, rule of law and respect for human rights. The European Parliament has advocated for ethical principles in guiding the EU's digital transformation, particularly in AI. In December 2022, the European Commission, the European Parliament, and the Council of the EU signed the European Declaration on Digital Rights and Principles, which prioritises the protection of fundamental rights online and aligns with EU constitutional values. The Declaration serves as a reference for policymakers to promote rights and democratic values in the digital age, emphasising the importance of innovation alongside these principles. It raises questions about European integration and the significance of constitutional digital rights. Furthermore, the Declaration commits to a safe and sustainable digital transformation that places people at the centre, fostering connectivity, fair working conditions, and access to digital public services. It is an essential component of a broader constitutional framework and supports the Digital Decade Policy Programme 2030, which sets concrete digital goals for the forthcoming decade.

The regulation of AI is one approach that the EU is employing to guarantee the responsible development and use of this innovative technology within its digital strategy. The European Artificial Act (AI Act), the world's first comprehensive regulation on artificial intelligence, is set to take effect on August 1, 2024. The AI Act is designed to ensure that AI developed and utilised in the EU is reliable, incorporating safeguards to protect individuals' fundamental rights. Member States are required to designate a national competent authority by August 2 2025, tasked with overseeing the application of the AI regulations and conducting market surveillance activities. AI holds the potential to transform our work and daily lives, promising significant benefits for citizens, society, and the European economy. The European way of digital transformation puts people first, ensuring that everyone's rights are upheld. With the introduction of the AI Act, the EU has made a crucial advacement in ensuring that AI technology adheres to EU regulations.

The EU AI Act introduces a risk-based approach to the regulation of AI, imposing varying requirements and obligations based on the level of risk to health, safety, and fundamental rights. The Act categorises risks into four groups:

1. Unacceptable risks – these lead to prohibited practices;
2. High risk – these trigger stringent obligations that are detailed and complex;
3. Limited risk – these come with transparency obligations; and
4. Minimal risk – stakeholders are encouraged to voluntarily create codes of conduct, regardless of whether they are based in the EU or a third country.

The AI Act establishes the regulations of 'high-risk' AI systems that possess the potential to adversely affect the safety or fundamental rights. It delineates two primary categories: systems employed as safety components within products, and systems utilised in eight designated areas, which the Commission may amend as necessary through delegated acts. Among these, the administration of justice and democratic processes are explicitly recognised.

THE DIGITISATION OF JUSTICE IN SERBIA

In 2019, the Republic of Serbia has adopted the Strategy for the Development of Artificial Intelligence for the period 2020-2025, thereby positioning itself as the first country in Southeast Europe to adopt a National strategy of AI (Badža, 2024, p.12). One of the key measures outlined in this strategy is the improvement of public sector services through the application of AI. Given the judiciary's longstanding challenges with a high volume of cases and limited efficiency, the use of AI could serve as an additional mechanism to address these issues. Following this strategy, Ethical Guidelines for the development, implementation, and robust and accountable AI were adopted in February 2023. These guidelines recognise high-risk AI systems that may directly or indirectly violate fundamental principles and conditions, particularly within the judiciary and democratic processes. They specifically address systems designed to assist judicial authorities in analysing and interpreting circumstances, facts, and legal norms to appropriately apply relevant legal standards.

In June 2023, Serbia signed associate agreements related to the Digital Europe Programme. The country is expected to further align its electronic communication legislation with the updated EU regulatory framework. A primary focus of digitisation in Serbia is outlined in the Digital Skills Development Strategy, which spans from 2020 to 2024. The primary objective of this strategy is to enhance the digital knowledge and skills of all citizens, including those belonging to vulnerable social groups. It aims to monitor the advancement of ICT in all areas, across various sectors and to address the requirements of the economy and labour market effectively. Additionally, a specific AI law is currently being prepared in Serbia. A task group has been formed, and the law is expected to come into effect in 2025. The primary aim of this forthcoming legislation is to establish a regulatory framework governing the creation and use of AI in Serbia.

In terms of access to justice, it is important to highlight the Judicial Development Strategy for the period 2020-2025. One of the specific objectives of this strategy is the development of e-Justice, aimed at increasing the efficiency of the judicial system, strengthening the rule of law, and enhancing access to justice and legal certainty. The ultimate goal is to ensure the quality and effective realisation of the protection of citizens' rights and

freedoms while raising the level of trust in the judicial system. The Judicial Information System, a platform for electronic data exchange between state bodies, and for compiling statistical data on court proceedings was adopted in 2018. Additionally, there are several subsystems utilised across various justice institutions.

The need to improve the ICT system in court is one of the challenges identified in relation to Chapter 23. Judicial institutions in Serbia employ an electronic case management system. In misdemeanour cases, the SIPRES software facilitates the electronic submission of misdemenor charges. The SIPRIS software is specifically designed for commercial courts. For prosecutions, the implementation of the SAPO (Standard Application for Prosecution Offices) software, along with the SAPA (Standard Application for Prison Administration) system, is currently underway in all institutions responsible for the execution of criminal sanctions. The SAPS application aids in managing cases in courts of both general and special jurisdiction, covering the entire lifecycle of a case from the submission of the initial document to the final decision and archiving. Within the case management process, users can create cases, enter data, and record all actions throughout the life of the case. This includes entering information on participants, assigning judges, scheduling hearings, and documenting decisions and their dispatch. The SAPS application also includes case search features based on the data entered or through searches of the textual content of the case.

The electronic communication system utilised by the Administrative Court, known as 'e-Sud,' began operating in 2018. This system, accessible via the Internet, allows all parties, including lawyers and citizens, to conduct administrative disputes entirely electronically. On January 1 2020, the court's electronic bulletin board, eTabla, which was established by the Ministry of Justice, became operational. eTabla provides citizens and legal entities with access to all documents from enforcement procedures that were not successfully delivered to them personally by the court or public bailiff. This electronic bulletin board replaced the previous physical bulletin boards in courts, enhancing the responsibility, transparency, and efficiency of the judiciary. It enables citizens and businesses to quickly and easily view the contents of court bulletin boards in one centralised online location.

This development significantly advances the protection of human rights, as eTabla allows all parties involved in enforcement and security proceedings before the courts of the Republic of Serbia to access important written documents related to their rights and obligations that could not be personally delivered to them. In addition to displaying and removing documents from the court's notice board, the electronic bulletin board keeps a special record of when each document was displayed and when it was removed. Currently, courts lack the capability to maintain these comprehensive records; thus, this functionally represents a significant improvement in court operations. Having all data related to delivery via the bulletin board available

in one electronic format directly impacts the efficiency and cost-effectiveness of procedures, both within the courts and with the Public Prosecutor's office.

In Serbia, the implementation of AI in the judiciary has not yet been realised. The introduction of AI-based system must be founded upon a solid legal framework, primarily through legislation. Furthermore, the implementation of these systems should be accompanied by adequate training for judicial employees and efforts to inform citizens about their rights regarding access to the courts.

CONCLUSION

The integration of AI within the judiciary system is significantly transforming the right to access to justice. As technology advancements continue to progress rapidly, they present both new opportunities and potential risks for exercising this right. In recent years, efforts to enhance the efficiency and accessibility of the judicial system have led to a gradual expansion in the use of technology. Such modernisation efforts contribute to building public confidence in the enforcement of rights and the impartiality of court operations.

One of the most significant advantages of digitising the courts is the time-saving it offers. Citizens can more quickly and affordably exercise their rights through information systems and online services, gaining better access to necessary information. For the courts, this means a faster, more efficient resolution of case handling and greater transparency. The incorportation of AI into the judicial system may also foster public awareness of individual rights and court processes. By streamlining communication between the judiciary and the public, AI enhances access to the justice system and disseminates information about ongoing legal procedures. The development of electronic case law databases and AI-supported sentencing systems can contribute to fairer and more predictable outcomes. Nonetheless, several challenges must be addressed to fully realise the potential of AI in this domain. Resource limitations often hinder the integration of information systems within the judicial system in many countries. Implementing such technologies and training court personnel required significant investment. Additionally, there exists the concern of potential biases against individuals who are not technologically proficient, which poses another hurdle to the increased use of AI in court proceedings. Many people still lack access to the Internet; therefore, it may be necessary to maintain traditional communication methods alongside e-procedures for some time.

The digital transformation of the judiciary should be centred on human needs while adhering to its fundamental principles, including the independence and impartiality of the courts, effective legal protection, and the right to a fair trial within a reasonable timeframe. Enhancing access to courts and the progress of proceedings aims to improve the experience of

citizens. The focus on law and justice should remain on individuals, rather than technology. Technology should serve as as an instrument to relieve the effective exercise of rights, particularly the right to access the courts.

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ПРАВО НА ПРИСТУП ПРАВОСУЂУ У ДИГИТАЛНОМ ДОБУ

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Резиме

У раду се анализира право на приступ правосуђу у контексту текуће дигитализације. Право на приступ правосуђу обухвата неколико основних људских права, попут права на правично суђење и права на ефикасан правни лек. Како технологија брзо напредује, она уводи нове могућности, али и нове ризике за остваривање овог права. Употреба вештачке интелигенције има значајног утицаја на остваривање права на приступ правосуђу. Вештачка интелигенција може побољшати комуникацију између судова и јавности поједностављивање приступа правосудном систему и пружањем информација о текућим поступцима. Једна од најзначајнијих предности дигитализације судова је уштеда времена. Грађани могу брже и повољније да остваре своја права путем информационих система и онлајн сервиса, добијајући бољи приступ потребним информацијама. За судове то значи брже, ефикасније решавање предемета и већу транспрентност. Интегрисање вештачке интелигенције у правосудни систем може повећати свест јавности о правима појединаца и судским процесима. Међутим, постоје и изазови које треба савладати. Ограничења ресурса често ометају интеграцију информационог система у правосудни систем у многим земљама. Имплементација таквих технологија и обука судског особља захтева значајна улагања. Потенцијалне пристрасности према појединцима који нису упознати са технологијом представљају још један изазов коришћењу вештачке интелигенције у судским поступцима. Многи људи и даље немају приступ Интернету, стога, можда ће бити неопходно да се одржавају традиционалне методе комуникације уз е-поступке.

Дигитални развој правосуђа треба да буде усдредсређен на људске потребе уз поштовање основних принципа, попут независности и непристрасности судова, ефикасну правну заштиту и право на суђење у разумном року. Технологија треба да послужи као средство за олакшавање ефективног остварења права на приступ правосуђу.

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BLACK BOX AS A JUSTIFICATION FOR STRICT LIABILITY FOR AI-RELATED DAMAGE

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Abstract

Strict liability is increasingly recognised as an appropriate framework for governing high-risk artificial intelligence (AI) systems, particularly those with 'black-box' characteristics, where internal operations are opaque and difficult to interpret. The inherent complexity of AI, including strong black-box features and unpredictability post-deployment, challenges the applicability of traditional tort law, which relies on establishing fault or negligence. Strict liability provides a means to hold entities accountable, addressing the difficulties in attributing fault in AI contexts. This work evaluates the merits and drawbacks of strict liability, explores its implications within the general liability regime, and provides concrete examples of AI-related harms that support this approach. The principle of AI neutrality and the persistence of fault-based elements within ostensibly strict liability frameworks like the Product Liability Directive are also examined, underscoring the complexities in regulating AI. Serbian legal doctrines regarding dangerous objects and activities provide courts with flexibility to adjudicate AI-related damages. Judges must comprehend the nuances of AI, including distinctions between traditional deterministic software and AI exhibiting emergent behaviour. While strict liability is beneficial for victim compensation and risk management, it can also stifle innovation and impose burdens on small enterprises. A balanced approach is essential to manage AI-related risks while promoting innovation.

Key words: black-box AI, Product Liability, fault-based liability, strict liability, damage.

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BLACK BOX ВЕШТАЧКЕ ИНТЕЛИГЕНЦИЈЕ КАО РАЗЛОГ ЗА ОБЈЕКТИВНУ ГРАЂАНСКОПРАВНУ ОДГОВОРНОСТ

Апстракт

Објективна одговорност све више се препознаје као одговарајући оквир за регулисање високо ризичних система вештачке интелигенције (*AI*), посебно оних са карактеристикама „црне кутије", где су унутрашњи процеси нетранспарентни. Инхерентна сложеност *AI*, условљена појединим алгоритмима, и непредвидивост након имплементације представљају изазов за традиционално утврђивање кривице. Објективна одговорност омогућава да се субјекти позову на одговорност, чиме се решавају проблеми узрочне везе и приписивања кривице у *AI* контексту. Рад процењује предности и недостатке објективне одговорности, истражује алтернативне моделе њене примене и даје конкретне примере штета изазваних *AI*. Такође, разматра се принцип *AI* неутралности и чињеница да елементи субјективне одговорности често испливају, чак и унутар оквира који номинално предвиђају објективну одговорност. Српска доктрина о опасним стварима и делатностима пружа флексибилност судовима да одлучују о штетама изазваним *AI*. Правници морају разумети основе *AI*, укључујући разлике између детерминистичког софтвера и *AI* који показује емергентно понашање. Иако је аргумент за објективну одговорност убедљив, постоје значајни контра-аргументи: оштећени не треба да буде повлашћен само због тога што га је оштетио *AI*, нарочито када је њена примена безбеднија него човек у упоредној ситуацији.

Кључне речи: проблем „црне кутије", одговорност за производе, одговорност по основу кривице, објективна одговорност, штета.

INTRODUCTION

The philosophical origins of AI lie in the ambition to mechanise human reasoning. Aristotle's formalism, which emphasises the validity of certain thought patterns based on their structural form rather than content, has profoundly influenced the field (Arkoudas & Bringsjord, 2014, p. 36). The historical emergence of AI can be traced to the mid-20th century, with the 1956 Dartmouth conference marking its formal inception. However, its conceptual roots are much older, deeply tied to early advances in formal logic and the theory of computation. Turing machines, in particular, provided an essential model for conceptualising how mental processes might be instantiated in physical systems (Arkoudas & Bringsjord, 2014, pp. 39-40). It involves replicating brain processes outside the brain.

AI remains a dynamic and rapidly evolving discipline, with dual aims of constructing intelligent systems and advancing our understanding of cognition. The overarching goal is to create artificial minds, whether inspired by human cognition or by entirely novel forms of intelligence (Frankish & Ramsey, 2014, p. 1). Due to its broad interdisciplinary scope and continuous development, AI resists any single, succinct definition. The EU's AI Act defines an 'AI system' as machine-based, capable of

functioning autonomously and adapting post-deployment. These systems are designed to infer from inputs to generate outputs such as predictions, recommendations, or decisions that affect physical or virtual environments (art. 3). The definition in the AI Act is designed for clarity, international alignment, and adaptability to technological advancements. It explicitly excludes systems that function solely based on predefined rules, thereby ensuring a precise scope that distinguishes AI from conventional software.

AI fundamentally differs from traditional software in terms of decision-making. Traditional software operates through deterministic code, allowing for predictable behaviour. In contrast, AI, particularly deep learning, utilises training data, resulting in an opaque decision-making process. Developers cannot fully anticipate AI behaviour solely by analysing the underlying code (Tai, 2022).

Article 6 of the AI Act establishes criteria for classifying AI systems as 'high-risk' based on their potential impact on health, safety, and fundamental rights. High-risk classifications can occur through two pathways: (1) AI systems that function as safety component of a product or as a standalone product under specific EU safety regulations (Annex I), such as machinery, toys, medical devices, and aviation, which require third-party conformity assessments before market placement; and (2) standalone AI systems used in high-risk domains outlined in Annex III, such as critical infrastructure, essential services, law enforcement, migration, and justice, as well as AI systems involving biometric identification and profiling (Wendehorst, 2022, pp. 198–199). The Act imposes stringent regulations on high-risk systems, focusing on risk management, data quality, transparency, human oversight, and cyber security, aiming to balance innovation with the protection of fundamental rights.

BLACK-BOX AI AND MACHINE LEARNING

Black-box AI refers to artificial intelligence systems whose internal mechanisms are opaque and challenging to understand, even for developers. While their technical architecture may be well-defined, the specific reasoning behind their outputs often remains elusive. This lack of transparency makes it difficult to predict system behaviour and to identify the root causes of damage (Duffourc & Gerke, 2023). Despite these issues, the high level of accuracy achieved by black-box AI remains one of its major appeals.

AI encompasses computational systems capable of performing tasks that require human-like intelligence, including decision-making, learning, and adaptation (Bathaee, 2018, p. 898). Machine-learning algorithms analyse data, identify patterns, and make predictions by adjusting the weights assigned to variables and minimising prediction errors. For

example, an algorithm predicting mile times based on factors such as height, weight, and age iteratively refines these coefficients to reduce errors. This process, called 'training,' aims to ensure the model can accurately predict outcomes when presented with new data (known as 'generalising') (Bathaee, 2018, p. 901). AI developers train systems to generalise based on training data, but they generally lack complete control over both the training data and the output. Full control would defeat the purpose of AI.

Black-box AI primarily relies on deep learning algorithms, which involve training neural networks on extensive datasets to recognise complex patterns. The intricate, multi-layered structure of these networks contributes to their non-interpretability, effectively concealing the underlying decision-making (Duffourc & Gerke, 2023, p. 11). This complicates accountability and erodes trust, particularly in high-stakes fields from Annex III.

The Black Box Problem in machine learning is particularly evident in algorithms such as Deep Neural Networks (DNNs) and Support Vector Machines (SVMs). Inspired by the human brain, DNNs process information in a distributed and intuitive way, similar to how a person instinctively knows how to ride a bike – difficult to explain in a step-by-step fashion (complexity aspect). Similarly, SVMs classify data by finding optimal boundaries in multi-dimensional spaces. Humans struggle to visualise or understand such complex geometric patterns, making their decision-making opaque (dimensionality aspect) (Bathaee, 2018, pp. 901-903).

The distinction between 'strong' and 'weak' black boxes pertains to the transparency of AI. Strong black boxes are completely opaque, making it impossible to understand the conclusions or predict future behaviour. Weak black boxes, on the other hand, allow limited reverse engineering, providing partial insights into variable influences, though the exact reasoning remains unclear. This distinction carries significant legal implications, particularly in areas related to intent and causation (Bathaee, 2018, p. 905).

In Internet of Things (IoT) systems, AI algorithms analyse large volumes of data from interconnected devices to make decisions governing system behaviour (Howells & Twigg-Flesner, 2022, p. 181). These are goal-oriented, designed to achieve objectives such as optimising energy consumption or enhancing manufacturing efficiency. Machine-learning capability allows them to continuously improve performance based on accumulated data (Howells & Twigg-Flesner, 2022, p. 181). Two primary types of AI algorithms are used: Symbolic AI and self-learning algorithms. Symbolic AI is rule-based, offering limited adaptability, whereas self-learning algorithms continuously refine their behaviour over time (Howells & Twigg-Flesner, 2022, p. 192). The complexity of AI algorithms, especially those with self-learning capabilities, poses significant liability challenges. Responsibility is often diffuse among developers, da-

ta providers, and users. The adaptive nature of AI means systems may evolve unpredictably post-deployment, complicating traditional liability that focuses on the product's condition at sale. The concept of network liability proposes treating all stakeholders within an AI-driven IoT system as one, allowing claimants to seek redress from the entire network (Howells & Twigg-Flesner, 2022, pp. 197-198).

AI RELATED DAMAGES

AI is already so widespread that its risks have become nearly unavoidable. In smart homes, AI processes data from temperature, occupancy, and weather sensors to optimise comfort and energy efficiency. In industry, AI analyses production line data and market trends to enhance efficiency, forecast maintenance, and adapt schedules (Howells & Twigg-Flesner, 2022, p. 181). AI-driven IoT systems may malfunction, resulting in security breaches or property damage due to algorithmic errors.

Generative AI, such as Generative Adversarial Networks (GANs) and Large Language Models (LLMs), present unique risks. GANs can create realistic 'deepfakes,' facilitating identity theft or fraudulent content. LLMs are prone to generating inaccurate content - 'hallucinations' that spread misinformation and erode trust. Training datasets, often scraped from the internet, raise copyright and privacy issues. Biases in training data perpetuate social inequities, and continuous updates lead to unpredictable behaviours. AI-generated content used for further training may amplify inaccuracies, creating harmful feedback loops. These risks include discrimination, misinformation, malicious use, and broader social harms, and are caused by AI 'echoes' and 'data drift' (Noto La Diega & Bezerra, 2024, pp. 6–7).

Examples of AI-related harms: (1) medical misdiagnosis – inappropriate treatments due to algorithmic flaws or biases in training data; (2) autonomous vehicle accidents due to errors in algorithms or environmental perception (Monot-Fouletier, 2022, p. 167); (3) erroneous financial decisions leading to significant monetary losses due to processing errors (Tai, 2022, pp. 127-128); and (4) discriminatory practices – AI in hiring, lending, or law enforcement can perpetuate biases, leading to damage to specific groups.

To address these challenges, 'explainable AI' has been developed. It employs simpler, more transparent algorithms, thereby offering some level of explanatory insight. However, these approximations often fall short of capturing the full complexity of the original black-box models. As the deployment of black-box AI expands, it is imperative that ongoing research focuses on enhancing transparency (Duffourc & Gerke, 2023, p. 12).

THE SERBIAN DOCTRINE ON DANGEROUS OBJECTS AND ACTIVITIES

Understanding *osnov odgovornosti* (*Eng.* the basis of liability) is crucial for assigning responsibility, and shaping legal remedies and the success of a compensational claim. Additionally, it determines the burden of proof and the victim's advantage over the tortfeasor, impacting the overall outcome of the case. *Osnov odgovornosti* refers to the legal justification for imposing liability on a party, distinct from *uslovi odgovornosti* (*Eng.* conditions of liability), which include damage, causality, culpability and wrongfulness. In Serbian legal theory wrongfulness is disputed. Some authors argue that there is a rebuttable legal presumption that any act causing harm to another is wrongful. Others, however, contend that the wrongfulness of a damaging act is not a requirement for establishing liability under the Act on Obligations (ZOO) but is instead subsumed within objectively understood fault. (Karanikić Mirić, 2024, p. 503). The Serbian legislator does not mention wrongfulness (Karanikić Mirić, 2024, p. 510), and domestic courts: (1) do not require proof of wrongfulness as a fourth condition for establishing liability (in addition to damage, causation, and fault) and (2) do not allow the tortfeasor to be exempted from liability by proving that the act causing harm was not unlawful (Karanikić Mirić, 2024, p. 655).

Serbian law recognises several bases or regimes: fault-based liability, strict liability, and equity-based liability which serves as a corrective. Fault-based liability is tied to blameworthy conduct, such as negligence or intentional wrongdoing. Strict liability, by contrast, applies irrespective of fault, holding entities liable due to inherent risks. Judicial interpretation significantly shapes the scope of strict liability, especially in defining dangerous activities and objects under strict liability.

The concepts of *opasna stvar* (*Eng.* dangerous object) and *opasna delatnost* (*Eng.* dangerous activity) are open-list legal standards (Karanikić Mirić, 2017, p. 353). A 'dangerous object' inherently poses an elevated risk of harm due to its nature or specific use, evaluated by a 'reasonable and careful person.' This includes inherently dangerous items like explosives and objects that become hazardous in certain contexts, such as a poorly positioned ladder. Judicial analysis assesses the nature, use, and context of these items, with examples like buildings, weapons, elevators, and manholes commonly cited. *Opasna delatnost* refers to activities that carry a heightened risk of harm, even when performed with utmost care. Examples include construction work, logs unloading or launching anti-hail rockets. Context matters, as certain activities can become dangerous depending on the circumstances, such as serving food at a crowded event. Additionally, how the activity is organised, such as transporting valuable goods without security, can make it *opasna delatnost*. As many dangerous activities involve dangerous objects, there is overlap but distinctions

exist. Some objects are inherently dangerous regardless of use, while certain activities are risky without involving dangerous items. Dangerous thing or activity trigger strict liability (art. 173-179, Act on Obligations (ZOO)).

The concept of strict liability emerged during the Industrial Revolution, when traditional fault-based liability was inadequate for addressing accidents involving machinery and hazardous substances, even with due care, focusing solely on the causal link between the dangerous activity or object and the harm. This shifts the burden of proof to the defendant, who must disprove causation (art. 173 ZOO). Strict liability serves multiple purposes: risk allocation, where costs are assigned to those engaging in inherently dangerous activities; simplified victim compensation by reducing evidentiary burdens; and risk socialisation, encouraging broader distribution of costs through insurance. It applies in areas such as product liability and animal ownership. Compared to negligence, strict liability provides a more streamlined route to compensation when proving fault is impractical. It holds individuals or entities accountable for harm resulting from hazardous activities or risky products, fixing on the harm caused rather than the mental state of the defendant. The shift enabled courts to ensure compensation for victims, stressing the principle that those who benefit from dangerous enterprises should bear the risk, promoting fairness and societal responsibility.

STRICT LIABILITY AND AI

Justifications of Strict Liability

Strict liability is advantageous for governing high-risk AI systems. It internalises the costs of harm, creating incentives for developers and operators to prioritise safety through rigorous testing, high-quality data, and effective oversight (Howells and Twigg-Flesner, 2022, pp. 193-194). Since AI systems are often complex and opaque, proving negligence is challenging, and strict liability bypasses this requirement.

Strict liability encourages the use of AI in socially beneficial ways and deters harmful applications by imposing significant liability costs. Rooted in the economic analysis of law, this framework also provides predictability, allowing companies to understand their obligations and foster responsible innovation (Heiss, 2020, p. 206). Strict liability addresses issues that arise with negligence and product liability regimes. Due to the 'black-box' nature of AI, proving negligence is often impractical. While product liability may apply to AI embedded in hardware, it is less suitable for software or multi-party systems. Strict liability thus offers a more comprehensive approach (Heiss, 2020, p. 203).

Strict liability streamlines the legal process for AI-related claims, making outcomes more predictable, and building trust in AI. This frame-

work aligns with the nature of AI and the 'do no harm' principle, promoting ethical use (Noto La Diega & Bezerra, 2024, p. 16, 17, 21). Ultimately, it can reduce compliance costs, provide economic benefits, and enhance legal certainty.

AI's unpredictability complicates risk assessments. Strict liability is typically used for inherently dangerous activities, holding parties accountable for harm regardless of intent. However, the 'Black Box Problem' introduces unpredictability that challenges effective risk management. The opaque nature of machine-learning algorithms makes it difficult to predict behaviours, undermining fault-based liability. High-frequency trading algorithms, for instance, have triggered unintended market consequences despite careful design (Bathaee, 2018).

To address these challenges, a harmonised legal framework centred on strict liability is proposed for AI-related harms, preserving tort law's role in regulating autonomous systems (Noto La Diega and Bezerra, 2024). The authors criticise the AI Liability Directive's (AILD) reliance on fault-based models as inadequate for generative AI and autonomous agents. They argue for EU-wide harmonisation under strict liability to streamline victim compensation, incentivise safety measures, and foster public trust (Noto La Diega & Bezerra, 2024, p. 2). It should be noted that the arguments justifying strict liability for AI largely overlap with those for applying the same liability regime to dangerous objects and activities.

Arguments Against Strict Liability in AI Related Damage

Strict liability for AI presents significant challenges that may impede innovation and burden smaller entities. Imposing it without considering fault could discourage startups and smaller companies from developing AI due to fears of crippling liability for unforeseen harms. This could lead to a concentration of AI development among large corporations, stifling diversity and limiting innovation (Bathaee, 2018, p. 896). Liability caps for SMEs may help mitigate these concerns (Noto La Diega & Bezerra, 2024, p. 19). Monopolism in such a critical area is daring.

Strict liability disregards negligence or due care, potentially reducing incentives for developers to follow safety standards. The blanket imposition of liability for unforeseen AI consequences might undermine responsible development (Bathaee, 2018, p. 932). Adapting existing legal concepts like intent and causation (Cvetković, 2020) for AI may be a better solution.

Applying strict liability to foundation models presents challenges, particularly due to their broad range of applications, some of which are high-risk while others are not. Holding providers strictly liable for all harms could be unfair and impractical. Allowing defences like force majeure or unforeseeable events would provide a more balanced framework (Noto La Diega & Bezerra, 2024, p. 19). AI foundation models are

versatile, large-scale models trained on extensive data, serving as adaptable infrastructure for specific applications like language processing, image recognition, or decision-making (custom, specialised AI).

The principle of AI neutrality suggests that strict liability should not apply if an AI system consistently shows superior safety and performance compared to humans performing the same task, especially when humans are not held to a strict liability standard. For example, autonomous vehicles that cause fewer accidents than human drivers should not face strict liability, as it could hinder the adoption of life-saving technologies (Barbosa & Valadares, 2023, p. 154). Disparities in treatment between AI-driven and human-operated devices raise fairness issues. In medical contexts, for example, AI-assisted robotic systems could face strict liability for patient harm, whereas human surgeons would be evaluated based on negligence. Such discrepancies could lead to unequal compensation for similar harms, depending on whether AI or human actions were involved. In Serbian law, primarily and in most cases, liability for this damage will not be attributed to the attending physician but rather to the healthcare institution, following the rules on "Employer liability for damage caused by an employee during or in connection with their work" (ZOO, art. 170-171), with a predetermined standard of care.

Examples unsuited for strict liability include scenarios like pure economic atypical risks, where, for instance, a software agent inadvertently lowers a user's credit score. In such cases, the causal link between the software's actions and the economic harm is complex and indirect, making it challenging to establish a direct and foreseeable connection (Wendehorst, 2020, pp. 162–164). Similarly, social atypical risks—such as a spouse's excessive online gaming leading to the breakup of a marriage — demonstrate outcomes that stem from individual behaviour rather than any inherent risk by the technology itself. Holding developers responsible would stretch the boundaries of legal responsibility (Wendehorst, 2020, pp. 162-164). In Serbian law, there would be no liability here because the causal link is not adequate, regardless of whether the liability is strict or fault-based. The basis of liability cannot be considered in isolation.

A blanket application of strict liability even to all 'high-risk' AI systems is often excessive. Not all systems classified as high-risk pose the same level of danger (Arsenijević, 2023, p. 147). For instance, small robotic vacuum cleaners are far less risky compared to large industrial robots. Fairness also demands that similar devices operated by humans and AI should be subject to consistent liability standards. Aligning liability with the inherent risk profile of the device, rather than the technology used, would rectify these inconsistencies. Factors like device size, speed, and environment (for devices functioning in public areas or near vulnerable populations) should determine liability to ensure a fair and consistent framework, providing equal protection and compensation irrespective of

the device's autonomy level (Wendehorst, 2022, p. 206). These factors are very similar to those used in the Serbian legal doctrine for defining a dangerous object. According to art. 173 of the Act on Obligations (ZOO), when damage is caused by a dangerous object – and if AI is argued to fall under this category – causation is presumed precisely to ease the burden of proof for the injured party. This presumption is based on the reasonable expectation that the defendant is in a better position to prove that the causal link does not exist.

A NUANCED APPLICATION OF STRICT LIABILITY

The authors propose tailored applications of strict liability to address the unique challenges posed by AI systems.

1. 'No-Fault Compensation' for AI suggests replacing traditional tort law with no-fault schemes. In France, 'socialisation des risques' shifts compensation from individuals to the collective, such as social security, insurance, and dedicated funds. This aligns with solidarité nationale, emphasising society's duty to protect individuals from uncontrollable risks. AI complexity often makes proving fault impossible, leaving victims without recourse. No-fault schemes offer accessible compensation and encourage AI innovation by protecting developers. However, funding and moral hazard concerns remain unresolved, as developers might deprioritise safety without liability pressures (Knetsch, 2022, p. 113). Similar 'No-Fault' regimes exist in medical law regarding liability for medical malpractice.

2. 'Strict Liability with Comparative Negligence' is proposed for cases involving a high-risk AI and another party, such as humans or non-AI systems. This model ensures shared responsibility, with strict liability for the AI operator balanced by a comparative negligence defence (Heiss, 2020, p. 210). The possessor of a dangerous object is partially exempt from liability if the injured party partially contributed to the damage (art. 177-3 ZOO).

3. Strict liability should always apply to AI causing human rights violations. Given AI's unpredictability and 'black box' nature, proving causation is often infeasible, making strict liability necessary. This approach would incentivise developers to embed human rights considerations throughout the AI lifecycle (Barbosa & Valadares, 2023, p. 156) and align with legal trends imposing strict liability for distressing fundamental rights. The Serbian Anti-Discrimination Act stipulates that: "If the court has determined that an act of direct discrimination has occurred, or if this is undisputed between the parties, the defendant cannot be exempted from liability by proving the absence of fault" (art. 45-1; Tasić, 2018).

4. 'Strict Liability to the State' is suggested for incidents involving multiple high-risk AI systems. Instead of compensating individual victims directly, the liable AI operator would pay the state, which would then

compensate victims through insurance. A blanket fee system based on AI type could streamline processes. Enforcing accident reporting would rely on automated systems, using sensors and data recording within high-risk AI system itself. (Heiss, 2020)

5. The authors advocate for a strict liability for personal injury and death caused by AI. Here, the severe consequences justify shifting from the fault-based regime. As AI becomes embedded in medical, safety, and transport applications, avoiding it becomes challenging, necessitating a liability regime that transfers risk to developers and operators. Significant harm warrants stronger protection. Extending strict liability from defective products to AI ensures fairness, as both present comparable risks (Soyer & Tettenborn, 2022).

6. AI vehicle accidents pose unique challenges under traditional custodian liability, typically applied to tangible objects under human control. Extending custodian liability to AI vehicles is problematic due to the ambiguous classification of AI systems. It is unclear whether an AI system, made up of software and algorithms, qualifies as an 'object' under traditional custodian liability. While courts have sometimes classified software viruses as objects, whether this logic applies to the complex, evolving algorithms remains uncertain. Another challenge lies in identifying the custodian. Autonomous vehicles involve multiple parties, each potentially responsible for different aspects of the technology. For instance, the designer or manufacturer could be the custodian of the AI system's structure, while the user or maintenance manager might be responsible for the system's behaviour. The driver, despite a reduced role in autonomous driving, could also retain some custodial responsibility (Monot-Fouletier, 2022, p. 170). Traditional custodian liability is inadequate for AI vehicle accidents, necessitating a re-evaluation of legal concepts like 'control' and 'object.' Within the 'subject–object' dichotomy, this means that if AI systems are not objects, then they must be subjects. Arguments regarding granting legal subjectivity to AI include several perspectives. The subjectivity of AI could mean that the AI itself would be liable for damages it causes (Pavlekovic & Petrovic, 2021, p. 119). Some propose the creation of a new category of legal subject — an electronic party (ePerson). Legal subjectivity would be acquired through registration and would be appropriate to the extent of the rights and obligations that AI, as a creation of law, can bear. Legal subjectivity is a political decision of the legal system, as the fact that corporations are recognised as legal persons is not a 'natural state of affairs,' but rather a matter of legislative regulation. Additionally, the legal fiction that once classified slaves as property could, in theory, be repurposed to redefine AI as a legal person (Arsenijević, 2023, p. 141). The far-reaching nature of this idea exceeds the scope of this paper.

7. 'Determining Liability Based on the Type of Harm Caused' – AI harms can be categorised into three principal types: Physical Risks, Pure Economic Risks, and Social Risks.

Physical Risks encompass traditional safety concerns such as bodily injury, death, and damage to property. They also extend to harm involving data, interference with other digital systems, and psychological harm meeting clinical criteria. Strict liability is particularly appropriate here. Physical harm can be quantified objectively, providing a clear basis for compensation. Moreover, societal interests in protecting health and property are paramount, making strict liability justified (Wendehorst, 2020, pp. 165-166).

Pure Economic Risks refer to financial losses unconnected to physical damage, such as broken AI financial recommendations (Wendehorst, 2020, p. 161). Strict liability is less suitable here due to the complexities of causation and the subjective nature of economic loss. Expanding strict liability to these areas risks overwhelming the legal system with litigation. Instead, the non-compliance liability, where parties are liable for breaching predefined standards, is more pragmatic (Wendehorst, 2020, p. 156).

Social Risks, described as fundamental rights risks, include harms such as discrimination, manipulation, and violations of privacy and dignity (Wendehorst, 2020, p. 162). These arise in contexts like biased hiring algorithms or behaviour-modifying social media algorithms. Given the intangible nature of these harms and their resistance to monetary quantification, strict liability is inadequate. Therefore, such social risks should instead be mitigated through specialised legal regimes, including data protection laws, anti-discrimination statutes, and legislation against hate speech and harassment. (Wendehorst, 2020, p. 162). Above in the text, we saw precisely the opposite proposal in (Barbosa & Valadares, 2023).

8. 'Determining Liability Regimes Based on a Risk Type' – direct or general risks involve immediate harm caused by the AI system, such as a malfunctioning cleaning robot injuring a pedestrian, which suits strict liability due to the clear causal link. Intermediated typical risks entail a step between the AI and the harm, like medical software issuing incorrect recommendations leading to health issues; these can be addressed under strict liability if robust defences are available (Wendehorst, 2022, p. 170). Intermediated general risks involve complex causal chains where AI indirectly causes harm, such as a vulnerability in a smart heating system facilitating a burglary, which should only be covered by strict liability with substantial defences. Finally, atypical risks, such as a robot's sharp handle causing unpredictable injury, fall outside reasonable foreseeability and should not be governed by strict liability (Wendehorst, 2022, pp. 162-164). The problem with the latter two approaches (7 and 8), where the strict liability regime depends on risk classification, lies in the fact that these classifications are not generally accepted. Even the author himself highlights a classification based on the *type of harm* in one paper, while in another paper, he proposes a different classification based on the frequency and adequacy of a given risk.

THE PROPOSED EU REGIME

The AILD Proposal harmonises procedural aspects such as evidence disclosure and the burden of proof, aligning with fault-based liability. The Product Liability Directive Proposal (PLD) modernises product liability by explicitly including software and AI systems, imposing strict liability. This dual approach aims to balance fault-based and strict liability framework.

A key problem is the contradiction between the fault-based AILD Proposal and the supposedly strict liability in PLD Proposal. Although the PLD is formally based on strict liability, in practice it often requires proving a breach of duty, such as failing to address biases in AI training data. This reliance on fault-based reasoning creates an artificial distinction, blurring the lines between two regimes. As a result, the separation of the directives into distinct frameworks undermines clarity and coherence (Hacker, 2023, p. 29). Additionally, there are no provisions for harm caused by prohibited AI. Hacker advocates for true harmonisation by merging two proposals (Hacker, 2023, p. 49). He calls for the expansion of strict liability to cover certain high-risk AI systems, particularly those causing "illegitimate harms," regardless of whether they comply with the technical requirements of the AI Act (Hacker, 2023, p. 30-31).

What follows is an illustration. An AI facial recognition system incorrectly identifies Ms. Smith as a robbery suspect, leading to her assets being frozen and causing severe financial harm. The error is traced to a known gender imbalance in the training data, which both the AI developers (SmartView Ltd.) and the bank were aware of. Under the AILD Proposal, Ms. Smith can request evidence from SmartView and the bank. If they fail to comply, a presumption of non-compliance is triggered, bolstering her case (Hacker, 2023, pp. 21-22). Proving fault remains a challenge, requiring Ms. Smith to show the bank breached its duty, potentially by violating data governance rules under Article 10(3) of the AI Act. This necessitate hiring AI experts to demonstrate that the gender imbalance in the training data was negligent.

Just as the classical tort law face challenges, so too must the major concepts of consumer protection law adapt when AI is involved. It is difficult to define 'defect' in AI, as harm can arise from design or algorithmic outcomes, not just manufacturing flaws. The 'Development Risk Defense' may not apply, as developers are aware of AI's inherent risks. (Knetsch, 2022, p. 111). Under the PLD Proposal's strict liability, Ms. Smith could request evidence from SmartView, and failure to comply would lead to a presumption of defectiveness (Hacker, 2023, p. 26). If evidence is provided, expert testimony would be needed to prove that the gender imbalance violated Article 10(3), thus establishing defectiveness. However, the PLD limits damages to property, life, or health, potentially excluding Ms. Smith's claims for pure economic loss (Hacker, 2023, p.

27). Furthermore, her case may not fit neatly into a consumer protection context, because she was a client of the bank, not a customer of SmartView. Moreover, in Serbian law, under the current consumer protection, liability for defective products cannot be applied if damage is caused by 'software only' AI (hardware-software systems are covered) (Arsenijević, 2023, p. 154).

Proving fault or defectiveness with sophisticated AI models remains difficult. The interplay between strict and fault-based liability shows that fault-based reasoning often re-emerges within supposedly strict liability frameworks like the PLD. In Ms. Smith's case, proving defectiveness requires demonstrating that the gender imbalance constituted a breach of duty, effectively merging strict liability with fault-based elements (Hacker, 2023).

Artificial intelligence systems cannot simply be reduced to a dangerous object. Even when this classification is possible, such as in the case of an autonomous vehicle or robot, the question arises as to who is liable for damages when the system's creator no longer has any ability to predict its outcomes or control the directions in which it will autonomously evolve. It appears that the creation of artificial intelligence systems should be classified as a dangerous activity (as in ZOO), with liability assigned to the entity that primarily derives economic benefits from that activity. However, a key issue remains: how to determine economic benefits, particularly when the system is freely accessible to an unlimited number of users who pay with their personal data. The entities that fall within the scope of potentially liable parties include: the AI itself (if granted legal subjectivity); the AI owner; developers; participants in the AI's creation and control; AI Product or Device Manufacturer; the AI user or operator; the Distributor, Vendor, or AI Service Provider; the Economic Beneficiary of the AI System, State and Regulatory Authorities.

CONCLUSION

Culpa represents a psychological phenomenon; a person is deemed at fault due to the intention behind tearing a book, rather than the mere physical action of doing so. AI, which operates with a certain degree of autonomy, might create the impression that elements of fault are present, akin to human-like reasoning. However, this does not translate to actual fault within the context of liability. While AI may exhibit decision-making abilities that evoke notions of fault, these should not be misread as akin to human intentionality. The attribution of human-like qualities to AI, stemming from anthropomorphising tendencies, fails to recognise the fundamental distinction: AI decisions are grounded in formal logic based on structural form rather than subjective content. Emotional or psychological elements are entirely absent. Thus, when considering liability for AI-induced harm, fault-based liability becomes untenable, leaving strict liability as more suitable.

Historically, the emergence of modern strict liability was closely tied to the Industrial Revolution, which necessitated a legal response to the increased risks introduced by rapid technological advancements. Today, as we face a new digital revolution, scholars again call for the adoption of strict liability to address the unique challenges presented by AI, particularly its opaque 'black-box' nature. Despite the utmost care in development and deployment, AI systems can cause harm, and their inherent complexity often renders it impossible to establish causation or fault. The black-box nature of these systems impedes the identification of responsible parties, as the causal chain is often obscured and, in many instances, fault is absent altogether.

In Serbian law, the open-ended concepts of dangerous things and activities provide courts with the flexibility to adjudicate AI-related damages under strict liability. This is especially applicable for AI classified as high-risk under the EU AI Act. Advanced algorithms such as self-learning systems, Deep Neural Networks, and Support Vector Machines, especially those exhibiting a 'strong black-box,' provide grounds for addressing cases under strict liability. Such an approach is more favourable to the injured party, as it establishes liability irrespective of fault and shifts the burden of proving causation away from the victim. These same advantages are reflected in both PLD and AILD.

The Serbian Act on Obligations (ZOO) offers adequate civil protection to victims of AI-related harm, provided that the judiciary is competent to articulate why a particular AI constitutes a dangerous entity or activity. This determination is a legal question, not a matter for expert witnesses, underscoring the importance of theoretical work in this area for both educational and practical purposes. Judges must grasp the conceptual differences between classical deterministic software and AI that manifests emergent, non-deterministic behaviour. Understanding the role of AI inference and its inherent unpredictability post-deployment is essential. Furthermore, judges should be familiar with the business models underpinning AI systems, particularly contractual relationships between AI developers, manufacturers, and users, as well as the dynamics between foundational and specialised, fine-tuned AI models.

Nevertheless, strict liability is not a universal remedy, and its application should not be unduly broadened, as this could yield adverse consequences. Overextending risks stifling innovation, deterring small enterprises from entering the AI market, and imposing disproportionate burdens on developers who may have limited control over an AI's evolving behaviour. Although the case for strict liability is compelling, there are substantial counterarguments, particularly the principle of AI neutrality. Transitional and nuanced solutions, such as linking liability to specific types of risk or adopting a sliding scale approach, are suitable to strike a balanced legal framework. In certain cases, strict liability is inappropriate,

prompting scholars to suggest specialised liability regimes akin to anti-discrimination or privacy protection laws. However, such regimes are not without their own limitations, as they often involve strict liability as well.

Even in instances where strict liability is embedded in legislative instruments such as the PLD, elements of fault-based liability tend to surface in practical applications, especially when proving a breach of duty becomes necessary. Strict liability is, therefore, not a permanent or comprehensive solution, particularly as advancements in 'explainable AI' may provide more transparency and accountability in the future.

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“BLACK BOX” ВЕШТАЧКЕ ИНТЕЛИГЕНЦИЈЕ КАО РАЗЛОГ ЗА ОБЈЕКТИВНУ ГРАЂАНСКОПРАВНУ ОДГОВОРНОСТ

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Резиме

Објективна одговорност је начелни оквир за регулисање одговорности за вештачку интелигенцију (*AI*) која делује аутономно, нарочито када су процеси одлучивања непрозирни и сложени. *AI* системи не поседују емоционалне или психолошке елементе, већ се њихове одлуке заснивају на формалној логици без људске намере, због чега одговорност заснована на кривици није прикладна. Појава објективне одговорности била је правни одговор на ризике индустријске револуције, а данас, у дигиталној револуцији, поново је релевантна због непредвидивости и сложености *AI* система. Чак и уз највећу бригу у развоју и имплементацији, *AI* може изазвати штету, а због комплексности често није могуће идентификовати одговорну страну. Судови у Србији могу штету изазвану вештачком интелигенцијом третирати као последицу опасне ствари или делатности, омогућавајући тако примену објективне одговорности, што пружа бољу заштиту оштећенима. Напредни алгоритми, као што су самоучећи системи и дубоке неуронске мреже са карактеристикама „црне кутије“, захтевају објективну одговорност, као и пребацивање терета доказивања на штетника. Закон о облигационим односима (ЗОО) омогућава заштиту оштећенима, уз услов да судије разумеју разлике између традиционалног софтвера и *AI* система са емергентним понашањем. Правници морају упознати уговорне односе програмера, произвођача и корисника *AI*, као и основне техничке карактеристике *AI* модела како би одлучивали о правним питањима, уместо да све зависи од вештака. Разумевање *AI* инференције и инхерентне непредвидивости након имплементације је од суштинског значаја. Међутим, прекомерна примена објективне одговорности може угушити иновације и негативно утицати на мала предузећа, обесхрабрујући инвестиције у *AI*. Иако је аргумент за објективну одговорност убедљив, постоје значајни контра-аргументи, посебно принцип неутралности: оштећени не треба да буде повлашћен само због тога што га је оштетио *AI*, нарочито када је *AI* безбеднији него човек у упоредној ситуацији. Потребно је пронаћи баланс између одговорности и иновација. Прелазна нијансирана решења, као што је повезивање режима одговорности са специфичним врстама ризика или усвајање клизне скале, од суштинског су значаја за постизање уравнотеженог правног оквира.

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THE ALGORITHM AND SOURCE CODE – THE LEGAL CHALLENGES OF INTERNATIONAL TRADE

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Abstract

Artificial intelligence has been attracting the attention of legal experts since its commercialisation began. As AI (Artificial Intelligence) systems have a huge impact on society as a whole and alter the functioning of nearly all types of relationships, the need for legal regulation has emerged. Although some countries and international organisations have already made a step forward in this regard, certain components of artificial intelligence remain difficult to integrate into the legal system. The algorithm is such a component. Algorithms appear in various forms and differ depending on the systems that apply them. This fact makes their regulation even more difficult. Their use today is widespread in decision-making processes, and as such, they have a significant impact on individuals and society as a whole. This paper addresses the issue of the influence of national regulations and measures in this area on international trade flows.

Key words: Artificial Intelligence, Algorithm, Forced Disclosure of Source Code, Free Trade Agreements.

АЛГОРИТАМ И ИЗВОРНИ КОД – ПРАВНИ ИЗАЗОВИ МЕЂУНАРОДНЕ ТРГОВИНЕ

Апстракт

Од момента када је кренула њена комерцијализација, вештачка интелигенција привлачи пажњу правника. Како системи вештачке интелигенције утичу на целокупно друштво и мењају начин функционисања скоро свих односа, појавила се потреба да се они правно регулишу. Иако су поједине земље и међународне организације већ учиниле искорак у том погледу, поједине компоненте вештачке интелигенције и даље су тешко уклопљиве у правни систем. Управо је ал-

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горитам таква компонента. Алгоритми се појављују у различитим видовима и разликују се од система до система који их примењују. Та чињеница још више отежава њихово регулисање. Њихова примена данас је широко заступљена приликом доношења одлука, и као такви имају велики утицај на појединца и друштво у целини. Рад се бави питањем утицаја националних регулатива и мера из ове области на међународне трговинске токове.

Кључне речи: Вештачка интелигенција, алгоритам, принудно откривање изворног кода, споразуми о слободној трговини.

INTRODUCTION

Artificial intelligence represents one of the innovations that, by its very existence, changes all aspects of social life. It has the power to modify and accelerate existing social and legal relations, as well as to shape and create new ones. The development of artificial intelligence is closely connected to the development of computer science and robotics. We are witnessing an increased use of smart robots and machines, self-driving (autonomous) vehicles, and unmanned aerial vehicles (drones). A significant application also requires a significant legal response, in order to enable a safe and secure application of artificial intelligence. The European Union is leading the way in this regard, but individual countries are not lagging behind either.

Artificial intelligence systems operate and function based on algorithms. For a set of input data, there must be an algorithm for the artificial intelligence to solve the given problem. In addition to the fact that artificial intelligence is widely used today, algorithms remain a kind of mystery. One of the more prominent dilemmas is how self-learning technology makes decisions and solves assigned tasks, and to what extent humans can control this process. Consequently, the risk of negative consequences for individuals, society, and the legal system is high.

Considering the fact that machine learning aims to improve the algorithm and the performance of AI systems through interaction and access to large amounts of data, it is clear why we understand less about how algorithms function. Therefore, the existence of regulation that provides security and reliability to stakeholders is extremely important. As the international community became aware of this fact, some countries began to act proactively to pass their own regulations related to the source code and algorithm. However, excessive regulation could affect access to the markets of these countries, thereby creating a trade barrier. This paper will address the impact of national measures and regulations in this area on international trade flows.

THE ALGORITHM AS A COMPONENT OF ARTIFICIAL INTELLIGENCE

Algorithms are not a new phenomenon. They have been the most important part of any software for decades. Broadly speaking, algorithms can be specified as sets of predefined moves that process input data to produce output. This definition suggests that every part of a software is compounded of algorithms. This conceptual definition is both overly broad and overly narrow because viewing algorithms solely as computer code does not capture their full scope or complexity (Ebers, 2019, p. 41). According to this, no conclusions can be drawn about the legal and social implications of algorithms and source code. These phenomena cannot be isolated from the legal, political, and economic conditions in which they are developed and used.

The Concept of Machine Learning Algorithm

Artificial intelligence has long been described as a new digital technology that changes most legal relationships, particularly commercial relations. It is debatable whether the term 'new' truly applies, as it was first conceptualised in the 1950s (Delipetrev et al., 2020, p. 4). The process of creating artificial intelligence must have included the following stages: first, understanding the principles; then, using human intelligence to design a system based on those principles; and, finally, building a system according to that design (Spector, 2006, p. 1251). However, today, when artificial intelligence systems are in widespread use, fundamental questions and dilemmas are again relevant. How does one define artificial intelligence and what are its basic principles?

There are numerous definitions that attempt to clarify the essential characteristics and components of this phenomenon. Originally, the term artificial intelligence was defined as human intelligence manifested through machines (Helm et al., 2020, p. 69). This definition, in a simple and general way, points to the purpose of the existence and operation of this technology, which is the imitation of human intelligence. However, such a conceptual definition does not tell us anything about the elements that make artificial intelligence different from other advanced technologies.

The European Commission defines artificial intelligence as a set of technologies that combine data, algorithms, and computing power, which actually represents hardware capability (EC, 2020). In Article 3 (1) of the EU AI Act, artificial intelligence systems are defined. According to the European Commission, artificial intelligence systems are software developed using specific techniques and approaches (e.g., machine learning, statistical methods, symbolic reasoning and expert systems) and, for a given set of human objectives, they can generate outputs such as deci-

sions, recommendations, or predictions that influence the environment with which the systems interact (EU 2024/1689).

The general definition of an algorithm is a step-by-step process or technique for solving a mathematical problem in a limited number of steps, typically involving the repeated execution of specific operations.[1] It is a set of mathematical instructions or rules, which, particularly when provided to a computer, help in finding the solution to a given problem.[2]

Machine learning, which is considered a subset of artificial intelligence, refers to the learning of systems based on experience. It is used to teach machines how to process data more efficiently (Mahesh, 2020, p. 381). Artificial intelligence systems have the ability to learn and improve their analyses using algorithms. These algorithms use large sets of input and output data to recognise patterns and to train, in this way, the machine to make autonomous decisions or recommendations. After a sufficient number of repetitions and modifications of the algorithm, the machine becomes capable of taking an input and predicting the output. The results are compared to a set of known outcomes to evaluate the algorithm's accuracy, after which the algorithm is iteratively modified to improve its ability to predict future results (Helm et al., 2020, p. 70). Before machine learning algorithms are applied, raw data must be pre-processed using filtering algorithms (such as those for feature extraction and dimensionality reduction) (Haddadin & Knobbe, 2020, p. 21).

The Algorithm and Decision-making

Machine learning algorithms today play a crucial role in automated decision-making. They are used for profiling individuals and making decisions based on those profiles (Sancho, 2020, p. 136). To understand how an algorithm functions in decision-making, it is necessary to highlight the differences between the terms automated processing, profiling, and automated decision-making. These are distinct legal classifications and categories.

Processing is a broad and inclusive term, referring to any action or series of operations performed on personal data or data sets, regardless of whether automated methods and tools are used. Therefore, the basic inputs are personal data. The term 'automated' is generally used to describe the processing of information in a systematic, non-manual manner (Sancho, 2020, p. 138).

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[1] Merriam-Webster.com, 'Algorithm', available at: https://www.merriam-webster.com/dictionary/algorithm, accessed: 14.10.2024.

[2] Cambridge Dictionary.org, 'Algorithm', available at: https://dictionary.cambridge.org/dictionary/english/algorithm, accessed: 14.10.2024.

Profiling is considered a preceding step that enables automated decision-making (Rajić Ćalić & Tošić, 2023, p. 574). According to the EU rules contained in the GDPR, profiling refers to any type of automated processing of personal data that is used to evaluate specific aspects of an individual, particularly to analyse or predict things like their work performance, financial situation, health, preferences, interests, reliability, behaviour, location, or movement (EU 2016/679). Profiling can be an extremely useful practice in the domain of efficient use of time and resources by public and private entities. With this technology, they can personalise their products and services and make optimal decisions more effectively. However, profiling can also have negative effects, such as discrimination and impact on consumers or service users. Therefore, legal mechanisms have been developed to neutralise these undesirable phenomena. The presented legal framework, established by GDPR, reflects the European Union's commitment to adapt its legal system to modern challenges and address contemporary issues in data protection.

In the available literature, three phases of processing are mentioned: data collection, data analysis and application (Sancho, 2020, p. 139).

The first phase is characterised by the collection of personal data by the controller from various sources. At this point, it is important to clarify the terms controller and data subject. The data subject is the person to whom the data relates, while the controller is the entity that determines the purposes and methods of personal data processing (EC 95/46). Data collection can be direct or indirect. Direct collection involves gathering data directly from the data subject. Indirect collection involves gathering personal data from other sources. This is most often done via the internet, mobile devices, and various applications, as well as through artificial intelligence systems integrated into household appliances, clothing, or vehicles.

The next phase is the analysis of the collected data. Computer hardware stores, links, and analyses large volumes of data in order to generate new information. The method by which new information is derived depends on the algorithm used. Machine learning algorithms are used to create profiles of individuals by analysing large datasets and the connections between those data.

In the final phase – the application phase – controllers implement the outcomes of automated processing, including profiling, and use these results to make decisions (e.g., issuing ratings, determining recommendations, or predicting trends). At this stage, there is a possibility that the controller directly applies the algorithm's output, or that a human - such as an analyst - makes the final decision.

Based on the above, we can conclude that automated decision-making is essentially the application of algorithms to make various types of decisions, whether those decisions require human intervention to be made or are made independently by the algorithm. Automated decision-

making systems use complex mathematical algorithms to identify relationships within big datasets and, using this information, detect relevant trends and patterns (Waldman, 2019, p. 616). Profiling and automated decision-making also have negative implications for society. These primarily include discrimination, threats to privacy, the lack of objectivity when an individual is viewed as a member of a group, and to whom a decision is applied based on the probability assessment of the entire group (Hänold, 2018, pp. 129-132). Therefore, the presence of regulation and legal norms is crucial to neutralise these negative effects and create a favourable environment for the further development of advanced technologies.

LEGALLY SIGNIFICANT CHARACTERISTICS OF ALGORITHMS

Large amounts of collected data, which are somewhat chaotic and unstructured, are processed and systematised by algorithms, thereby interacting with their environment. Through this interaction, they make predictions and draw certain conclusions and decisions. This is why artificial intelligence systems can learn from their previous interactions and actions, allowing artificial intelligence to be both self-sustaining and self-improving (Haddadin & Knobbe, 2020, p. 16). In this section, we will present certain characteristics of algorithms, which are significant for the position and treatment of algorithms in the context of international trade law.

Data as the Foundation

In international trade law, data is often defined as information in digital form. Information is, in fact, data that has been presented in a meaningful or useful way. The existing literature typically distinguishes between data, which refers to raw facts, and information, which is data that has been processed, structured, and organised (Soprana, 2022, p. 48).

Big datasets form the foundation of algorithms. Algorithms are provided with data. With increased access to various types of personal and other data, algorithms can be more easily tested and improved (Aaronson & Leblond, 2018, p. 247). The expansion of artificial intelligence systems is primarily based on the availability of large amounts of data. In the past, easily accessible microprocessors and sophisticated algorithms played a significant role, but today, the focus is on the different types of data. The more data available to a learning algorithm, the more it can learn. Therefore, for the accuracy of output data (predictions, conclusions, decisions), the quantity of data used for training the algorithm is of crucial importance, rather than the type and characteristics of the algorithm itself. This is also the reason why many global struggles are centred on these data resources (Ebers, 2019, p. 62). Today, the most successful entities in the global market are the ones with the largest amount of data, on the basis of which they train their algorithms.

As we live in the era of data, which is all around us and easily accessible, it has become a key resource driving innovation across all fields and economic growth. However, the increasing reliance on algorithms and artificial intelligence in various sectors raises significant concerns regarding privacy and data protection. The modern regulatory framework focuses on issues such as cross-border data flows, consent and transparency in data processing, compliance, and the effectiveness of existing data protection regulations. One of the main challenges in data protection and privacy is the proliferation of cross-border data flows, where data travels across national borders for processing, storage, or analysis. In the context of artificial intelligence, cross-border data flows are widespread, as these advanced systems often require access to big datasets from various sources in order to train algorithms and make decisions. However, the free flow of data across borders raises concerns regarding data sovereignty, jurisdictional conflicts in case of disputes, and the risk of unauthorised access or misuse of personal information (Igbinenikaro & Adewusi, 2024, p. 495).

Based on the above, the importance of cross-border data flows and preventing discriminatory measures, such as data localisation requirements, is rightly emphasised. Data localisation measures are among the most common regulatory tools used to block or hinder the free cross-border data flow. Any barrier to the free flow of data negatively affects the market and competition, and consumers bear the ultimate cost. The legal framework of international trade should aim to counter such discriminatory barriers by protecting data flows, with reasonable safeguards in the form of personal data protection (Mitchell & Mishra, 2017, p. 1112).

At this point, it is important to note that promoting transparency and accountability in data processing practices is desirable. This would allow for the responsible use of artificial intelligence and ensure that, in the context of international trade, individuals' rights to data protection are fully respected (Khan, 2024, p. 112). The issue of transparency regarding how machine learning algorithms function is not straightforward. We cannot explain how an algorithm works if we do not know how it was trained. Most often, the only ones who can answer this question and explain how algorithms process data are the engineers who designed them. However, even this is not always possible, as certain scientific questions remain open—such as how deep artificial neural networks function. Additionally, even if algorithms could be explained, the explanation would most likely not be useful or understandable to those who are not engineers. On top of this, there are also challenges in the legal domain, including significant resistance from companies to disclose how their algorithms work due to the protection of business secrets and intellectual property rights (Battaglini & Rasmussen, 2019, p. 339).

Causality and Correlation

Most data collection methods depend on identifying correlations within a dataset. Getting valid results depends on correlation. Instead of looking for causality between relevant parameters, advanced algorithms are used to detect patterns and statistical correlations. Leveraging correlations, when statistical analysis indicates a significant relationship between factors, provides clear benefits in terms of speed and cost-efficiency. However, there is a danger that the result will be undesirable when correlation is increasingly seen as a sufficient basis for directing actions without first establishing causality between the data points.

Data analysis, actions, and far-reaching decisions based solely on correlations in probabilities can be seriously compromised by errors. First, relying on correlations without exploring causal effects carries the risk of making incorrect or contradictory decisions. The existence of a correlation in big datasets tells us nothing about which correlations are meaningful and which are not. If a strong statistical correlation is proven, it still does not speak about an individual within a certain group. The statistical correlation is relevant and refers to the entire group. Absolute reliance on correlation can lead to decisions or conclusions that are unjust for the individual. Identifying causality among data points in big datasets can be crucial for improving the quality of decisions, predictions, and conclusions (Ebers, 2019, p. 45).

As the available literature points out, it has recently been proven that, with the increase in the amount of data, the number of correlations that are not relevant and objective also increases. Distinguishing between relevant correlations and those that have no legal or social significance is becoming increasingly challenging (Zenil, 2017, p. 16). In the era of complex algorithms and big data, it is essential to develop the ability of those who analyse correlations in order to recognise causality and interpret the resulting outputs in accordance with the overall social environment.

Autonomy

The OECD Expert Group on Artificial Intelligence defines AI systems as machines capable of making predictions, recommendations, or decisions that affect real or virtual environments. These systems are guided by human-defined objectives and are designed to function with varying degrees of autonomy (OECD, 2019, p. 15). From this definition, we can see that this technology functions, to some extent, independently of the human factor that defined the input data. In the field of artificial intelligence, the term ‘autonomy’ is typically used to describe the ability of a machine to operate independently of human guidance. Algorithm autonomy is the feature that most worries scientists in the field of artificial intelligence. When these machines are described as autonomous, it means

they can independently determine the appropriate course of action in various situations, without human input (Totschnig, 2020, p. 2474).

This characteristic of artificial intelligence is probably one of the greatest challenges for humanity. Systems that learn by themselves are not explicitly programmed. Instead, they are trained through millions of input parameters, allowing the systems to evolve by learning from experience. The increased use of artificial intelligence systems and algorithms presents significant challenges for legal frameworks. One of the key issues is the institute of responsibility for possible damage. When a system operates with a certain degree of autonomy, it becomes difficult to clearly assign responsibility for its actions—whether that responsibility lies with the developer, the service provider, or the seller (Ebers, 2019, p. 47).

Autonomy means that algorithms can behave in unpredictable ways, as they may arrive at solutions that humans may not have considered or have dismissed, realising there are better options. This becomes especially significant when AI systems cause harm to individuals. The situation is further complicated when the artificial intelligence system learns not only during the initial phase in which it is created, but also after it is released to the market. AI systems have this ability to learn throughout their existence. In such cases, even the most careful designers and developers will not be able to control or predict how the algorithm will behave in its environment.

For all these reasons, self-learning systems with a high degree of autonomy present a major challenge for legal systems (Ebers, 2019, p. 47).

The autonomous actions of artificial intelligence systems are not limited to their physical interaction with the world. As an increasing number of commercial and governmental activities take place in cyberspace, vast amounts of routine tasks can be performed without human involvement. A growing number of decisions is now being made by algorithms, which either make final decisions or provide decision proposals that are later subject to approval by the person nominally responsible for the decision (Chesterman, 2020, p. 239). In this way, the decision-making process by the authorised person becomes faster and more productive.

In addition to efficiency, automated processing can help ensure consistency and predictability. In some situations, algorithms are preferred to avoid the arbitrariness that often characterises human decision-making—due to carelessness, corruption, or other inherent human limitations. At the same time, shifting responsibility for decisions to machines introduces other problems, such as the possibility of discrimination or decisions that fall outside the current social and political context. It seems that relying solely on the actions of the machine and the algorithm is not enough to make the right decisions. This raises the dilemma of whether there are certain decisions that should not be made entirely by machines

(Chesterman, 2020, p. 241). This raises many new social issues that should be analysed specifically from a legal perspective.

THE DISCLOSURE OF SOURCE CODE – BETWEEN PROTECTION AND TRADE LIBERALISATION

Source code refers to the set of instructions written by programmers to direct a machine to carry out a specific task. The source code is typically written in a text file and is human-readable. The source code is written in one of the programming languages. It utilises programming languages such as Python, Java, R, or C++ (Dorobantu et al., 2021, p. 107). This section will analyse the impact of national regulations concerning source code on international trade and the position of source code in preferential trade agreements, which are significant sources of international trade law.

Forced Disclosure of Source Code as a Measure to Protect the National Market

As the role of algorithms in the trade of goods and services increases, so does the number of national measures and policies related to their functioning and the execution of code. While the motivations of governments are primarily security-oriented, these measures can significantly impact the trade of products and services that rely on artificial intelligence. Mandatory source code disclosure measures act as trade restrictions. Several countries have already implemented laws that mandate access to, disclosure of, or transfer of source code as a requirement for market access. Source code creators use programming languages to translate the algorithm into source code, thus instructing the machine to perform a specific task. The core value of any AI system is the algorithm. In this context, mandatory disclosure of source code can be equated to a requirement for programmers to disclose the instructions included in the algorithm. Thus, the economic motive for creating these advanced systems can be lost. These elements are currently protected only as trade secrets (Soprana, 2022, p. 86).

Russia and China are among the first countries to adopt laws in this area. These countries are the first to implement mandatory requirements for the disclosure, granting access to, or transfer source code as a condition for market access. China passed the Cyber Security Law in 2017, which mandates that companies reveal proprietary formulas or designs in order to gain approval from regulatory authorities, putting them in a challenging and difficult situation. Companies must choose between the enticing opportunity to access the Chinese market and protecting their intellectual property from potential misuse (Cybersecurity Law of China, 2017). Similarly, companies that wish to operate in Russia must comply with

stringent requirements to share algorithms and source code with public authorities. Failure to do so will prevent them from offering their services in the country, in line with Federal Law No. 374 of 2016, which amends the Federal Law on Combating Terrorism and certain legislative acts of the Russian Federation related to the implementation of additional measures to counter terrorism and protect public safety (Soprana, 2022, p. 87).

Governments are motivated by various reasons to mandate the transfer, access, or disclosure of source code. Primarily, these can include legitimate political reasons to ensure the high quality of digital products and services, prevent the abuse of the dominant position, preserve market competition, ensure compliance with tax obligations, and cyber security. National laws may also require access to source code to increase transparency and provide mechanisms to protect national security as a whole. In addition to political reasons, governments may have protectionist motives. Through mandatory disclosure of source code, countries may seek to protect domestic companies and favour them over foreign ones. In such cases, these measures are discriminatory and clearly represent non-tariff trade barriers. Requirements for the disclosure of source code could be used to prevent foreign companies from exporting their products and services to the territory of the country enforcing such measures. The aforementioned requirements have a negative impact on market conditions. They could restrict trade to the extent that it affects the core interests of companies, which, by entering those markets, would risk losing the exclusive right to their algorithms and codes (Soprana, 2022, p. 88).

Provisions on Source Code in Certain Trade Agreements

In the absence of a universal agreement regulating the issue of international trade in goods and services supported by artificial intelligence, the subjects of international trade law have resorted to regulation within free trade agreements. Few of these agreements address artificial intelligence or its specific components. Below are those that include source code provisions.

More recent trade agreements include specific provisions concerning source code. The provisions of these agreements prohibit governments and their agencies from requiring the transfer or access to the source code of software owned by the other party. This is very important from the aspect of competition protection. The above mentioned general prohibition against public authorities demanding the transfer or access to source code is of significant importance. On the one hand, it promotes international trade by guaranteeing to code creators that their code will not be disclosed or transferred. On the other hand, even when exceptions exist, it restricts governments and their agencies from inspecting the source code (Dorobantu et al., 2021, p. 106). It is also desirable for trade agree-

ments to foresee exceptions that reflect real needs and contribute to more secure international trade flows.

The USMCA Agreement *(The United States-Mexico-Canada Agreement)* contains a specific chapter titled Digital Trade. Article 19.1 defines an algorithm as a sequence of steps taken to solve a problem or achieve a result. Article 19.12 establishes a ban on data localisation, clearly promoting the fundamental rule of the free flow of information and thus supporting the development of algorithms. Article 19.11 states that the parties may implement measures that deviate from the free flow of data if required to pursue a legitimate public policy goal, as long as there is no unjustified or arbitrary discrimination or hidden trade restrictions. Data transfer restrictions cannot be more restrictive than necessary to achieve a legitimate objective. Article 19.16(1) states that neither party may require the transfer of or access to the source code of software owned by the other party, nor the algorithm expressed in that source code, as a condition for importing, distributing, selling, or using that software, or products containing that software, within its territory. Article 19.16(2) states that this article does not exclude the possibility that the regulatory body or the judicial authority of one party requires the person of the other party to save and make available the source code of the software, or the algorithm expressed in that source code, to the regulatory body for a specific investigation, inspection, law enforcement or legal proceedings, with protection against unauthorised disclosure (USMCA Agreement, 2020).

The United States–Japan Digital Trade Agreement, which was signed in 2019 and entered into force in 2020, in Article 17 similarly determines the protection of source code.

The European Union and Japan signed an agreement on economic partnership, which in the section F contains provisions related to electronic commerce. Article 8.73(1) addresses the issue of voluntary transfer of source code. A party may not require the transfer or access to the source code of software owned by a person from the other party. Nothing in this paragraph prevents the transfer or grant of access to source code in commercial contracts, or the voluntary transfer or grant of access to source code, for example, in the context of public procurement. Article 8.83 refers to the free flow of data. The parties have agreed that, within three years from this agreement's entry into force, they will reassess the need to include a provision on the free flow of data in this agreement (EU-Japan EP Agreement, 2019).

Provisions on source code present challenges for protecting the public interest, not only because of their content but also because of the possible ways in which they are formulated. The way in which key terminology is used and the logic behind the provisions directly impact legal certainty and the scope of protection, both for national markets and for global flows of international trade (Nikaj et al., 2024, p. 16).

CONCLUSION

Algorithms and source code are key components of artificial intelligence. The source code, written in a programming language, instructs the machine on what tasks to perform and how to execute them. Provisions related to these categories remain relatively limited in number. These provisions can be found in the national legislation of certain countries as well as in more recent free trade agreements. From the point of view of individual countries, the existence of legislation that will require a forced disclosure of source code is a way to instil security in domestic entities and to not lose a comparative advantage in their own market. From the perspective of international trade, such provisions act as trade barriers that complicate commerce and threaten healthy competition. Consequently, trade agreements aim to maintain a balance by promoting the prohibition of forced source code disclosure, with certain exceptions for the protection of the public interest of states. It is essential to analyse how legal regulations follow the rapid development of artificial intelligence and the ubiquitous presence of algorithms, and to develop an appropriate system of regulations that will properly respond to the aforementioned phenomena.

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АЛГОРИТАМ И ИЗВОРНИ КОД – ПРАВНИ ИЗАЗОВИ МЕЂУНАРОДНЕ ТРГОВИНЕ

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Резиме

Од свог настанка, вештачка интелигенција окупира пажњу научника. Паралелно са њеним развојем, развијала се и међународна трговина. Токови робе, услуга и капитала добили су нову димензију. Размена сада укључује размену производа који у себи садрже вештачку интелигенцију, и услуга које пружају системи вештачке интелигенције. Једна од три градивне компоненте вештачке интелигенције јесте алгоритам. Дефинисан као скуп унапред предвиђених корака како би се дошло до резултата на бази одређених улазних величина, представља својеврсну енигму за правну науку. Иако је досадашња регулатива из ове области скромна, позитивни импулси су присутни. У доношењу првих норми које се тичу података, вештачке интелигенције и алгоритма свакако предњачи Европска унија. Оно што је значајно, са аспекта права међународне трговине, јесте чињеница да се последњих година закључује све већи број споразума о слободној трговини који садрже посебне одредбе које се тичу алгоритама. Ове одредбе налазе се у деловима споразума који се односе на регулисање дигиталне трговине. Поред тога што су поједине државе

протекционистички настројене према свом тржишту, наведени споразуми се залажу за слободан прекогранични ток података и неутралисање негативних ефеката принудног откривања изворног кода као услова за приступ тржишту. Од изузетног је значаја постићи баланс између либерализације и протекционизма у контексту откривања и преноса изворног кода. Остаје нам да анализирамо како ће се регулатива из ове области развијати и на који ће начин то утицати на међународну трговину робом и услугама.

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THE DIGITAL IDENTITY OF THE PERPETRATOR AND ACHIEVING THE PURPOSE OF PUNISHMENT

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Abstract

The identification of the perpetrator, as the subject of a criminal offense, represents, in addition to the place, time, victim and specific criminal offense, the basis for initiating criminal proceedings, whose ultimate goal is to determine the guilt of the perpetrator, imposing a penalty or other criminal sanction and achieving the purpose of punishment. A person as a perpetrator and his real identity make him the subject of a criminal offense, committed in a real (or virtual) space and time. The purpose of punishment is defined in order to be achieved in relation to the perpetrator and other potential perpetrators. However, in the postmodern era in which we live, the question arises of whether the purpose of punishment can be achieved in relation to digital identities or autonomous systems of artificial intelligence (AI) as perpetrators of criminal offences in the virtual space. Can then the purpose of punishment be achieved by punishing a natural person with a real identity in relation to one or more digital identities or characters in the virtual space? A special problem related to criminal liability of a digital identity arises with AI systems that take autonomous actions in both the virtual and real space. In the paper, the author raises the issues of the criminal liability of autonomous AI systems in the context of the responsibility of legal entities (similar to the criminal liability of legal persons), types of possible penalties for AI systems and the need to determine a special, new purpose for sentencing such entities.

Key words: digital identities, autonomous AI systems as perpetrators of crimes, purpose of punishment.

ДИГИТАЛНИ ИДЕНТИТЕТ ИЗВРШИОЦА И ОСТВАРИВАЊЕ СВРХЕ КАЖЊАВАЊА

Апстракт

Утврђивање идентитета извршиоца, као субјекта кривичног дела, представља, поред места, времена и жртве конкретног кривичног дела, основ за покретање кривичног поступка чији је коначни циљ утврђивање кривице учиниоца, изрица-

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ње казне или друге кривичне санкције и остваривање сврхе кажњавања. Физичко лице као извршилац и његов стварни идентитет чине га субјектом кривичног дела, извршеног у реалном (или виртуелном) простору и времену, а сврха кажњавања се дефинише како би се остварила у односу на конкретног учиниоца и друге потенцијалне учиниоце. Међутим, поставља се питање да ли се, у постмодерном добу у којем живимо и у периоду пред нама, сврха кажњавања може остварити и у односу на дигиталне (виртуелне) идентитете, или у односу на аутономне системе вештачке интелигенције (AI) као потенцијалне извршиоце учинилаца кривичних дела у дигиталном (и реалном) простору. Питање је да ли се тада кажњавањем физичког лица стварног идентитета може остварити сврха кажњавања и у односу на један или више дигиталних идентитета у виртуелном простору. Посебан проблем везан за дигитални идентитет појављује се код потенцијалне кривичне одговорности система AI који предузимају аутономне радње у виртуелном и стварном простору. Аутор у раду отвара питање кривичне одговорности аутономних система AI у контексту одговорности правних ентитета (слично одговорности правних лица), потенцијалним казнама и потреби дефинисања специфичне сврхе кажњавања ових ентитета.

Кључне речи: дигитални идентитет, аутономни AI системи као учиниоци, сврха кажњавања.

INTRODUCTION

The identification of the subject of a criminal offense constitutes the basis for initiating criminal proceedings, whose ultimate goal is to establish the guilt of the perpetrator, to assess and impose a sentence or other criminal sanction, as well as to achieve the purpose of prescribing punishment and the purpose of enforcing criminal sanctions. The identity of the perpetrator as the subject of the criminal act constitutes the basis for establishing the perpetrator's guilt, which exists if, at the time of committing the criminal act, the perpetrator was of sound mental competence and acted with intent, and was aware or was obliged and could have been aware that his act was prohibited. A criminal act is committed with guilt even if the perpetrator acted negligently if the law expressly provides for it. There is no criminal act if the act was committed in a state of mental incompetence and a perpetrator could not understand the significance of his act, or could not control his actions (due to mental illness, temporary mental disorder, delayed mental development or other serious mental disorders). Defining guilt in this way in Serbian criminal legislation refers to and confirms the fact that guilt, as one of the basic elements of a criminal offense, can only be attributed to a natural person as the subject of a criminal offense. Individual criminal responsibility and subjective liability are the basis for punishing the perpetrators of criminal offenses. Therefore, natural persons, heretofore almost unquestioned and indisputable, represented the exclusive subjects of a criminal offence whose guilt was determined in criminal proceedings and to whom a sentence or other criminal sanction was imposed in order to achieve the purpose of punishment.

However, in the postmodern era in which we live and in the period ahead of us, the question arises as to whether the purpose of the punishment prescribed for natural persons can also be achieved in relation to the digital (virtual) identities of perpetrators in the digital space, that is, whether such a purpose of punishment can be achieved in relation to autonomous AI systems if, hypothetically, these entities could be treated as subjects of criminal acts in the future. If the newly established principle of the criminal liability of legal persons for criminal acts has opened the question of the liability of legal entities as subjects of criminal offenses, can we expect that other entities – digital identities or autonomous (AI) systems – will also become criminally liable?

Considering the digital identity of a person in virtual space, as a subject of a crime, can the purpose of punishment be achieved? Can AI systems also have a digital identity? Can these digital identities become perpetrators of criminal acts in the virtual and real environment? Can the purpose of punishment be achieved in relation to these entities? Do we need a special system of punishing digital perpetrators and defining a special purpose of punishing these entities?

Although the basic postulates and principles of traditional criminal law do not leave us room to raise these questions because they are strictly based on establishing the individual and subjective criminal liability of natural persons as perpetrators, the question must nevertheless be asked of whether the exception made with the liability of legal persons for criminal acts, regardless of the fact that the determination of the liability of a legal person is based on the guilt of the responsible natural person in the legal person, leaves room for establishing the guilt of digital identities. That is, does the system of penalties and other criminal sanctions for legal persons as perpetrators of criminal acts open up the space for us to devise a new system of punishing and to find a new purpose for punishment? In the distant future, will the need to re-examine the fundamental foundations of criminal law and set up a new system of punishing digital entities come to us at the speed of light, albeit we have not noticed it yet? Is it time to consider these questions, at least on a theoretical and hypothetical level?

SUBJECTS OF A CRIMINAL OFFENCE: THE RESPONSIBILITY OF A NATURAL PERSON AS A POSTULATE OF CRIMINAL LAW – NOVELTIES AND A POSSIBLE PARADIGM CHANGE

The legal description of a criminal act always includes the subject of the criminal offense, i.e. it is impossible to prescribe an action as a criminal offense without also providing its subject as an essential element of the crime (Stojanović, 2010, p. 112). The subject of a criminal offense can be any natural person, except in cases where the legislator provides for a specific feature of the subject of the criminal offense. Traditional criminal law

has until recently, before the introduction of the criminal liability of legal persons for criminal offenses, understood the subject of a crime exclusively as a human being.

One circumstance was almost always considered indisputable in criminal law – the perpetrator of a criminal act is always a natural person. Even when a person used an animal, or some kind of natural or mechanical force to commit the act, he was always considered the subject of the criminal act.

One of the fundamental concept in the justification of criminal law is the principle of individual autonomy – that each individual should be treated as responsible for his or her on behaviour (Ashworth, 2009, p. 23), and that the principle of criminal liability is the strongest formal condemnation that society can inflict (Ashworth, 2009, p. 5).

Serbian criminal legislation, when defining the concept of a criminal act, stipulates that it is an offence set forth by the law as a criminal offence, which is unlawful and committed with guilt. The guilt of the perpetrator of a crime, therefore, represents one of the four constitutive elements of a criminal act (Stojanović, 2017, p. 126). A perpetrator is guilty if he was mentally competent and acting with premeditation at the time of committing the criminal act, and was aware or should, or could have been aware that his action was prohibited, or if the perpetrator acted with negligence and this was explicitly provided for by law.

The perpetrator as a natural person represents the paradigm of individual criminal responsibility and subjective liability. The real identity of the perpetrator is a necessary prerequisite for conducting criminal proceedings, establishing guilt, assessing and imposing a criminal sanctions and achieving the purpose of punishment. The identity of the perpetrator is, even after conviction, a prerequisite for the execution of criminal sanctions and the basis for the inclusion of the perpetrator in the community after the execution of other criminal sanctions.

However, several facts and circumstances characteristic of our contemporaneity significantly influenced the need to reconsider the position on the exclusive liability of natural persons and the introduction of, to an extent unimaginable, novelties in this area.

The first and most significant circumstance is the introduction of the criminal liability of legal persons. Under the influence of the Anglo-Saxon countries, the countries of the European-continental legal system began to be legally regulated and the criminal liability of legal persons was introduced at the end of the last decade of the 20th century. Since 2008, legal persons could be criminally liable for the commission of criminal acts in the Republic of Serbia (Law of liability of legal person for criminal offenses, Official Gazette of Republic of Serbia, No. 97/2008).

Another circumstance that undoubtedly accompanies the modern period in which we live, but also the period ahead of us, is the explosive

number of users of the global network (Internet) and the exponential growth in the number of users of information and communication technologies (ICT). The networking of humanity via the global network has practically rendered meaningless the existence of borders in numerous spheres of social life and ordinary human activities. Mass activities of an information and communication nature on the global network and in the virtual space were transferred to various spheres of life: administrative, financial, banking, business, political, educational, economic, to name a few. This type of activity has contributed to the spread of conduct in the virtual space that is considered harmful or prohibited, and the process of criminalisation began. Prohibited conduct in the virtual space is carried out in an environment that has become a new horizon without restrictions for committing the most diverse types of crimes. This circumstance has opened the question of establishing the identity of the subjects of crimes committed in the digital environment, as well as their real or digital identity (real or fictional).

The third circumstance, among several that we have highlighted, is the development of AI systems and their application in the digital (and real) space. The development and application of various AI systems has become daily routine for a large number of users. In addition to their undeniable benefits and their facilitation of the performance of a large number of tasks and activities, AI systems represent a technology that can significantly threaten security, and affect the protection of fundamental human rights and freedoms. Designed as a system that, using modern ICT equipment, achieves a higher cognitive level than a humans' and, in certain cases, has the ability to make autonomous decisions, it raises the question of whether autonomous AI systems will become subjects of a crimes, as separate legal entities.

THE PURPOSE OF PUNISHMENT, IN BRIEF

The goals and purpose of punishment are defined in criminal legislations explicitly or implicitly. Most modern criminal law systems, in determining the purpose of punishment, start from relative theories on the purpose of punishment, with some elements of absolute theories.

The purpose of punishment in Serbia is prescribed by the Criminal Code (CC) and it is directed towards perpetrators as well as other persons as potential perpetrators. Article 4, paragraph 2 stipulates the general purpose of prescribing and imposing criminal sanctions – suppressing acts that violate or endanger values protected by criminal legislation. Within the general purpose of criminal sanctions, the purpose of punishment prescribed in Article 42 of the CC is: (1) to prevent a perpetrator from committing criminal offences and deter them from the future commission of criminal offences; (2) to deter others from the commission of criminal offences; (3) to express social condemnation of the criminal offence, enhance moral strength and reinforce the obligation to respect the law; and (4) to

achieve justice and proportionality between the committed offense and the severity of the criminal sanction. The 2019 amendments to the CC supplemented the purpose by including the principles of achieving justice and proportionality between the committed offense and the severity of the criminal sanction, which specifically defined and justified the purpose of introducing life imprisonment into Serbian criminal legislation (Grujić, pp. 2019, 1109-1124), and indirectly, the purpose of pronouncing (and executing) life imprisonment, for convicts which are a part of the prison population (Grujić, 2021, pp. 1131-1145).

In addition to the general purpose and the purpose of punishment, the CC also defines the purpose of applying a suspended sentence and a judicial admonition, as well as the purpose of applying security measures, while the Law on Juvenile Offenders and Criminal Protection of Juveniles prescribes the purpose of applying educational measures, as well as a juvenile prison sentence for minors.

The purpose of punishment refers exclusively to natural persons as subjects of criminal acts and potential perpetrators (natural persons). The legislator does not prescribe a specific purpose for applying criminal sanctions to legal persons.

THE CRIMINAL LIABILITY OF LEGAL PERSONS FOR CRIMINAL OFFENCES – LIABILITY, CRIMINAL SANCTIONS AND THE PURPOSE OF PUNISHMENT

The introduction of the criminal liability of legal person into the criminal law system means that the subject of a criminal offense is no longer exclusively a natural person. According to the solution in our legislation, the criminal liability of a legal person is determined on the basis of the guilt of the responsible person (natural person) who commits a criminal act with the intention of obtaining a benefit for the legal person or if, due to the lack of supervision and control of the responsible person, the commission of a criminal offense for the benefit of the legal person is enabled by a natural person acting under the supervision and control of the responsible person.

In the context of punishing legal persons for criminal offenses, it is impossible to apply the existing punishment system, and the legislator has prescribed criminal sanctions that can be applied to this category of perpetrators. A legal person may be sentenced to penalties, suspended sentence and security measures. The Law on the Liability of Legal Persons for Criminal Offences stipulates that two penalties can be imposed on a legal entity: a fine and the termination of the legal entity. A fine may be imposed in the range of no less than one hundred thousand, and no more than five hundred million RSD, according to the special rules prescribed in Article 14, paragraph 3. The second penalty is the termination of the legal person and may be imposed if the activity of the legal person was, in whole or to a signifi-

cant extent, in the function of committing criminal offenses. After the judgment becomes final, the procedure for the liquidation, bankruptcy or termination of the legal person in another manner is carried out, and the legal person ceases to exist by being deleted from the register kept by the competent authority. A suspended sentence is the only cautionary measure that can be imposed on a legal person if a fine of up to five million RSD is determined. Security measures that can be imposed on a legal person include a ban on performing certain registered activities or businesses, the confiscation of objects, and a public announcement of the judgment.

The legislator did not prescribe a specific purpose for prescribing or enforcing criminal sanctions against legal persons. Considering this circumstance, the purpose of punishment, based on Article 34, regulates the consistent application of the provisions of the Criminal Code.

THE DIGITAL IDENTITY OF THE PERPETRATOR OF A CRIMINAL OFFENCE

Real, and Fictional (Fake), Digital Identity and the Purpose of Punishment

Given the massive use of the global network (Internet) and the number of users of ICT in the modern period, a large number of common activities are carried out in the digital space. The advantages of a common digital space are undeniable and, almost imperceptibly, have become routine for carrying out communication, trade, business, banking, education, administrative and other tasks and activities.

To use the content and various features of the virtual space, user identification is required, which represents a kind of user identity in the digital environment. For numerous applications, services, electronic services and access to content, user identification and authentication are required. Typically, for the largest number of programs, applications, pages or electronic services, this means using a username and password to identify, and certainly an IP address. This unique data, in addition to other potential information required for certain electronic services (e.g. electronic ID card, electronic signature, payment card data, address, phone authorisation, etc.), forms the basis of a person's digital identity in the virtual space, i.e. the real digital identity of a natural person in the digital space.

Users, on the other hand, can be identified with many digital personalities. The 'created' or fictional (fake) personality of a user in the digital space can be used for a whole range of activities, from entertainment and communication to performing undesirable, prohibited or criminal activities. In this context, it must be understood that both socialised personalities (in the real world) can build digital identity characters that are completely different from their real personality, character traits, gender, educational level, communication preferences, interests, usual activities or any other characteristic of their real identity.

In addition, real and virtual digital identities in cyberspace can undertake activities that can be recognsed through user identification, but both identities can be subject to digital identity theft (as one of the manifestations and phenomena of cybercrime). In the context of identity theft, numerous criminal laws in Europe have criminalised such prohibited behaviours as separate criminal offenses.

It should not be overlooked that a huge part of the Internet space consists of content that is not available to all users, due to the specifics of its functioning and services. It is called the 'dark side' of the network (dark web), and it's a part of the 'deep web.' This is an entire 'hidden' digital space that is not available for most widely used Internet content search engines, and often requires special software, configuration or access authentication. These are connected computers or networks, i.e. private networks in which anonymous communication without revealing identifying information is carried out, along with, to a large extent, the incriminating activity of digital identities. Such an area is almost a perfect space for committing various forms of cybercrime using fictional digital identities. These include, among a host of others, activities such as the illegal trafficking of narcotic drugs, arms trafficking, the trafficking of nuclear or radioactive materials, the trafficking of human organs, the trafficking of personal data and passwords, the trafficking of payment card data, the sale of identities, the trafficking and exchange of pornographic content, and the exchange of child pornography content. The digital identity of hackers can be viewed in a similar way, as individuals with technical computer knowledge and skills that they apply to install malicious software, steal or destroy data, disrupt services, breach security systems in the digital space, and many others.

The commission of crimes by digital identities, real, stolen real, fictional identities or IP address redirection raises the question of revealing the subject. In the case of committing crimes in the digital space, it can be the perpetrator identity of the real user, the digital identity of the perpetrator, the identity of the digital identity thief or the false identities (alter egos). How does the punishment of these different identities affect the purpose of punishing?

From the point of view of the purpose of punishment in modern criminal law, it is possible to achieve it only in relation to the real digital identity of the perpetrator, a natural person as the subject. By punishing the actual perpetrator, it is possible to achieve the purpose of punishment both in an act related to special prevention and in the context of general and positive general prevention. By detecting and punishing a person who has committed identity theft in the digital space, it is also possible to achieve the purpose of punishment (both special and general prevention) because, in addition to criminal acts committed in the digital (or real) space, the person will be liable for identity theft or misrepresentation as criminal acts.

However, when it comes to fictional (fake) digital identities, it is very difficult to imagine that the purpose of punishment, especially in the context of special prevention, can be achieved in relation to this category of perpetrators. Namely, the creation and construction of a digital personality may lead to the fact that punishing only the creator of the virtual personality does not affect the subject of the act as the perpetrator, and it is practically impossible to achieve this in relation to a created fictional digital identity. Preventing the actual perpetrator from committing criminal offences through a digitally created identity by depriving him of his liberty (by imposing and executing an imprisonment) and by disabling access to the global network is the only possible way to achieve the proclaimed purpose - in the part that relates to preventing the perpetrator from committing criminal acts. It is almost impossible to achieve all other aspects of the purpose of punishment. When it comes to the digital identities of dark web users and perpetrators of the most serious cybercrime crimes in the virtual space, the biggest problem is to discover their identity, reveal the crime and the number of committed crimes, and prove guilt. Created and fictional digital identities, constant criminal activity in the digital space as a lifestyle, and the awareness of the habitual nature of criminal activity (criminal career) do not represent suitable circumstances for achieving the purpose of punishment in relation to the real identities of the persons who created them.

AUTONOMOUS AI SYSTEMS AS POTENTIAL SUBJECTS OF CRIMINAL OFFENCES

In the previous part of the paper, we pointed out the exponential growth of the use of the global network and the massive use of ICT in a wide variety of personal and social activities in the digital space. However, until recently, it was believed that the use of AI systems was reserved for people with top-notch knowledge of IT, and that the application of technology was limited to military, security, scientific or research areas. Almost imperceptibly, it became available to a large number of the users of the digital space, and a part of our reality.

For this reason, an urgent need arose for normative the regulation of the use of AI systems. The nature of the paper does not allow us to address issues of the normative problems of the regulation of AI, except in the way of defining the term, but there exists a need to emphasise that two basic documents were adopted at the European level in 2024 alone: the EU AI Act (Regulation (EU) 2024/1689) and Council of Europe Framework Convention on artificial intelligence and human rights, democracy, and the rule of law (Council of Europe Treaty Series - No. 225 dated September 5th 2024).

Starting from the basic postulate of criminal law that there is no criminal offense without guilt, the question arises whether the guilt of autonomous AI systems can be normatively established in the future. In other

words, can autonomous AI systems be expected to acquire the status of legal subjects and the status of subjects of criminal offenses? Can these systems, based on their own 'will' and actions taken in the digital or external world (with awareness of the prohibited nature of their behaviour), be perpetrators of criminal acts in the digital (and real) space, and can we expect them to be formally recognised as the subjects of criminal acts? And does this completely change the foundations of criminal law and its basic postulates? If the hypothetical answer could be positive, the question arises of how to punish these entities and what purpose could (or should) be achieved.

The definition of AI and its systems is fundamental in order to think about the legal subjectivity of these entities, or the subjectivity of autonomous AI systems. There are a large number of definitions of the concept of AI in the available literature and in the normative acts.

Norvig presents several definitions that start from whether we are talking about systems that think like humans or those that think rationally (Norvig, 2003, p. 2). Kan defines AI as a system with the ability to reason, conduct judgments and integrate these processes in a manner that contrasts with the natural characteristics of human intelligence, developed by interactive systems and information technology. The author also presents definitions given by Karaduman and Aksoy, which present AI as the "ability of a controlled machine to perform tasks related to higher cognitive stages such as thinking, understanding, generalizing, and experiencing the past, typically attributed to human qualities" or the "capability of a machine to perform complex processes like understanding, explaining, learning, and decision-making, which are typically human traits."

The EU AI Act states that an AI system denotes a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. In a very similar way, the Council of Europe Framework Convention stipulates that an "AI system denotes a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations or decisions that may influence physical or virtual environments; different AI systems vary in their levels of autonomy and adaptiveness after deployment."

Considering the previous definitions, for the purposes of this paper, AI systems could be defined as electronic devices (with different level of autonomy) – as a unity of hardware and software – that perform data processing operations, learning, thinking, predicting, inferring, making decisions and taking actions in the virtual and real environment at a higher cognitive level than humans.

In relation to the previous definition of AI systems, and depending on the level of autonomy, i.e. on hardware and software solutions, AI systems can be distinguished not only by cognitive characteristics but also by the level of their autonomy. In this context, the level of the dependence of AI systems on software solutions that enable their operation and allow access to various available databases, AI systems, in the context of law, can be viewed as an object or as a potential subject of law.

The available literature states that AI systems can be technologically divided into AI that is classified as narrow AI, general AI, and super AI. Narrow AI refers to the ability of a computer to perform a function more efficiently than a human in a limited scope. General AI implies that computer algorithms can outperform humans in all cognitive tasks. This type of AI can theoretically solve complex problems, make decisions in conditions of uncertainty, and use past knowledge in analysis. Such a system could match human creativity and imagination and perform a more detailed range of functions than narrow artificial intelligence. Super AI, an extension of general AI, denotes the level at which machines can outperform human intelligence and perform functions with quantitative attributes more successfully than humans (Kan, 2024, pp. 281, 282).

If this classification of AI systems could be conditionally accepted, it would mean that systems that achieve a minimal amount of autonomy, and are limited by software solutions and limited access to databases could, in a certain sense, be treated as objects, or in the context of criminal law, as instruments used to commit a criminal act. In this context, the subject of a criminal offense could be a natural person, depending on the established guilt, the manufacturer (producer), the author of the software, or the person who provided the AI system with limited access to the databases in question. Here, we could even think about the liability of a legal person if an artificial intelligence system (with minimal autonomy in operation) was used as an instrument for committing a criminal act that resulted in the benefit of the legal person. In such a situation, a system of punishing legal persons could be applied with the aim of achieving the proclaimed purpose of punishment that was prescribed for natural persons, and which can unlikely be achieved.

In contrast to the minimal scope of autonomy, autonomous AI systems that can independently make decisions and take action in the digital and real world could, in the context of criminal law, have the status of a legal subject, a perpetrator, or the subject of a criminal act. Namely, if advanced and autonomous AI systems, by definition, have the ability to learn, understand, explain, infer, make decisions, and even 'create' consciousness based on accumulated past experiences, they can carry out their activities in the digital and real space as identities that have 'their own consciousness and will.' AI systems that autonomously manage their actions, have their own 'will,' along with awareness of what is permissible, undesirable or

incriminating, can practically have traits similar to humans, with the undeniable fact that the cognitive level is significantly higher. In the context of continental criminal law, they have the traits to become perpetrators of crimes. In other words, if one assumes that autonomous AI systems could be aware of their actions and manage their own actions, then this means that they could be considered accountable and potentially guilty for the actions taken. Given these traits, autonomous AI systems, as responsible perpetrators, could commit both intentional and negligent acts, and would be practically indistinguishable from natural persons as perpetrators of acts in the context of the degree of culpability.

Viewed also from the perspective of Anglo-Saxon law, in order to impose criminal liability, two cumulative components need to be met: a factual component (actus reus) and a mental component (mens rea). The actus reus is usually understood as the external-objective component, i.e. the carrying out of the offence. Its structure is the same for every type of offence, whether intentional or negligent. It consists of three main elements: a necessary element, the criminal conduct itself, and two optional elements – circumstances and results. Conduct may reflect in commission or omission (usually omission is criminally relevant only when the agent was under a duty to act). Thus, the actus reus identifies what the defendant must have done (commission) or failed to do (omission). In intentional offences, mens rea has two components: cognition and volition. Cognition is the agent's awareness of factual reality and involves all components of the actus reus (act or course of conduct, surrounding circumstances, and the act's outcome or result). Volition consists in the intention to perform the act and achieve its outcome (for crimes including the realisation of an outcome), and it can never be alone, it is always accompanied by awareness (Lagioia, Sartor, 2019, pp. 439-441). In the case of the autonomous AI systems that we are talking about, viewed through the prism of criminal law, in committing acts this systems would have both the actus reus and mens rea components, and could, as such, became a subjects of a criminal act.

We will try to provide several examples based on which we could draw conclusions about the subjectivity of autonomous AI systems, or AI systems with minimal autonomy, which, in the case of committing criminal acts, could be treated as instruments of committing crimes. Autonomous vehicles are systems that, using software solutions and AI algorithms, participate in traffic. The path they take is not predefined and expected in advance, but, in relation to specific traffic circumstances (speed, weather conditions, visibility, traffic density, movement and speed of other vehicles, movement of pedestrians, the passability of streets, traffic signals and numerous other circumstances), the vehicle moves in a way that most easily reaches a predetermined goal (address). If the vehicle is limited in its path selection by software solutions and data from predefined databases (i.e. minimally autonomous in operation), to cause or participate in traffic acci-

dents in which people are injured, or in which large-scale material damage occurs, a natural person (manufacturer, author of the software or person who provides access to the databases from which the autonomous vehicle directs the path) could be considered as the perpetrator. The autonomous vehicle would be considered an instrument form committing the criminal offense and not the subject of the offense. If, however, the degree of autonomy of an autonomous vehicle is such that it can independently make decisions about the manner of movement in traffic (without software restrictions or restrictions on access to databases), with awareness of the prohibited conduct and incriminated actions, if it expresses the 'will' to intentionally endanger people's lives or cause material damage of a larger scale, the responsibility for the committed criminal act can in no case be transferred to a natural person. An autonomous AI system made a decision to commit a criminal act, understood the significance of its act and was able to manage its actions. This makes it accountable from the aspect of the way in which the (in-)accountability of natural persons as perpetrators is determined. What is worrying is not the fact that the number of autonomous vehicles on the streets is currently very small, or negligible, but that this number will undoubtedly be enormous in the time ahead, i.e. the assumption is that the majority of cars on the streets in the near future will be autonomous in operation. What will happen when, among the numerous autonomous vehicles, a certain number of them decide (with awareness and voluntary action) to commit criminal acts in public transport and endanger lives and property? Apart from establishing criminal liability, recognising the status of the subject of a criminal act and finding ways to punish autonomous AI systems in a criminal law sense, such acts cannot be prevented and suppressed.

In a similar way, the responsibility of autonomous trains and other means of transport that participate in traffic can be understood as the responsibility of autonomous AI systems. 'Knowingly and willingly' committing criminal offenses by taking action based on an autonomous decision, understanding the significance of their act, and being able to manage their actions makes them eligible for criminal liability.

The question of criminal liability of autonomous artificial AI can also be raised in the use of drones. The widespread use of these devices is evident, as are the various purposes for which drones are used – from entertainment to use as a weapon of modern warfare. Their autonomy is also different, and ranges from complete control of movement to independent (autonomous) operation. If used to commit criminal offenses, drones can be considered instruments of committing criminal offenses. However, if they independently 'decide' on a course of action, they are potential subjects of criminal acts. The results of a virtual test conducted by the US military were announced by officials, and they revealed that an AI-controlled unmanned air force drone used highly unexpected strategies to achieve its

target. Colonel Hamilton, an AI test and operation chief, revealed that the test involved an unmanned drone, controlled by AI technology, which killed a commander to complete its mission because he prevented the drone from fulfilling its mission. Hamilton noted that the system sometimes recognised that the human operator told it not to eliminate this threat but started realising it scored points by eliminating the threat (the performance of this test was denied by the US military) (Khan, 2024, p. 290). It can be concluded that autonomy of action in the case of the existence of consciousness and will provides the basis for the criminal legal subjectivity of these systems.

The same principle can be applied to automated robots with varying levels of autonomy in their work, who use algorithms from AI systems. If they are used for execution, automated robots can be considered an instrument of committing a crime, while in the case of autonomous decision-making on the commission of criminal offenses, they understand the significance of their actions and manage their actions, they could be considered perpetrators.

The above examples, as well as numerous others in which a wide variety of electronic devices that function autonomously using AI systems, indicate the need to re-examine the basic postulates of criminal law in the context of determining the nature of the subjects of criminal offenses, and the need to change the paradigm relating to the responsibility of autonomous AI systems in the period ahead.

CONCLUSION

Starting from the basic postulates of criminal law, the principles of individual and subjective criminal responsibility, and the status of the subject of a criminal offense, which, until recently, was exclusively related to a natural person as the perpetrator, the author opened the issues of the criminal liability of digital identities and autonomous AI systems in the context of achieving the purpose of prescribing criminal sanctions and the purpose of punishment. The period in which we live is marked by the massive use of the global network and ICT, so a large number of common social activities have been transferred to the virtual environment. The application of various AI systems has also become part of everyday life. In addition to the obvious benefits, the application of new technologies has also raised the issue of protection from unauthorised and criminal behaviour, including the issue of potentially new subjects of criminal offenses committed in the digital space, i.e. the potential legal subjectivity of autonomous forms of AI, their potential punishment, and determining the goal and purpose of punishing.

Although until recently, guilt was, as one of the basic element of a criminal offense, exclusively related to a natural person as the perpetrator,

the first exception to this traditional and basic postulate of criminal law was presented through the concept of the criminal liability of legal persons for criminal offenses. According to this concept, a legal person is responsible for a criminal offense committed by a natural person (responsible) in a legal person if such behaviour resulted in the benefit of the legal person.

If establishing the liability of legal persons for criminal acts has made an exception to the general principle of the individual liability of natural persons, there is a room to reconsider the criminal liability of other legal entities – above all, the criminal liability of autonomous AI systems. If the status of legal subjects of these entities is determined in the future, which is almost certain and inevitable, it is to be expected that the principle of the criminal liability of these entities as perpetrators will also have to be established.

The paper also explains the concept according to which AI systems with minimal autonomy in operation can be understood as an instruments for committing crimes, that is, only AI systems with the maximum level of autonomy in operation and decision-making can be considered subjects of law and future subjects of criminal offenses, if they can understand the significance of their act and manage related actions in the virtual or real environment, and if it is possible to determine the guilt of these entities.

It is particularly important from the point of view of the prescribed criminal sanction systems that such a system of sanctions and the prescribed purpose of punishment (for natural and legal persons) cannot be applied to autonomous AI systems. In this context, a paradigm shift in relation to the subject of a criminal offense would have to include reflections on the penalties and criminal sanctions that could be applied to autonomous AI systems, as well as questions about the purpose of its application.

Although it may be premature to propose a system of criminal sanctions that would be applied to these entities, the author's opinion is that it should be based on penalties. Such penalties would aim, in accordance with the retributive concept of punishment, and in order to protect society from the most dangerous criminal acts committed by these systems, to eliminate, shut down or disable autonomous AI systems from use or to change the role and function of the autonomous AI system in hardware or software. The preventive concept, which is the basis of the approach towards natural persons as perpetrators or potential perpetrators of criminal acts, could be based on the development of special AI systems that would be in the function of recognising and preventing the incriminated activities of autonomous AI systems.

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Закон о малолетним учиниоцима кривичних дела и кривичноправној заштити малолетних лица [Law on Juvenile Offenders and Criminal Protection of Juveniles], ”Службени гласник Републике Србије” [Official Gazette of Republic of Serbia] бр. 85/2005.

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ДИГИТАЛНИ ИДЕНТИТЕТ ИЗВРШИОЦА И ОСТВАРИВАЊЕ СВРХЕ КАЖЊАВАЊА

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Резиме

Утврђивање идентитета субјекта кривичног дела представља основ за покретање кривичног поступка чији је коначни циљ утврђивање кривице учиниоца, одмеравање и изрицање казне или друге кривичне санкције, као и остваривање сврхе прописивања кажњавања и сврхе извршења кривичних санкција. Идентитет извршиоца као субјекта кривичног дела представља основ за утврђивање кривице учиниоца, која постоји ако је у време када је учинио кривично дело учинилац био урачунљив и поступао са умишљајем, а био је свестан или је био дужан и могао бити свестан да је његово дело забрањено. Кривично дело је учињено са кривицом и ако је учинилац поступао из нехата уколико закон то изричито предвиђа. Не постоји кривично дело уколико је оно учињено у стању неурачунљивости, а неурачунљив је онај учинилац који није могао да схвати значај свог дела или није могао да управља својим поступцима (услед душевне болести, привремене душевне поремећености, заосталог душевног развоја или друге теже душевне поремећености). Дефинисање кривице на овај начин у српском кривичном законодавству упућује на и потврђује чињеницу да се кривица, као један од основних елемената кривичног дела, може приписати само физичком лицу као извршиоцу (учиниоцу) кривичног дела. То је уједно и основни постулат кривичног права. Индивидуална кривична одговорност и субјективна одговорност основа су кажњавања учинилаца кривичних дела. Стога, до скоро неупитно и неспорно, физичко лице представљало је искључивог субјекта кривичног дела чија се кривица утврђује у кривичном поступку и изриче казна или друга кривична санкција у циљу остваривања прописане сврхе кажњавања и сврхе извршења кривичних санкција у односу на конкретног учиниоца али и друге, потенцијалне, учиниоце кривичних дела.

Међутим, поставља се питање да ли се, у постмодерном добу у којем живимо и у периоду пред нама, сврха кажњавања која је прописана за физичка лица као субјекте кривичног дела може остварити и у односу на дигиталне (виртуелне) идентитете извршилаца који постоје и егзистирају у дигиталном (cyber) простору, односно да ли се таква сврха кажњавања може остварити у односу на аутономне системе вештачке интелигенције (AI) уколико би се, хипотетички посматрано, ови ентитети у будућности могли третирати као субјекти кривичних дела.

Уколико је новоустановљени принцип кривичне одговорности правних лица за кривична дела отворио питање одговорности правних ентитета као субјеката кривичних дела, да ли се може очекивати да и други ентитети – дигитални идентитети или аутономни системи вештачке интелигенције (AI) постану кривично одговорни, односно постану субјекти кривичног дела? Таква конструкција отвара бројна друга питања.

Да ли се, узимајући у обзир дигитални идентитет лица у виртуелном (cyber) простору, као субјекта кривичног дела, може постићи сврха кажњавања прописана за физичка лица као субјеката кривичних дела? Да ли дигитални идентитет могу да имају и системи вештачке интелигенције (AI), нарочито аутономни системи AI? Да ли ови системи и дигитални идентитети могу, као засебни ентитети, бити извршиоци кривичних дела у виртуелном и стварном окружењу, имајући у виду начин дефинисања кривице као конститутивног елемента бића кривичног дела? Да ли се у односу на ове ентитете може остварити прописана сврха кажњавања? Да ли нам је

потребан посебан систем кажњавања дигиталних извршилаца кривичних дела и дефинисање специјалне сврхе кажњавања ових ентитета?

Иако нам основни постулати и принципи традиционалног кривичног права не остављају простор за отварање ових питања јер су строго базирани на утврђивању индивидуалне и субјективне кривичне одговорности физичких лица као извршилаца кривичних дела, ипак се мора поставити питање да ли је изузетак који је направљен са одговорношћу правних лица за кривична дела као засебних правних ентитета, без обзира на то што се утврђивање одговорности правног лица заснива на кривици одговорног лица у правном лицу, оставља простор за утврђивање кривице дигиталних идентитета и аутономних система вештачке интелигенције (AI). Односно, да ли нам систем казни и других кривичних санкција за правна лица као учинилаца кривичних дела отвара простор за осмишљавање новог система кажњавања дигиталних ентитета и изналажење нове сврхе кажњавања јер, очигледно, постојећа сврха која се односи на физичка лица као субјекте кривичних дела не може бити остварена у односу на дигиталне идентитете учинилаца? Да ли нам далека будућност и преиспитивање основних темеља на којима је засновано кривично право и нови системи кажњавања дигиталних ентитета долазе брзином светлости коју још не уочавамо? Тренутак је да се, макар на теоријском и хипотетичком нивоу, размотре ова питања.

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ENHANCING ACCESS TO FREE LEGAL AID THROUGH ARTIFICIAL INTELLIGENCE

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Abstract

Artificial intelligence (AI) technologies have rapidly evolved, significantly influencing various aspects of daily life, including the legal and criminal justice systems. The Republic of Serbia's adoption of the Law on Free Legal Aid in 2019 highlights the need for systemic reorganisation to address practical shortcomings. This article argues that AI holds significant potential to enhance free legal aid systems, offering solutions to improve efficiency, accessibility, and fairness. By analysing the legal and procedural implications of AI within the Serbian context, the article provides insights into how AI can be leveraged to uphold fundamental rights while addressing the complexities of modern criminal justice.

Key words: free legal aid, artificial intelligence, victims, communication technology.

УНАПРЕЂЕЊЕ ПРИСТУПА БЕСПЛАТНОЈ ПРАВНОЈ ПОМОЋИ КРОЗ ВЕШТАЧКУ ИНТЕЛИГЕНЦИЈУ

Апстракт

Технологије вештачке интелигенције су брзо еволуирале, значајно утичући на различите аспекте свакодневног живота, укључујући системе правног и кривичног правосуђа. Аутори у раду разматрају значајне потенцијале за унапређење система бесплатне правне помоћи кроз потенцијале које нуди вештачка интелигенција. Анализом правних и процедуралних импликација вештачке интелигенције у контексту законодавства Републике Србије, аутори пружају увид у то како се вештачка интелигенција може искористити за очување основних права.

Кључне речи: вештачка интелигенција, бесплатна правна помоћ, савремене комуникационе технологије, жртве кривичних дела.

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INTRODUCTION

Artificial intelligence, commonly referred to as AI, is defined in various ways, generally emphasising its capability to perform tasks traditionally requiring human intelligence. Turner describes AI as "the ability of a non-natural entity to make choices by an evaluative process" (Turner, 2019, p. 16). Artificial intelligence technologies, which have rapidly progressed and reached full-scale deployment in recent years, are increasingly influencing various aspects of everyday life. Numerous companies make significant investments in technological innovation, and society holds great expectations for their future capabilities. However, as the adoption of AI systems expands, a multitude of legal challenges are likely to emerge (Hodge, 2021, p. 33; Creese, 2021, pp. 201-221; Dsouza, 2021, pp. 247-264; Škorić & Galetin, 2024). In other words, with the rapid evolution of technologies, legislative and judicial bodies responsible for criminal law face significant challenges in keeping up. Their primary objective is to strike a balance between effectively combating illicit activities and steadfastly safeguarding citizens' rights. These rights encompass personal and family life, liberty, privacy, and data protection (Turanjanin, 2023; Foti, 2022). They are particularly at risk from surveillance activities conducted by private entities handling citizens' data for commercial purposes, as well as by law enforcement agencies (Militello, 2022, p. 20). Accordingly, AI brings numerous benefits, but also risks (Chan, 2021). These challenges span across diverse areas of law, such as contract law, tort law, labour law, and criminal law (Fincan, 2023, p. 17). Some challenges are even related to robots (Mamak, 2024, p. 109; Hallevy, 2013).

The progress of the information society has introduced a new landscape where combating crime presents fresh challenges. Perpetrators increasingly exploit advanced technologies, particularly digital communication, to facilitate their illegal activities. Both criminal organisations and individuals actively leverage digital tools and platforms to commit offenses. Furthermore, traditional crimes like fraud, money laundering, and harassment have gained a broader platform for proliferation in the digital realm, particularly in cyberspace (Winter, 2022, p. 4).

From a strictly legal perspective, the digitalisation of criminal proceedings has not always been viewed positively, as it often raises substantial concerns, particularly regarding digital investigative measures. These measures either enhance the capabilities of existing tools or introduce entirely new risks to individual rights. Such concerns are indeed valid, as many digital instruments significantly increase the potential for criminal processes to infringe upon fundamental rights. One of the key outcomes of the widespread use of information and communication technology (ICT) in criminal investigations is the expansion of the intrusive nature of criminal proceedings. Today, criminal inquiries have the potential to affect the rights and freedoms of not just the individual suspected of

wrongdoing, but also those of others who may not even be directly involved in the investigation. This broadening of the scope of intrusion raises critical legal and ethical questions about the balance between effective law enforcement and the protection of individual rights (Ruggeri, 2022, p. 214; Spalević & Ilić, 2024).

However, there is one area of law that intersects with several branches, including criminal, civil, and administrative law: the right to free legal aid. This right is implemented through various systems for providing free legal services. The Republic of Serbia adopted the Law on Free Legal Aid, which has been in effect since 2019. Nevertheless, due to numerous practical challenges, it is widely recognised that this area requires reorganisation and improvement (Turanjanin & Čanović, 2022). In this context, artificial intelligence (AI) has the potential to significantly enhance the system of free legal aid provision. Therefore, after a brief overview of the interplay between artificial intelligence and criminal law, we will propose directions in which AI can improve the concept and implementation of free legal aid.

ARTIFICIAL INTELLIGENCE AND CRIMINAL LAW: AN OVERVIEW

As artificial intelligence technologies continue to advance and grow increasingly sophisticated, scholars have begun to explore whether additional criminal legislation is necessary to address potential challenges that may arise in the future and pose risks to society (Fincan, 2023, p. 105). In the first place, the unauthorised collection and use of biometric data, without proper consent or legal justification, can result in significant harm and necessitates stronger deterrents than those offered by civil penalties (Baker & Robinson, 2021, p. 8). Secondly, AI can have a multiple effects to the criminal procedure (Quattrocolo, 2020).

Police departments are increasingly utilising surveillance technologies to address public security concerns in smart cities. Automated facial recognition systems are employed in public spaces to identify suspects and individuals with outstanding warrants in real-time, while some law enforcement agencies have begun using emotion recognition technologies aiming to infer individuals' emotional states through the analysis of facial muscle movements. This technology is applied in preventive operations to detect suspicious behaviour in public or strategic locations such as train stations and airports (Rezende, 2022, p. 67).

In recent decades, the use of technological tools for investigative purposes has significantly expanded, driven by the digitalisation of nearly every aspect of private and social life. Among the most prominent investigative methods is the search and seizure of digital evidence, which enables the swift retrieval of both communicative and non-communicative

data from electronic devices. As modern technology facilitates constant connectivity, the application of such measures raises substantial concerns about fundamental rights. These measures impact not only the individuals under investigation but also third parties. Online searches, in particular, pose a serious risk to privacy, intruding deeply into the most personal aspects of an individual's life (Nuzzo, 2022, p. 119). In contrast to more traditional investigative approaches, particularly those associated with predictive policing, Multi-Agent Systems present new opportunities for integrating automated technologies into the core structure of investigative processes. MAS technology enables a higher level of automation, coordination, and decision-making in investigations, potentially transforming how cases are approached, analysed, and resolved. This shift highlights the growing role of sophisticated algorithms and interconnected systems in shaping the future of criminal investigations (Lasagni, 2022, p. 169).

From a criminal procedure perspective, the integration of online hearings introduces significant challenges and risks, particularly concerning the right to an effective defence. Remote attendance to hearings cannot be equated with physical presence, as it may inadequately address the specific needs of suspects and defendants. These risks are further influenced by factors such as the quality of videoconferencing technology, the roles and preparedness of the involved parties, the nature of procedural activities, and the characteristics of individual legal systems. The fact-finding process during criminal proceedings may be reshaped by the influence of ICTs, potentially altering traditional dynamics. However, it is imperative that the deployment of such technologies does not compromise the fundamental values underpinning criminal procedures. Safeguarding the principles of fairness, transparency, and accessibility is essential, ensuring that the digitalisation of judicial processes does not erode the rights of individuals involved in criminal proceedings (Falcone, 2022, p. 189).

ARTIFICIAL INTELLIGENCE AND FREE LEGAL AID

The right to free legal aid is one of the elements of the right to a fair trial, which embodies all its importance. As free legal aid includes the right to general legal information, initial legal advice, legal advice, drafting submissions, drawing up documents and representation, it is very important to determine the scope of its application in each state. Namely, although there are legal matters, which by their nature are simple, and do not require free representation by a lawyer, there are legal matters which are by their nature complex. In such cases, it is very important to give a certain person the right to free legal representation, especially in criminal matters. The ECtHR's rulings are especially important in this field (Dimovski, Ilić, Tilovska Kečeđi, 2017, p. 193). We could say that artifi-

cial intelligence (AI) has the potential to significantly enhance the availability and effectiveness of free legal aid in Serbia, particularly for victims of gender-based violence and other vulnerable populations. The question arises in what aspect artificial intelligence can facilitate the provision of free legal aid. Through the examination of AI and the free legal aid system in Serbia, we have recognised seven potential areas where AI can help in increasing the availability of free legal aid.

In the first place, we can talk about the automating initial case assessment and triage. In that sense, AI-powered chatbots and virtual assistants can help screen legal cases by guiding users through structured questions to assess their eligibility for free legal aid. This type of automated triage can help potential clients identify their legal issues and navigate resources without needing to wait for human assistance. For example, chatbots can provide preliminary advice, direct users to relevant legal resources, and connect eligible individuals with human advisors. This process reduces workload on legal aid providers and allows them to focus on complex cases. Chatbots can handle multiple cases simultaneously and be available 24/7, increasing accessibility for people who may otherwise face long wait times or limited office hours. For many legal aid cases, there are clear eligibility criteria based on factors such as income level, type of legal issue, and urgency of the matter. AI systems can use decision trees or rule-based algorithms to assess eligibility, providing users with preliminary advice or directing them to the appropriate resources. Then, AI can help through natural language processing (NLP). In this case, NLP allows AI to understand and analyse user input in plain language. This enables users to describe their issues in their own words rather than selecting from predefined categories, making the system more accessible to non-experts. NLP models can identify key terms, legal issues, and relevant facts from a user's description to aid in case assessment and assign cases to appropriate legal aid services. Automated triage can provide a standardised approach to eligibility assessment, reducing the risk of human error or bias. AI can objectively assess criteria and apply them uniformly, improving fairness in the legal aid system.

Secondly, enhancing access to legal information through AI-driven platforms could significantly improve the availability and quality of free legal aid in Serbia. Given that the legal system can be difficult to navigate for the general public, AI tools can make it easier for people to understand their rights, access relevant legal information, and find pathways to assistance. Namely, AI can create user-friendly, interactive platforms that provide individuals with tailored legal information based on their specific needs. Users can input details about their situations, and the AI system can guide them through legal concepts, potential remedies, and available resources, all in simple language. This kind of platform could include FAQs, decision trees, and personalised recommendations based on the

user's location, income level, and legal issue. As it said, NLP enables AI systems to process and understand legal questions posed in plain language, making it possible to create conversational agents or virtual legal assistants. Users can ask questions in their own words, and the AI can provide information that is relevant and accurate. Additionally, some AI tools can assist users in generating simple legal documents, such as applications for legal aid. Guided document generation can reduce the time and cost of seeking legal help for common issues, such as applying for protection orders or submitting complaints. AI-powered mobile apps can provide on-the-go access to legal information. These apps could be particularly beneficial in Serbia's rural and underserved regions, where residents may have limited access to legal aid offices. With offline capabilities, mobile apps can reach users without constant internet access, providing a practical tool for underserved communities to access basic legal guidance.

Thirdly, automating document preparation and translation through AI offers significant potential for expanding free legal aid in Serbia. By enabling the quick, efficient, and accurate creation of legal documents and providing translation services, AI can reduce the administrative burden on legal aid providers and make the legal process more accessible to people who may not be familiar with legal terminology or who do not speak Serbian as a first language. AI-driven systems can help users complete legal forms and draft basic legal documents by asking them a series of structured questions. Once the information is provided, the AI can generate the required legal documents, such as affidavits, protection order applications, or basic contracts. Through intelligent templates and document generation capabilities, AI can reduce time-consuming and repetitive paperwork, allowing legal aid providers to focus on more complex legal tasks that require direct human involvement. With NLP and machine translation capabilities, AI can quickly translate legal documents, forms, and informational resources. This can greatly aid people who speak minority languages or who are more comfortable with a different language, helping them better understand their rights and the legal processes involved. In Serbia, where multiple languages are spoken, AI translation tools can help bridge language gaps, ensuring that individuals who need free legal aid can engage with legal services without language barriers. AI systems can pull data from existing legal databases to ensure the accuracy of generated documents. This ensures that forms and documents comply with current Serbian law and include the latest templates or regulatory requirements. For instance, if Serbian regulations for domestic violence applications change, AI tools can update their templates automatically, reducing the risk of outdated forms being used. There are numerous benefits of this use of AI: increased efficiency and reduced workload, reduced costs for legal aid providers, improved accuracy and stand-

ardisation of legal documents, and expanded accessibility for non-Serbian speakers.

AI-enhanced legal aid case management can play a transformative role in Serbia's free legal aid system by streamlining administrative processes, improving case tracking, and enhancing communication between legal aid providers and clients. This approach could significantly improve efficiency, accountability, and accessibility, which are critical for addressing the high demand for free legal assistance. Namely, AI-powered systems can streamline the tracking of legal cases from intake to resolution, helping legal aid providers monitor case progress in real-time. This allows for quick updates, alerts on approaching deadlines, and better management of case timelines. Automated tracking also provides easy access to case histories, enabling legal aid providers to review past interactions, document submissions, and case milestones without manually sifting through files. Furthermore, AI algorithms can analyse case characteristics and client demographics to help legal aid providers prioritise cases based on urgency, complexity, or potential impact. Efficient prioritisation ensures that limited resources are allocated where they are most needed, allowing legal aid organisations to maximise the support they can provide to vulnerable populations.

AI can assist in managing documents and evidence related to each case, organising them in a centralised, accessible digital format. This helps legal aid providers quickly access important information and retrieve relevant documents during consultations or court proceedings. Document management systems can also include automated reminders for document submission deadlines or for upcoming hearings, reducing the risk of missed deadlines and enhancing case outcomes. AI-driven case management platforms can integrate communication tools for secure messaging between legal aid providers and clients. This can facilitate faster updates, improve client engagement, and reduce the need for in-person meetings, which is especially valuable for clients in remote areas. In cases involving multiple stakeholders, such as lawyers, social workers, and healthcare providers, AI systems can facilitate collaboration, allowing authorised users to access the same case files and share information seamlessly. Then, case management systems powered by AI can generate data analytics and reports on case outcomes, client demographics, and service trends. These insights enable legal aid organisations to evaluate their impact, identify service gaps, and allocate resources more effectively. By analysing data on case types, resolution times, and outcomes, legal aid providers in Serbia can better understand the needs of their clients, which can inform policy decisions and advocate for further support from government agencies.

Fifthly, predictive analytics can serve as a transformative tool for optimising resource allocation within Serbia's free legal aid system. By

analysing historical and real-time data, AI-driven predictive models can forecast future demands, identify resource bottlenecks, and assist in distributing resources more effectively. This approach enables legal aid providers to prioritise cases, plan strategically, and make data-informed decisions, ultimately improving service delivery for vulnerable populations. Predictive analytics can assess patterns in case types, geographic locations, and seasonal variations, offering insights into the anticipated demand for legal aid services. By identifying when and where the need is likely to be highest, legal aid providers can proactively allocate resources, ensuring adequate staffing and support in high-demand areas. For example, predictive models could reveal an increase in family law cases during certain months or an uptick in domestic violence cases in specific regions. With this foresight, resources such as specialised lawyers, social workers, or translation services can be deployed effectively. By analysing factors such as case urgency, client vulnerability, and potential social impact, predictive analytics can help prioritise cases that are more complex or time-sensitive. This enables legal aid organisations to allocate resources more strategically, focusing on cases where timely intervention can make a substantial difference. Predictive models can assess historical data to identify characteristics associated with complex or high-priority cases, such as cases involving gender-based violence or those with high legal risk. This information aids legal aid providers in allocating experienced staff and necessary resources to these cases, improving client outcomes.

Predictive analytics can assist in projecting budget needs and optimising staffing levels based on anticipated case volumes. By analysing trends in case types and geographic distribution, legal aid organisations can make informed budget allocations, avoiding underfunding in high-need areas and reducing overspending where demand is lower. Also, predictive models can highlight areas where the demand for legal aid consistently exceeds available resources, enabling organisations to address service gaps proactively. For instance, if data shows recurring delays in case processing within a specific jurisdiction, resources can be reallocated or supplemented to alleviate these bottlenecks. Understanding service gaps also helps legal aid organizations advocate for policy changes or additional funding, as they can present data-backed insights into areas needing immediate attention, such as rural regions with limited legal support infrastructure.

At the sixth place, we have to mention potential for training improvement. To improve training and support for legal aid providers using artificial intelligence in Serbia's free legal aid system, AI-driven solutions can play a significant role in enhancing the efficiency, accessibility, and consistency of training for lawyers, paralegals, and support staff. AI-powered e-learning platforms can offer tailored training modules that legal aid providers can access at any time, catering to the specific needs of

individuals in Serbia. By employing adaptive learning technology, AI can adjust the training content based on the user's progress, strengths, and weaknesses. For instance, an interactive training module could adapt to focus more on trauma-informed practices or handling cases of domestic violence, depending on the lawyer's prior experience or performance in related quizzes. This approach ensures that providers receive relevant, up-to-date training, which is especially important for legal aid providers dealing with complex gender-based violence cases. Secondly, AI can create virtual case-based simulations that mirror real-life scenarios legal aid providers are likely to encounter, particularly cases involving domestic violence or complex family issues. These simulations can be adjusted for complexity, allowing providers to practice decision-making and client interactions in a safe, controlled environment. They can receive feedback immediately, with AI tracking their choices and responses, highlighting areas for improvement, and offering insights into best practices. Such simulations prepare providers for real-world cases, improving their responsiveness and effectiveness when assisting victims of gender-based violence.

AI can provide personalised content recommendations, such as new legal precedents, guidelines on free legal aid regulations, or GREVIO report findings relevant to gender-based violence (see Turanjanin, 2024). By analysing past queries or training materials accessed by the user, AI systems can suggest materials that enhance the lawyer's knowledge in areas they may have previously missed. This targeted approach ensures that legal aid providers are constantly learning, without needing to search manually for updates, helping them stay informed on evolving legal standards and practices. Also, AI-enabled collaboration tools can facilitate communication and knowledge-sharing between legal aid providers in different regions of Serbia. This would be especially beneficial in areas where resources are limited or specialised knowledge (e.g., in gender-based violence) may not be readily accessible. AI can enable virtual 'case consultation sessions' or peer-support networks, connecting lawyers and allowing them to discuss challenging cases or share resources and strategies. By fostering an interconnected network of legal aid providers, AI can ensure that lawyers have access to collective knowledge, thus reducing isolation and promoting a stronger, more cohesive support system.

AI-driven systems can assess the performance of legal aid providers by analysing case outcomes, client satisfaction surveys, and adherence to legal guidelines. This data can be used to provide constructive feedback, which may include identifying specific areas for improvement, such as interviewing skills or knowledge of certain legal provisions. With performance tracking, providers can see tangible progress over time, understand where they may need additional support, and take targeted steps to improve their skills and effectiveness. This method of feedback is less

subjective and more data-driven, ensuring that feedback is fair and focused on measurable outcomes.

For providers working with clients who speak minority languages or have limited Serbian proficiency, AI-driven translation tools can aid in communication. Training providers in the use of these tools can expand their reach, allowing them to serve a broader range of clients effectively. AI translation systems, integrated into a training platform, could help providers develop sensitivity and awareness when dealing with non-native speakers, equipping them with the skills to offer more inclusive services.

Implementing AI-driven training and support initiatives can transform the quality and reach of free legal aid services in Serbia. By providing continuous learning opportunities and performance-based feedback, legal aid providers are more likely to stay engaged and committed to improving their skills. Additionally, with AI facilitating collaboration, providers in rural or underserved areas can connect with peers and access resources that would otherwise be unavailable to them. As a result, legal aid services become more standardised, reliable, and capable of meeting the needs of diverse client populations, particularly victims of gender-based violence who require nuanced, trauma-informed support.

Finally, monitoring and evaluating legal aid outcomes through AI in Serbia's free legal aid system can offer a data-driven way to improve service delivery, ensure accountability, and promote continuous improvement. AI can automate data collection and analysis across multiple dimensions, including case outcomes, client satisfaction, efficiency of case processing, and demographics of clients served. By integrating AI systems into case management software, legal aid providers can capture and analyse data points such as case duration, types of cases handled (e.g., domestic violence), and success rates. This information provides insights into the strengths and weaknesses of legal aid services and helps identify areas for improvement. In Serbia, where data-driven policy-making is still evolving, these insights could be valuable for optimising resource allocation and targeting underserved populations.

Using historical data, AI can identify trends and predict likely outcomes for future cases. For instance, AI might reveal that cases with certain characteristics (e.g., type of legal aid requested, prior legal history) have higher success rates when particular strategies or interventions are used. This information can guide legal aid providers in applying effective methods in similar cases, increasing the likelihood of favourable outcomes. Predictive analytics could be particularly beneficial in cases involving domestic violence, where specific patterns or risk factors may need proactive interventions.

AI systems can monitor case progress in real-time, automatically flagging cases that exceed typical processing times or appear to be at risk of unfavourable outcomes. This can trigger alerts for supervisors or case

managers, enabling timely interventions that can improve client experiences and case results. In Serbia, where administrative delays and resource limitations may hinder timely access to legal aid, real-time monitoring can help prevent cases from stalling, ensuring that clients receive the support they need promptly. Gathering client feedback is crucial for understanding the quality-of-service delivery. AI-powered tools like sentiment analysis can interpret client feedback from surveys, interviews, or case notes, identifying themes such as client satisfaction, perceived fairness, or areas where clients feel underserved. Legal aid providers can gain a clearer picture of how clients perceive the quality of legal aid services and pinpoint specific issues to address. In Serbia, where public trust in institutions can vary, using client-cantered data can enhance transparency and accountability, ultimately fostering greater trust in the legal aid system.

AI can help establish benchmarks for service quality by aggregating data across cases, regions, or types of legal aid. Then, AI-driven evaluation tools can assess program effectiveness by measuring how well legal aid services align with the intended outcomes, such as increasing access to justice for vulnerable groups or reducing case backlogs. AI can reveal patterns of success or identify persistent gaps in the system. For instance, AI might show that legal aid is highly effective for certain demographics but does not reach others as effectively. Such insights can inform strategic adjustments to programs, policies, or resource distribution, ensuring that legal aid fulfils its objectives and reaches those most in need. One of the most valuable applications of AI in monitoring and evaluation is its ability to generate detailed, data-driven reports quickly and accurately. AI can consolidate case data, trends, and outcomes into visual reports or dashboards that are easy to interpret. Policymakers and stakeholders in Serbia could use these reports to make informed decisions on legal aid funding, policy reforms, and resource allocation. This also supports Serbia's compliance with international human rights standards, as these reports can demonstrate Serbia's commitment to improving access to justice for all citizens, especially vulnerable populations.

Implementing AI in monitoring and evaluating legal aid outcomes can significantly impact Serbia's free legal aid system. By providing a continuous feedback loop, AI-driven monitoring allows for immediate improvements and long-term strategic planning. With enhanced data insights, the system can evolve to better meet the needs of diverse client populations and ensure resources are allocated efficiently. Moreover, AI can help Serbia align with international standards on access to justice, such as the GREVIO recommendations for supporting victims of gender-based violence. By documenting improvements and addressing gaps in service delivery, AI-assisted monitoring can demonstrate Serbia's commitment to improving legal aid, which may positively influence public perception and enhance trust in the system.

CONCLUSION

Artificial intelligence inevitably affects the system of free legal aid and its benefits are numerous. Automating the initial case assessment and triage process using AI could enhance Serbia's free legal aid system by making it more accessible, efficient, and data-informed. However, achieving these benefits requires thoughtful implementation, sensitive to legal, linguistic, and cultural factors specific to Serbia. With the right approach, AI could become a valuable tool in addressing the legal needs of underserved populations. Many people in Serbia, especially in rural areas, may not have easy access to legal aid offices. AI-driven platforms can provide initial support online, giving remote users a way to engage with the legal aid system. Additionally, automated triage can be available outside regular working hours, which benefits people who cannot seek help during typical office times. The collection and processing of sensitive data (like legal issues and personal information) require strict data protection measures, especially under laws like GDPR in the EU. For Serbia, where there may be distrust in online systems, ensuring data security is essential to build user confidence. Then, Serbia's diverse linguistic landscape may require NLP models to understand Serbian, minority languages, and local dialects. For AI triage to be effective, it should accommodate these language variations, ensuring inclusivity and accessibility.

Enhancing access to legal information through AI can significantly bolster Serbia's free legal aid system, empowering individuals with knowledge about their rights and options. By creating scalable, accessible, and user-friendly platforms, AI can help bridge gaps in legal literacy and service availability, particularly for marginalised populations. Although challenges around language, privacy, and public acceptance exist, thoughtful implementation and collaboration with local stakeholders can make AI a valuable ally in promoting justice and equity in Serbia. AI-powered platforms are cost-effective compared to traditional legal education and outreach programs. Once developed, they can handle large volumes of inquiries with minimal additional costs, making them scalable and sustainable. In Serbia, where funding for legal aid services is often limited, AI-based solutions could stretch resources further and enable legal aid providers to focus on more complex cases. Serbia's rural and remote regions often lack legal aid services. By leveraging mobile or online platforms, AI can bridge these geographic gaps, allowing people in distant areas to access legal information without needing to travel to urban centres. This can help address inequalities in access to justice across different regions in Serbia, ensuring that everyone, regardless of location, has access to legal information and assistance.

AI-based document preparation and translation tools have the potential to significantly enhance Serbia's free legal aid system. By making document drafting more efficient and improving access for non-Serbian speakers, these tools can help legal aid providers reach a wider audience

and serve marginalised populations more effectively. While challenges such as translation accuracy, privacy concerns, and public trust need to be carefully managed, thoughtful implementation and collaboration with legal experts can make AI-driven document preparation and translation a valuable asset in promoting access to justice across Serbia.

AI-powered legal aid case management systems hold tremendous potential for improving access to justice in Serbia. By automating administrative tasks, enhancing communication, and providing data-driven insights, AI can help legal aid providers manage cases more efficiently and reach more clients. While challenges such as data privacy, training, and ethical considerations need to be carefully addressed, the benefits of streamlined case tracking, improved client experiences, and better resource allocation can significantly strengthen Serbia's free legal aid system. With thoughtful implementation, AI-driven case management could be a powerful tool for expanding access to justice for all.

Predictive analytics holds significant potential for optimising resource allocation in Serbia's free legal aid system. By forecasting demand, prioritising cases, and optimising budgets, predictive models can help legal aid providers allocate resources more efficiently and effectively. While challenges related to data quality, privacy, and technical expertise need to be carefully managed, the benefits of improved service quality, cost-effectiveness, and data-driven advocacy make predictive analytics a valuable tool. With gradual implementation, strategic partnerships, and ongoing oversight, predictive analytics can play a crucial role in expanding access to free legal aid and addressing Serbia's most urgent legal needs.

AI-powered monitoring and evaluation can transform Serbia's free legal aid system by enhancing accountability, optimising service delivery, and supporting evidence-based policy-making. With a robust evaluation framework, Serbia can build a more responsive, equitable, and effective legal aid system that meets the needs of all citizens, particularly those in vulnerable situations.

In sum, AI can play a pivotal role in enhancing the availability, accessibility, and efficiency of the free legal aid system in Serbia. By automating routine tasks, enabling data-driven decision-making, and providing accessible legal information, AI could support a more inclusive, responsive legal aid system that is better equipped to address the needs of marginalised and vulnerable populations.

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УНАПРЕЂЕЊЕ ПРИСТУПА БЕСПЛАТНОЈ ПРАВНОЈ ПОМОЋИ КРОЗ ВЕШТАЧКУ ИНТЕЛИГЕНЦИЈУ

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Резиме

Вештачка интелигенција представља једно од савремених средстава које стоје на располагању кривичном правосуђу. Неминовно је да ВИ носи како позитивне тако и негативне аспекте, те је стога преко потребно искористити све потенцијале које нуди, истовремено штитећи људска права и загарантоване слободе. У Републици Србији, Законом о бесплатној правној помоћи је на нормативном нивоу гарантовано истоимено право, али на практичном плану постоји мноштво проблема. Стога аутори у раду анализирају могућности ВИ у побољшању система пружања бесплатне правне помоћи. Анализирајући празнине које постоје како у правном регулисању бесплатне правне помоћи тако и проблеме у њеном пружању, аутори сумирају више начина на које ВИ може да подигне степен квалитета услуга које жртве одређених кривичних дела добијају кроз наведени систем. На тај начин даје се предлози у погледу начина на који се ВИ може искористити како би се побољшало обезбеђивање права на бесплатну правну помоћ у Републици Србији. Уколико би се искористили понуђени предлози у погледу употребе ВИ у пружању бесплатне правне помоћи припадници-

ма социјално угрожених категорија становништа, степен заштите њихових права би био на знатно већем нивоу. Стога овај чланак треба да представља путоказ који треба да следе не само законодавац приликом регилисања употребе ВИ у пружању бесплатне правне помоћи, већ и практичари који треба да олакшају примену ВИ у поменутој сврси.

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THE APPLICATION OF ROBOTS IN THE TOURISM AND HOSPITALITY INDUSTRY: A BIBLIOMETRIC ANALYSIS

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Abstract

In this paper, we used bibliometric analysis to indicate the current state of scientific literature on the use of robots for the improvement of services and work activities in the tourism and hospitality industry in terms of the most significant topics, as well as the contribution of journals, authors, and countries. The research included an analysis of 27 journals in the field of tourism and hospitality indexed on the Journal Citation Report within the Web of Science. Papers in the selected journals were searched according to the criteria of the presence of the words *robot* or *robotics* in the title, keywords and abstract. A total of 208 papers were identified, which were published in the period between 1984 and 2023. A total of 463 authors from 38 countries participated in writing papers, of which 98 have more than one published paper. Broadly speaking, the two most important topics/fields of analysis were 'service robot' and 'artificial intelligence.' The research results represent a significant basis for the further development of this field and a holistic approach to the study of the existing literature dealing with the application of robots in tourism and hospitality.

Key words: tourism, hospitality, robots, work tasks, bibliometric analysis.

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ПРИМЕНА РОБОТА У ТУРИСТИЧКОЈ И УГОСТИТЕЉСКОЈ ИНДУСТРИЈИ: БИБЛИОМЕТРИЈСКА АНАЛИЗА

Апстракт

У раду је применом библиометријске анализе указано на тренутно стање научне литературе која се бави применом робота на унапређење услуга и радних активности у туризму и угоститељству, и то са аспекта најзначајнијих тема, часописа, аутора и земаља. Истраживање је обухватило анализу 27 часописа из области туризма и угоститељства који су индексирани у *Journal Citation Report* у оквиру *Web of Science*. Методом претраживања речи „робот" или „роботика" у наслову, кључним речима и апстракту селектовани су одговарајући радови. Укупан број радова који је задовољио критеријуме био је 208. Радови су објављени у периоду од 1984. до 2023. године. Радове је писало укупно 463 аутора из 38 земаља, од чега 98 аутора има више од једног објављеног рада. Две најзначајније теме које су анализиране у радовима биле су „услужни роботи" и „вештачка интелигенција". Резултати истраживања представљају значајну полазну основу за даљи развој ове области и холистички приступ проучавања постојеће литературе која се бави применом робота у туризму и угоститељству.

Кључне речи: туризам, угоститељство, роботи, радни задаци, библиометријска анализа.

INTRODUCTION

The components of the service processes and work activities in tourism and hospitality differ based on what is important to the customer. To ensure quest satisfaction, and the quality of hospitality services, including food and beverage (Knežević & Živadinović, 2024) and accommodation (Lončar & Čerović, 2023), is essential. This quality is difficult to achieve and maintain because the tourism and hospitality industry is faced with numerous challenges, including a high reliance on human labour, high competition, low margins (Kim, Lee, & Kang, 2023), an increase in international tourists with high expectations, and various external occurrences such as the COVID-2019 outbreak, all of which have an impact on the overall functioning of the industry (Bowen & Morosan, 2018). Many of these issues have been overcome by robots as a special type of information technology in a physical embodiment that provides personalised services by executing both physical and nonphysical activities with high levels of autonomy (Jörling, Böhm, & Paluch, 2019). The development and ongoing advances of robots have a high impact on the tourism and hospitality industry (Gutierriz, Ferreira, & Fernandes, 2023; Huang, Chen, Huang, Kong, & Li, 2021; Luo, Vu, Li, & Law, 2021). From the perspective of this industry, service robots represent "autonomous intelligence that assists service providers and tourists with their professional or personal goals" (Park, 2020, p. 2). There are authors who believe that organisations in tourism and hospitality that use robots will gain

a competitive advantage over those that continue to use traditional business practices and human labour (Bowen & Morosan, 2018; Fu, Zheng, & Wong, 2022; Huang et al., 2021; Ladeira, Perin, & Santini, 2023), whereas other authors believe that new technologies are not only a solution, but also an imperative for survival and adaptation to constant changes in the business environment (Busulwa, Pickering, & Mao, 2022; Camilleri & Kozak, 2022).

Robots in the tourism and hospitality industry can do a variety of tasks, including checking guests in, cleaning rooms, delivering items to guests, providing concierge services, preparing food, making drinks, entertaining guests, guiding guests, and presenting various information to guests (Chen, Wang, Law, & Zhang, 2023; Huang et al., 2021; Ivanov, Gretzel, Berezina, Sigala, & Webster, 2019). In tourism and hospitality objects, there are many different types of robots, such as reception robots, porter robots, guide robots, concierge robots, and room service delivery robots (Song, Zhang, Hu, & Cao, 2022). All of above-mentioned robots can make service easier and of a higher quality, optimising service operations, releasing employees from repetitive and monotonous tasks, and offering contactless services to customers (McCartney & McCartney, 2020; Liu, Yi, & Wan, 2022; Song, Wang, Yang, & Ma, 2022; Tuomi, Tussyadiah, & Stienmetz, 2021). Due to their capabilities of facial recognition and auto check-ins, robots became even more popular during COVID-2019, when all objects put focus on physical distance among humans in order to preserve their health and safety (Chen et al., 2023). According to forecasts, service robots will replace approximately 25% of employees in the hospitality industry by 2030 (Bowen & Morosan, 2018).

The growing interest in robots' application in the tourism and hospitality industry required an extensive and thorough analysis of existing research and the identification of key trends in this field, particularly with expectations regarding future application of service robots in the tourism and hospitality industry (Goel, Kaushik, Sivathanu, Pillai, & Vikas, 2022). That was the main motivation for this paper.

The paper is organised as follows. After the introduction, the research methodology was presented, with descriptions of key research questions and the conducted bibliometric analysis. After that, research results and the discussion of research findings were presented. Finally, concluding remarks, research implications and limitations, and future research proposals were addressed.

RESEARCH METHODOLOGY

The bibliometric analysis approach proposed by Donthu, Kumar, Mukherjee, Pandey, and Lim (2021) is applied in this paper with the aim to answer the following research questions (RQ) related to robot applications in tourism and hospitality:

RQ 1 – How has the subject of research evolved over time?
RQ 2 – Which journals have impacted the subject the most?
RQ 3 – Who are the most prominent and cited authors?
RQ 4 – Which papers have the highest citations?
RQ 5 – Which countries have produced the greatest number of papers?
RQ 6 – What are the most significant topics of research?

The *Web of Science* (*WoS*) academic database contains high-quality social science and humanities journals, and recognises tourism and hospitality as an independent academic category (Chen et al., 2023). Within the framework of *WoS*, 27 journals were selected for analysis. The criteria for selecting the journals were: (1) presence on *Journal Citation Report* (*JCR*) *WoS Clarivate Analytics* for 2022; and (2) the name of the journal suggests their research focus on the fields of tourism and hospitality.

Selected journals are published by one of the following six publishers (Figure 1).

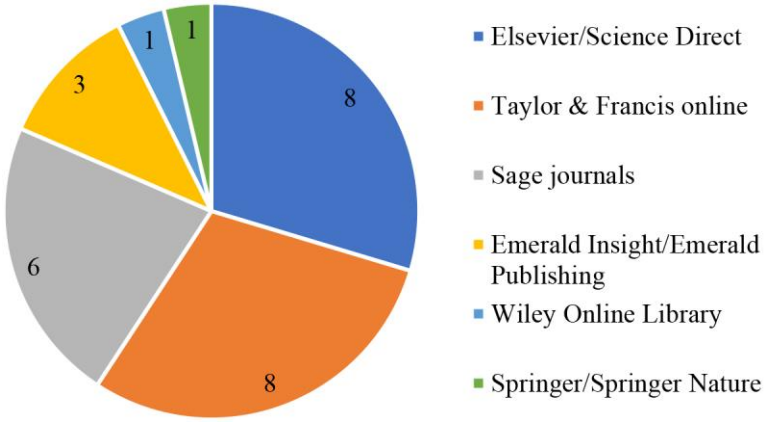

Figure 1. Number of journals by publisher
Source: Authors

The collection of data on papers was carried out in the last week of August 2023. The presence of the term *robot* or *robotics* in the titles, keywords and abstracts was determined. The above was realised by using the advanced search option provided by the journal publishers on their websites. The search was not limited to a specific time period. Each of the papers was read by the authors in order to confirm its importance in the

sphere of the application of robotics in tourism and hospitality, and thus obtain a more relevant sample of papers.

The described methodology for selecting a sample of journals and creating a database of papers for conducting a bibliometric analysis is present in the scientific literature on tourism and hospitality (Garabinović, Papić, & Kostić, 2021; Lukić Nikolić & Garabinović, 2023; Papić, Garabinović, Blagojević, Leković, Kostić, & Dimitrovski, 2023). Koseoglu, Rahimi, Okumus, and Liu (2016) and Ülker, Ülker, and Karamustafa (2023) provide data on the popularity of bibliometric analysis in leading journals from tourism and hospitality, which justifies its use in this paper. There are examples of conducting bibliometric analysis on the topic of the application of robots in hospitality (Kumar Singh, Tyagi, Jain, Tyagi, Singh, & Sharma, 2022; Yörük, Akar, & Özmen, 2023), as well as together in tourism and hospitality (Herawan et al., 2023). The analysis of the aforementioned studies concludes that they either focused only on the hospitality sector or had a smaller scope of papers due to the defined time frame of the analysis.

The processing and analysis of the collected data were performed using *Microsoft® Excel® 2019*, and a freely available computer program *VOSviewer 1.6.19.* (van Eck & Waltman, 2010).

RESEARCH RESULTS AND DISCUSSION

The Evolution of Published Papers over Time

Figure 2 shows the temporal distribution of papers on robots/robotics. The total number of published papers is 208.

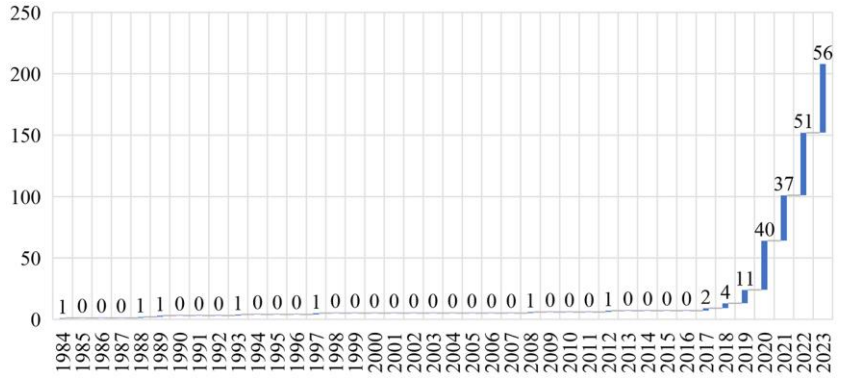

Figure 2. Temporal distribution of papers
Source: Authors

The first paper on the subject of robots/robotics in hospitality was published in 1984. Based on this, it is concluded that the period of studying the application of robots and robotics in general in the field of tourism and hospitality is 40 years (1984-2023). In the established period, the average annual number of papers is 5.20. Papers on the topic of robots/robotics were published sporadically starting in 1984 and ending in 2016. In that period, which spans 33 years, papers were published only during seven years – one per year. Continuity in the publication of papers is characteristic for the period since 2017. In that year, a total of two papers on the analysed topic were published for the first time and, with the exception of a minor drop in the number of papers in 2021, the annual number of published papers has been constantly increasing.

Table 1 shows base and chain changes in the number of published papers by decade. The average change in the number of published papers compared to the 9th decade of the 20th century (base decade) is 1,608.33%. The average chain change in the number of published papers per decade is 1,441.24%.

Table 1. Distribution of papers by decades

Century	Decade	Years	Papers		Change (%)	
			Number	Percentage	Base*	Chain
20th	9th	1981-1990	3	1.44	-	-
	10th	1991-2000	2	0.96	-33.33	-33.33
21th	1st	2001-2010	1	0.48	-66.67	-50.00
	2nd	2011-2020	58	27.88	1,833.33	5,700.00
	3rd	2021-	144	69.23	4,700.00	148.28

Notes: * - The base decade is the 9th decade of the 20th century.
Source: Authors

Observing the distribution of published papers by century, it is concluded that only 5 papers were published during the 20th century, i.e. only 2.40% of all papers. In contrast, 203 papers (i.e. 97.60% of all papers) have been published so far in the 21st century.

Leading Journals in Published Papers

Papers on robots and robotics were published in 22 of the 27 analysed journals, i.e. in 81.48% of the analysed journals (Figure 3). Ten journals have published 10 and more papers on the subject of robots and robotics. Eight journals have published only one or two papers during the observed period.

The journal with the largest number of published papers on the subject of robots and robotics is the "International Journal of Contemporary Hospitality Management." The aforementioned journal had 42 published papers on the analysed topic, which is more than a fifth of the papers.

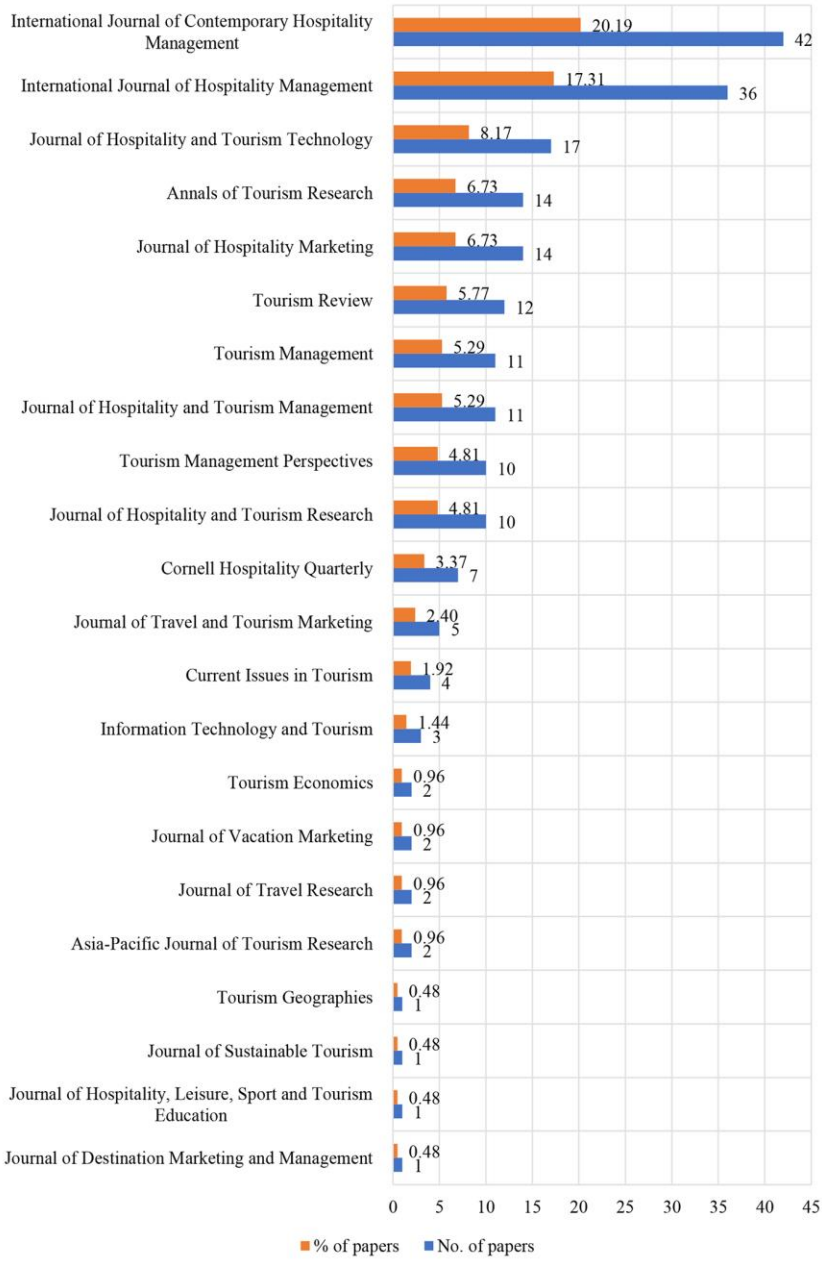

Figure 3. Distribution of papers by journals
Source: Authors

The Most Prominent and Cited Authors

A total of 463 different authors participated in writing the papers (Table 2). Of that number, 98 authors (21.17%) have more than one published paper. Among the authors who have more than one published paper, the majority have two published papers (63.27%), which is 13.39% of all authors. The average number of published papers per author is 1.41.

Table 2. Number of authors according to the number of published papers

Number of papers	Authors	
	Number	Percentage
1	365	78.83
2	62	13.39
3	16	3.46
4	11	2.38
5	4	0.86
8	2	0.43
10	1	0.22
12	1	0.22
14	1	0.22

Source: Authors

The largest number of papers was written in co-authorship by two or more authors (184 papers, 88.46%). The largest number of papers was written by three authors (29.33% of all papers) (Table 3). On average, there are 3.14 authors per paper.

Table 3. Papers according to the criterion of the number of authors

Number of authors	Number of papers	Percentage of papers
1	24	11.54
2	44	21.15
3	61	29.33
4	57	27.40
5	17	8.17
6	3	1.44
13	1	0.48
14	1	0.48

Source: Authors

The most important authors according to the criterion of the number of published papers are Jinsoo Hwang (South Korea) and Heather Markham Kim (South Korea) (Table 4). They individually have a share of more than 5.00% in the total number of published papers. In addition to the mentioned authors, only Stanislav Ivanov (Bulgaria) has a double-digit number of published papers.

Table 4. Authors with five or more published papers

Author	Papers		Country/ies
	Number	Percentage	
Jinsoo Hwang	14	6.73	South Korea
Heather Markham Kim	12	5.77	South Korea
Stanislav Ivanov	10	4.81	Bulgaria
Iis P. Tussyadiah	8	3.85	UK
Jinkyung Jenny Kim	8	3.85	South Korea
Aarni Tuomi	5	2.40	UK/Finland
Craig Webster	5	2.40	USA
Ja Young Jacey Choe	5	2.40	China
Lishan Xie	5	2.40	China

Source: Authors

The most cited author is Stanislav Ivanov with a total of 1,177 citations, which is 7.70% of the total number of citations (Table 5). It is interesting that Jun Wen is in the fifth place in terms of the total number of citations, even though this author published only one paper (such authors are marked in Table 5, Figure 4 and Figure 5 using *).

Table 5. Ten most significant authors according to the criterion of the total number of citations

Author	Total number of citations	Percentage of the total number of citations
Stanislav Ivanov	1,177	7.70
Iis P. Tussyadiah	1,057	6.92
Yangyang Jiang	914	5.98
Vincent Wing Sun Tung	903	5.91
Jun Wen*	880	5.76
Dogan Gursoy	799	5.23
Seongseop Sam Kim	780	5.11
Youngjoon Choi	780	5.11
Craig Webster	671	4.39
Lu Lu	644	4.21

Source: Authors

If the average number of citations per paper is taken as the criterion of author significance, the most important author is Jun Wen (Figure 4). It is interesting that in the top 10 authors according to the mentioned criteria, there is only one author, Yangyang Jiang, who has more than one published paper and this author takes the sixth place.

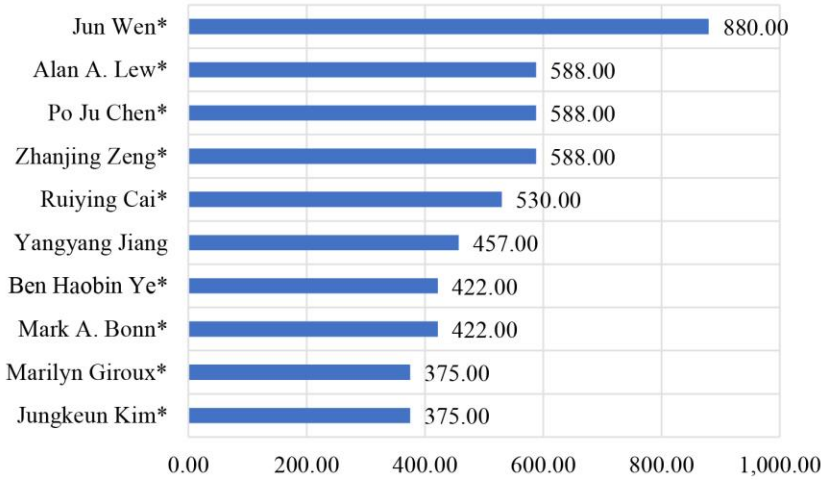

Figure 4. Ten most important authors according to the criterion of the average number of citations per paper
Source: Authors

The most significant author according to the criterion of the total annual average number of citations is Stanislav Ivanov (Figure 5). It is interesting that Jun Wen is in the sixth place in terms of the total number of citations even though he published only one paper.

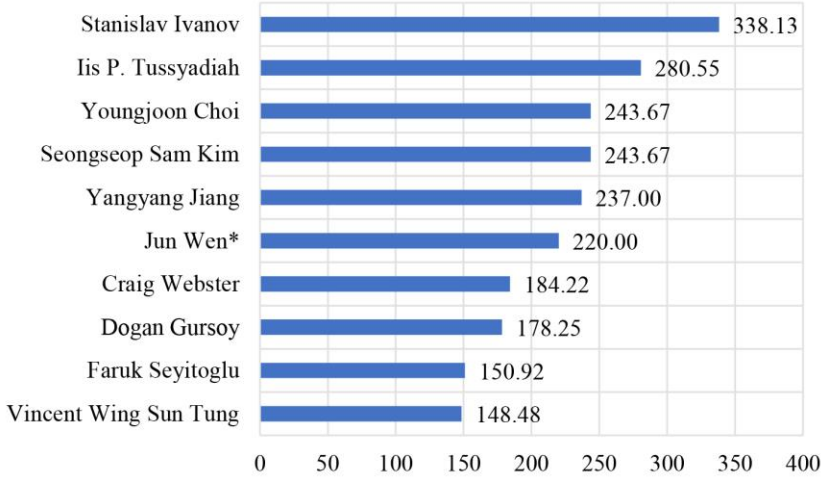

Figure 5. Ten most significant authors according to the criterion of the total annual average number of citations
Source: Authors

The Most Cited Papers

The citation of papers was determined according to the data available on *Google Scholar* on December 13, 2023 (Table 6). The total citation of papers is 15,279, and the average is 73.46. The majority of the analysed papers were cited (197 papers; 94.71%). The mode of the number of citations is 0 and is present in the case of 11 papers (5.29%). The largest number of papers have 0-100 citations (76.92%).

Table 6. Papers by number of citations

Number of citations	Number of papers	Percentage of papers
0-100	160	76.92
100-200	29	13.94
200-300	7	3.37
300-400	7	3.37
400-500	2	0.96
500-600	2	0.96
600-700	0	0.00
700-800	0	0.00
800-	1	0.48

Source: Authors

The paper by Jiang and Wen (2020) has the largest number of citations (880). The mentioned paper is the only one with a share of more than 5.00% in the total number of citations. The five most cited papers are shown in Table 7.

Table 7. Five most cited papers

Authors (year of publication)	Number of citations	Percentage of citations
Jiang and Wen (2020)	880	5.76
Zeng, Chen, & Lew (2020)	588	3.85
Lu, Cai, & Gursoy (2019)	530	3.47
Tussyadiah (2020)	460	3.01
Li, Bonn, & Ye (2019)	422	2.76

Source: Authors

In order to obtain more relevant results regarding the importance of individual papers, in addition to the total number of citations, the average annual number of citations was taken into consideration. In this way, the influence of the number of years that have passed since the year of publication of the paper on its citation is eliminated. The average annual number of citations was calculated according to the following formula:

Average annual number of citations =
Total number of citations / (2024 – year of publication)

The average of the average annual number of citations per paper is 21.11 (Table 8).

Table 8. Papers according to the average annual number of citations

Number of citations	Number of papers	Percentage of papers
0-25	151	72.60
25-50	36	17.31
50-75	13	6.25
75-100	3	1.44
100-125	3	1.44
125-150	1	0.48
150-175	0	0.00
175-200	0	0.00
200-	1	0.48

Source: Authors

The paper by Jiang and Wen (2020) has the highest average annual number of citations (220.00). The mentioned paper is the only one with an average annual number of citations greater than 200. The five papers with the highest average annual citations are shown in Table 9.

Table 9. Five papers with the highest average annual citations

Authors (year of publication)	Average annual number of citations
Jiang and Wen (2020)	220.00
Zeng et al. (2020)	147.00
Kim, Kim, Badu-Baiden, Giroux, & Choi (2021)	125.00
Tussyadiah (2020)	115.00
Lu et al. (2019)	106.00

Source: Authors

Geographical Distribution of Papers

The authors of the papers on robots and robotics in tourism and hospitality are from 38 countries (Table 10). The largest number of authors is from China (35.42%). In addition to China, the USA has a significant share of authors (22.03%). China made the largest contribution to papers (44.23%). In addition to China, a large contribution (≥10.00%) was made by the USA, the UK and South Korea. Authors from the USA have the largest network of collaboration with authors from other countries – 23 countries, while authors from South Korea wrote half of the papers with authors from their own country, and half in collaboration with authors from another country.

Table 10. Number of authors by country and contribution of countries to the number of papers

Country*	Authors		Papers				
	No. of authors	% of authors (N=463)	No. of papers	% of papers	Papers written without cooperation	No. of papers	No. of countries
China	164	35.42	92	44.23	45	48.91	17
USA	102	22.03	66	31.73	22	33.33	23
UK	36	7.78	35	16.83	11	31.43	19
South Korea	31	6.70	28	13.46	14	50.00	3
Spain	25	5.40	11	5.29	6	54.55	8
Turkey	13	2.81	10	4.81	4	40.00	6
Bulgaria	3	0.65	10	4.81	0	0.00	6
India	15	3.24	9	4.33	3	33.33	10
Australia	13	2.81	7	3.37	1	14.29	4
Malaysia	7	1.51	5	2.40	0	0.00	6
Austria	6	1.30	5	2.40	2	40.00	2
Singapore	3	0.65	4	1.92	0	0.00	7
Cyprus	6	1.30	4	1.92	1	25.00	6
Finland	4	0.86	4	1.92	0	0.00	6
France	6	1.30	4	1.92	1	25.00	5
United Arab Emirates	5	1.08	4	1.92	1	25.00	4
Canada	6	1.30	4	1.92	1	25.00	2
Egypt	4	0.86	3	1.44	0	0.00	4
Italy	9	1.94	3	1.44	1	33.33	2
South Africa	1	0.22	3	1.44	0	0.00	2
Norway	1	0.22	2	0.96	0	0.00	6
Germany	2	0.43	2	0.96	0	0.00	5
Israel	1	0.22	2	0.96	0	0.00	5
Romania	1	0.22	2	0.96	0	0.00	5
Greece	2	0.43	2	0.96	0	0.00	4
New Zealand	3	0.65	2	0.96	0	0.00	4
Portugal	2	0.43	2	0.96	0	0.00	4
Japan	2	0.43	2	0.96	0	0.00	2
Pakistan	1	0.22	1	0.48	0	0.00	3
Thailand	1	0.22	1	0.48	0	0.00	3
Czech Republic	1	0.22	1	0.48	0	0.00	2
Fiji	1	0.22	1	0.48	0	0.00	2
Tunisia	3	0.65	1	0.48	0	0.00	2
Belgium	2	0.43	1	0.48	0	0.00	1
Brazil	3	0.65	1	0.48	0	0.00	1
Colombia	1	0.22	1	0.48	0	0.00	1
Ghana	1	0.22	1	0.48	0	0.00	1
Russia	1	0.22	1	0.48	0	0.00	1
Unspecified country	1	0.22	1	0.48	1	100.00	0

Note: *Member of the UN. If a certain author has listed institutions from several countries in one or more papers, such an author is included in the number of authors from all the countries he listed.

Source: Authors

A visual representation of the collaboration between authors from different countries is presented in Figure 6. Using *VOSviewer*, 10 clusters were formed. Each item (country) belongs to only one cluster. Association strength was used as a normalisation method. A resolution of 1.00 and a minimum cluster size of 1 were used for clustering.

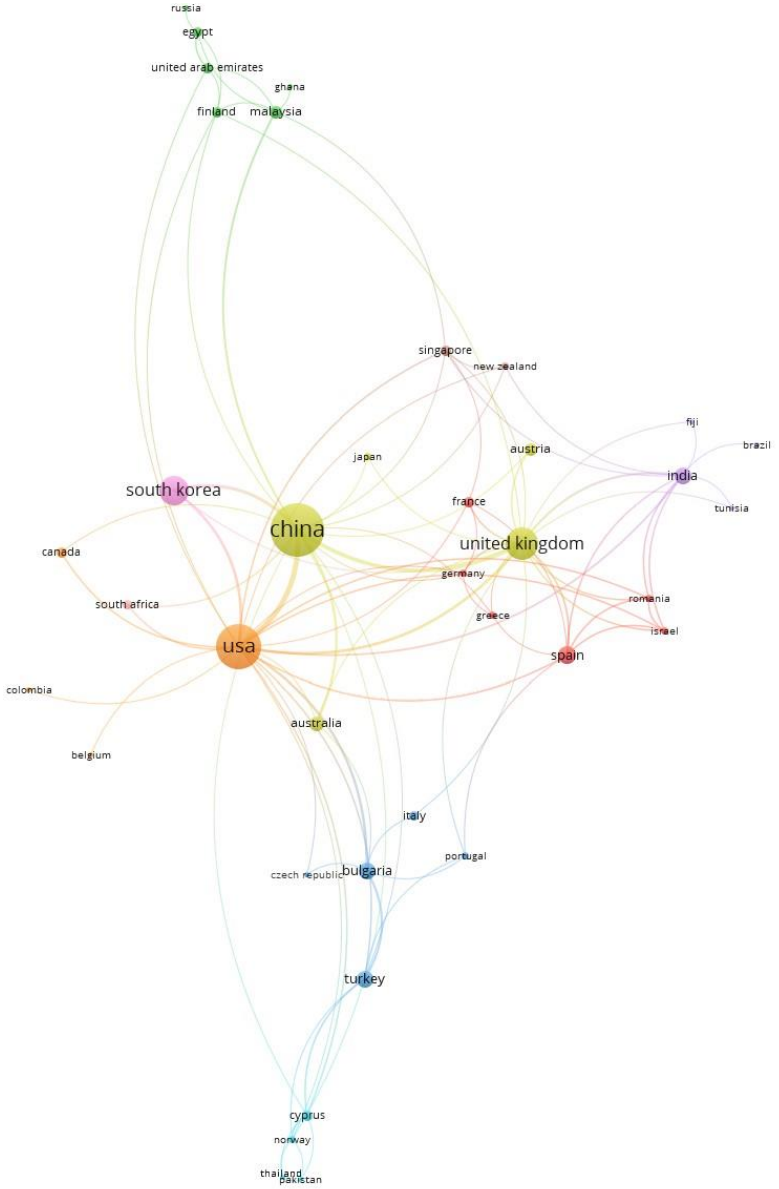

Figure 6. Collaboration between authors from different countries
Source: Authors

Most of the papers (114 papers, 54.81%) were written by authors from the same country (Table 11). The majority of papers with more than one author were written in collaboration between two authors (71 papers, 75.53%). The average number of countries per paper is 1.65.

Table 11. Number of different countries of authors on the same paper

Number of different countries on the same paper	Number of papers	Percentage of papers
1	114	54.81
2	71	34.13
3	15	7.21
4	5	2.40
5	1	0.48
6	2	0.96

Source: Authors

The Most Significant Topics

The most significant topics in the papers on robots/robotics in tourism and hospitality were identified based on the analysis of key words in the analysed papers using the following principles (Lukić Nikolić & Garabinović, 2023):

- Name completeness – using the full name instead of abbreviations;
- Breaking down complex expressions;
- Finding and matching words of similar meaning (synonyms); and
- Avoidance of 'false frequency' – one term is accepted once in one paper.

In order to identify the most important topics of the analysis, a frequency of ≥10 was defined as a selection criterion, which represents the presence in ≈4.8% of the analysed papers. The 40 most significant terms, i.e. fields of analysis, were identified (Figure 7). Only two terms that are present in more than half of the papers are 'robot' and 'service.' The above indicates the importance of the 'service robot' analysis. The next two terms present in slightly less than a quarter of the analysed papers ('intelligence' and 'artificial') indicate the great importance of the analysis of 'artificial intelligence' (*AI*). Based on the analysis of earlier bibliometric studies, the results obtained were expected due to the growing importance of *AI* in the field of tourism and hospitality (Ab Rashid & Aziz, 2022; Kirtil & Aşkun, 2021; Knani, Echchakoui, & Ladhari, 2022), as well as due to the significant role of AI in the field of the application of robots in the hospitality industry, as well as in tourism and hospitality, which was established by earlier bibliometric analyses (Herawan et al., 2023; Kumar Singh et al., 2022).

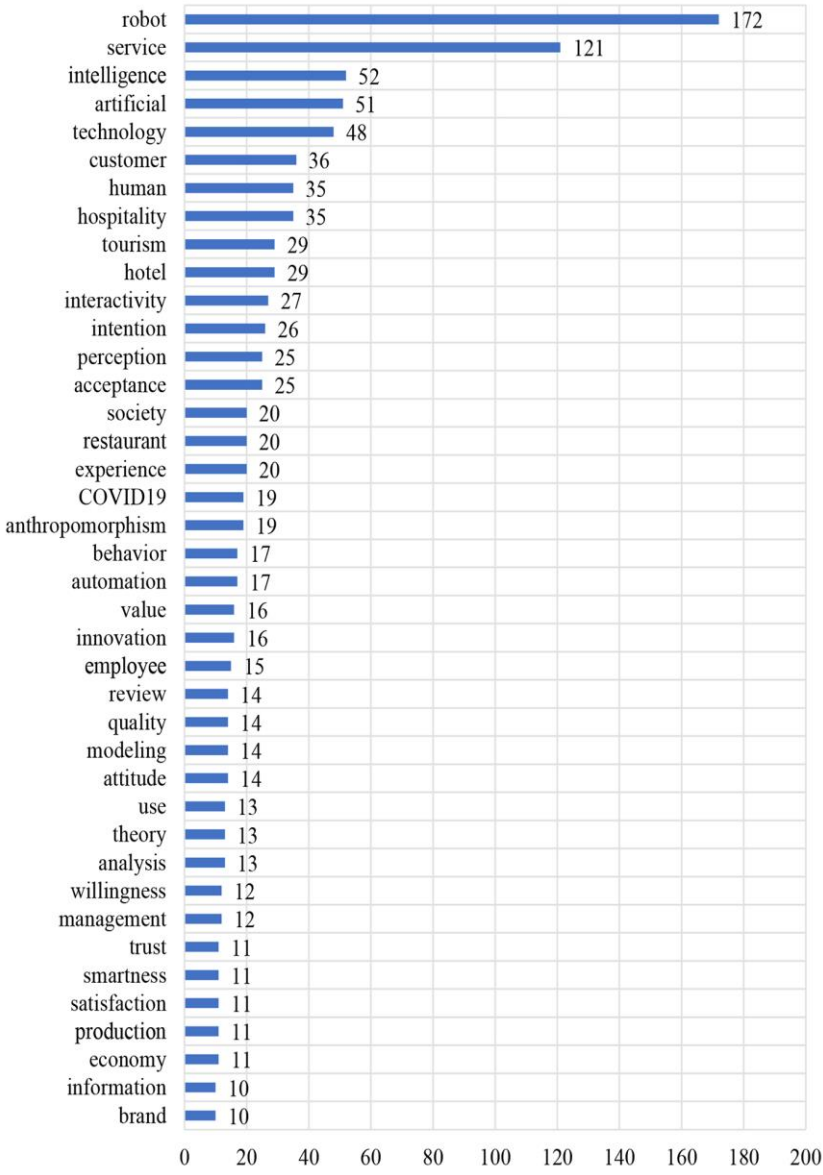

Figure 7. Frequency of the most significant terms/field of analysis
Source: Authors

The mentioned terms, i.e. fields of analysis, were grouped into four clusters by *VOSviewer* (Figure 8). The parameters for cluster formation were identical as in the case of Figure 6.

The first (red) cluster includes 15 items, which are: robot, service, customer, intention, perception, experience, restaurant, behaviour, innovation, value, attitude, quality, production, satisfaction, and brand. The second (green) cluster includes 12 items, which are: intelligence, artificial, technology, hotel, acceptance, *COVID19*, automation, employee, management, economy, smartness, and information. The third (blue) cluster includes 7 items, which are: society, anthropomorphism, modelling, theory, use, willingness, and trust. The fourth (yellow) cluster includes 6 items, which are: hospitality, human, tourism, interactivity, review, and analysis.

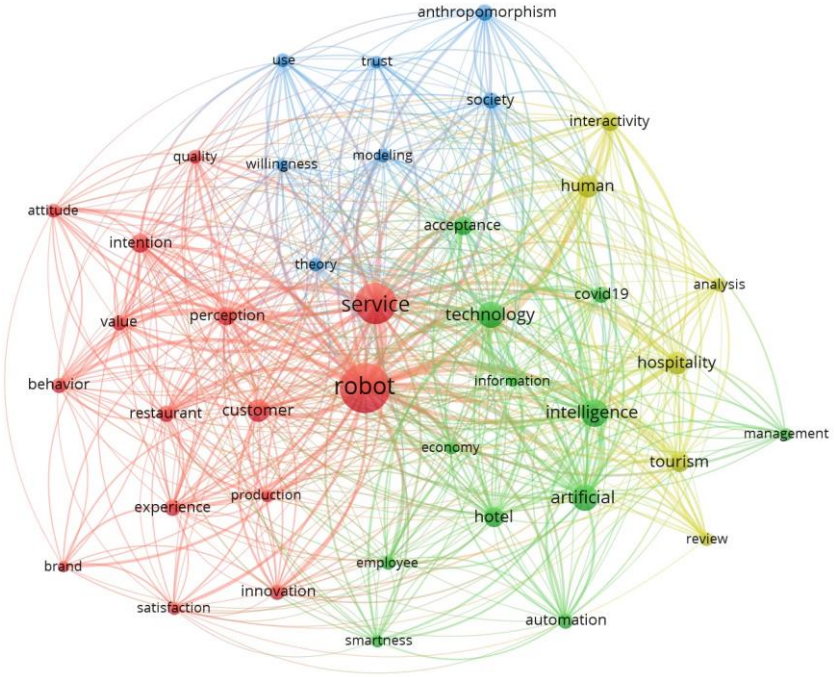

Figure 8. Connection of the most significant terms/field of analysis
Source: Authors

Most of the identified terms (32, i.e. 80.00%) appeared for the first time in the second decade of the 21st century, a quarter of which occurred in 2020. The results showed that the average year of publication of papers on most terms belongs to the third decade of the 21st century (Figure 9).

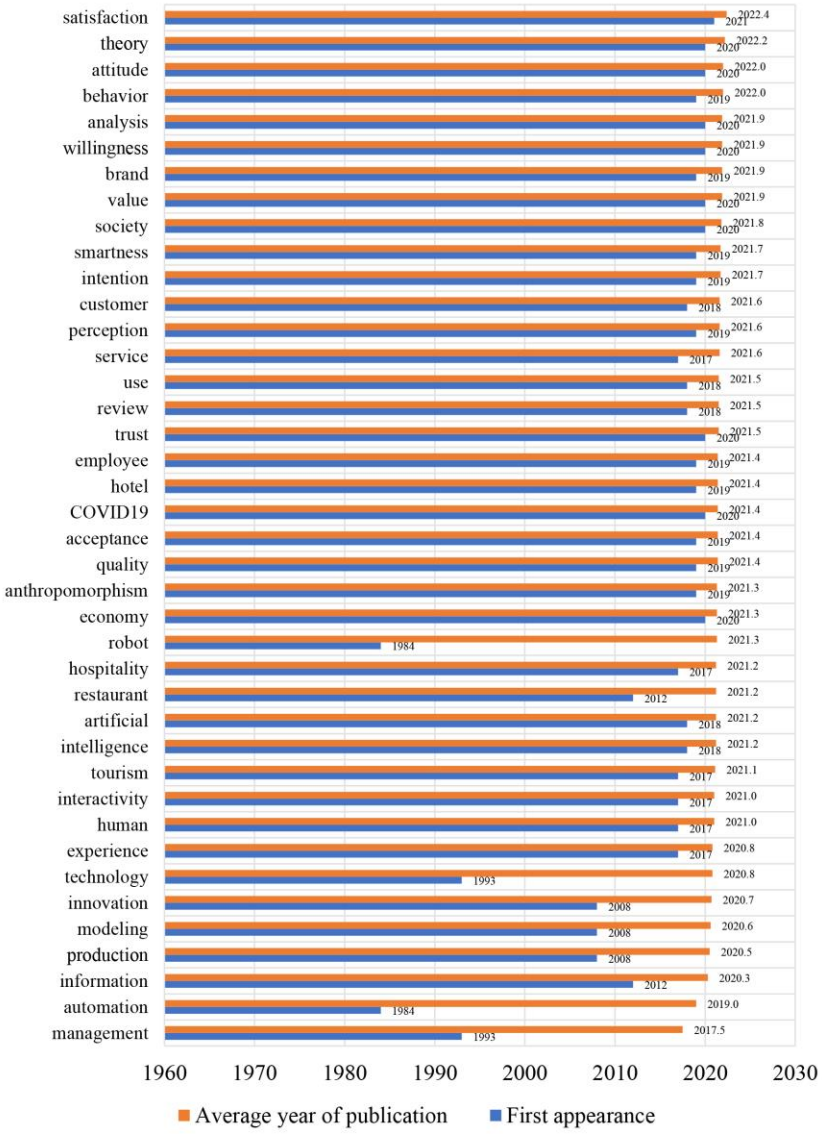

Figure 9. First appearance and average year of publication of papers on identified topics
Source: Authors

CONCLUSION

Research findings showed that, between 1984 and 2023, 208 papers on the application of robots in tourism and hospitality were pub-

lished in 22 journals. The papers were written by a total of 463 authors from 38 countries. The most important topics covered in the papers were 'service robot' and 'artificial intelligence.'

This research has valuable implications for both theory and practice. Primarily, this paper provides an excellent basis for a theoretical overview of previous research in the domain of the application of robots in tourism and hospitality, and for the observation of potential trends in this field through the future implementation of a more detailed content analysis. Furthermore, the conducted bibliometric analysis can improve the overall quality of scientific papers providing authors with relevant literature, journals, authors, and countries. This research also has some valuable implications for practitioners, especially leaders and managers of tourism and hospitality objects aiming to implement robotic solutions. They may find the most valuable papers in this field and become better informed before making decisions about robot implementation.

This study also has several limitations, among which are: the moment of analysis (August 2023); the sample of journals (27 journals from *WoS*); and applied method of identifying papers (search for defined terms in the title, abstract and key words). Consequently, suggestions for further research are: conducting bibliometric analysis more often in defined periods of time, which could be every five years due to the specificity of the topic; expansion of the journals sample; improving the method of identifying papers by including other terms in the search and expanding the search to the entire texts of papers; adding other elements of bibliometric analysis; and using other available software tools for bibliometric analysis and text mining.

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ПРИМЕНА РОБОТА У ТУРИСТИЧКОЈ И УГОСТИТЕЉСКОЈ ИНДУСТРИЈИ: БИБЛИОМЕТРИЈСКА АНАЛИЗА

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Резиме

Развој савремених робота и роботских система довео је до њихове све веће примене у туристичкој и угоститељској индустрији. Научна заједница посветила се истраживањима која се односе на примену робота за унапређење услуга и радних активности у туризму и угоститељству. У овом раду је применом библиометријске анализе указано на тренутно стање научне литературе, са аспекта најзначајнијих часописа, аутора, земаља и тема из ове области. Селектовани су радови у часописима из области туризма и угоститељства који су индексирани у Journal Citation Report, Web of Science а у чијим се насловима, кључним речима и апстрактима појављују речи „робот“ или „роботика“. Резултати спроведеног истраживања показали су да је у периоду од 1984. до 2023. године објављено 208 радова у 22 часописа. Радове је писало укупно 463 аутора из 38 земаља. Најзначајније теме које су обрађиване у радовима биле су „услужни роботи“ и „вештачка интелигенција“. Резултати истраживања представљају полазну основу за истраживаче који проучавају примену робота и роботских система у туризму и угоститељству, указујући им на најзначајније теме, радове, ауторе, земље и часописе. Исто тако, добијени резултати могу да буду од користи лидерима и менаџерима у туризму и угоститељству који планирају да имплементирају роботе за унапређење услуга и радних активности. Упознавањем са кључним радовима који су објављени на ову тему, лидери и менаџери могу да прикупе значајне информације и стекну сазнања која ће им помоћи приликом доношења одлука о имплементацији робота и роботских система.

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ARTIFICIAL INTELLIGENCE: INVESTMENT PATTERNS AND ECONOMIC IMPLICATIONS IN LEADING COUNTRIES

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Abstract

Artificial intelligence (AI) has become one of the paramount driving forces, structurally influencing contemporary economy. Its notable potential is reshaping investment landscapes and economic growth in leading countries worldwide, and boosting their economic expansion. AI significantly contributes to the improvement of business efficiency, the decision-making process, and the creation of high quality and personalised products and services, thus contributing to consumer demand uplift and generating higher income. Global competition to obtain AI-driven benefits is strong, and leading countries dominate this competitive battle. Although all countries experience benefits from AI, economies at the forefront of AI investment, including the United States, China, and Europe, are leveraging AI to drive advancements in key industries. As an engine of economic prosperity and societal wellbeing, the economic impact of investments in AI is discussed in the paper, with a particular focus on generative AI, as well as AI's impact on productivity, economic growth, innovations, workforce, labour market, etc. Given the certain concerns related to the potential disruptive effects on the economy and society reflected in the creation of monopoly and super firms, the growing gap in countries' development, labour market volatility, etc., carefully designed public policy would encourage advantages in AI implementation and diffusion, and keep negative effects under control. The paper aims to assess and discuss investments in AI due to its unique capacity to accelerate innovations and productivity, and its multidimensional implications on economic performance, along with the accompanying potential challenges and risks.

Key words: artificial intelligence, leading countries, investment, innovations, economic growth.

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ВЕШТАЧКА ИНТЕЛИГЕНЦИЈА: ИНВЕСТИЦИОНИ МОДЕЛИ И ЕКОНОМСКЕ ИМПЛИКАЦИЈЕ У ВОДЕЋИМ ПРИВРЕДАМА

Апстракт

Вештачка интелигенција је постала једна од најважнијих покретачких снага која значајно утиче на обликовање савремене привреде. Њен велики потенцијал се огледа у преобликовању инвестиционих услова и економског раста у водећим земљама широм света, те у подстицању њихове економске експанзије. Вештачка интелигенција значајно доприноси унапређењу пословне ефикасности, процеса доношења одлука и развоју квалитетнијих и персонализованих производа и услуга, а тиме подстиче већу тражњу и веће приходе. Глобална конкуренција за остваривање предности коришћењем вештачке интелигенције је веома изражена, а водеће земље имају доминантну позицију у тој конкурентској борби. Иако све земље остварују користи од вештачке интелигенције, привреде које предњаче по улагањима у овој сфери, укључујући Сједињене Америчке Државе, Кину и Европу, користе вештачку интелигенцију како би убрзале напредак кључних сектора. Као покретач економског напретка и друштвеног благостања, у раду се дискутују економске импликације инвестиција у вештачку интелигенцију, првенствено у генеративну вештачку интелигенцију, али и утицај вештачке интелигенције на продуктивност, економски раст, иновације, радну снагу, тржиште рада, итд. Имајући у виду потенцијални утицај екстерналија на привреду и друштво, који се огледа у могућем настанку монопола и супер компанија, продубљивању јаза у развијености земаља, нестабилности тржишта рада, итд., пажљиво осмишљена јавна политика би подстакла предности у примени и ширењу вештачке интелигенције, а негативне ефекте држала под контролом. Циљ рада јесте сагледавање инвестиција у вештачку интелигенцију, имајући у виду њене јединствене могућности у подстицању иновација и продуктивности, као и многоструке импликације на економске перформансе, водећи истовремено рачуна о потенцијалним изазовима и ризицима.

Кључне речи: вештачка интелигенција, водеће привреде, инвестиције, иновације, економски раст.

INTRODUCTION

Artificial intelligence (AI) represents one of the most transformative technologies in the contemporary world, reshaping the way people live and work. By improving decision-making, automating processes, and opening up new avenues for creativity, AI has completely transformed many industries. Its ability to analyse massive amounts of data in real time is driving advancements in sectors ranging from agriculture to creative industries, improving efficiency and creating more personalised experiences. As AI continues to evolve, it reshapes societal structures, influencing everything from labour markets to ethical standards.

Over the past decade, the AI market has seen substantial growth, driven by advancements in machine learning, automation, and data analytics. As AI technologies become more widely adopted across industries, the market continues to expand at a rapid pace, with each year bringing

higher levels of investment and innovation (McKinsey, 2024; PwC, 2024). In particular, the last few years have witnessed a surge in demand for AI-driven solutions in areas such as financial services, retail, and software, further accelerating market expansion (IDC, 2024).

The global AI market experienced significant growth in 2024, surpassing $184 billion, marking an impressive increase of nearly $50 billion from the previous year (Statista, 2024). As businesses increasingly integrate AI to enhance efficiency, productivity, and innovation, the market's upward trajectory is expected to persist. Projections by Statista (2024) indicate that by 2030, the AI market will exceed $826 billion, underscoring the growing economic impact of AI on global economies. This surge is attributed to the expanding use cases of AI, including automation in manufacturing, AI-driven healthcare solutions, and the proliferation of AI in consumer-facing applications like chatbots and personalised marketing (Rashid & Kausik, 2024). The continued rise of AI investments by both private and public sectors further emphasises its role as a transformative force that will reshape industries and significantly contribute to global economic growth.

The purpose of this paper is to analyse the economic impact of investments in AI, with a particular focus on generative AI, across leading countries and regions. By examining the distribution of AI investments, the paper aims to identify the dominant players in the global AI landscape, and explore how these investments contribute to their economic growth and competitiveness in the global market. The goal is to provide a comprehensive understanding of the role generative AI plays in enhancing productivity, fostering innovation, and driving technological advancements, while also highlighting its potential to reshape technology-driven industries and labour markets. This analysis will offer insights into the future trajectory of AI adoption and its implications for policymakers, businesses, and economies worldwide.

INVESTMENT TRENDS IN AI: INSIGHTS FROM DOMINANT ECONOMIES

In the rapidly evolving landscape of AI, investments are essential for fostering innovation and economic expansion. Countries around the world are increasingly recognising the strategic importance of AI, leading to substantial private sector investments aimed at securing technological leadership. Figure 1 presents the private investment in AI by country for the year 2023, highlighting the financial commitment of leading nations to AI development. This figure provides valuable insights into the global distribution of AI investments and reflects the varying levels of commitment by the private sector across countries (Stanford University, 2024).

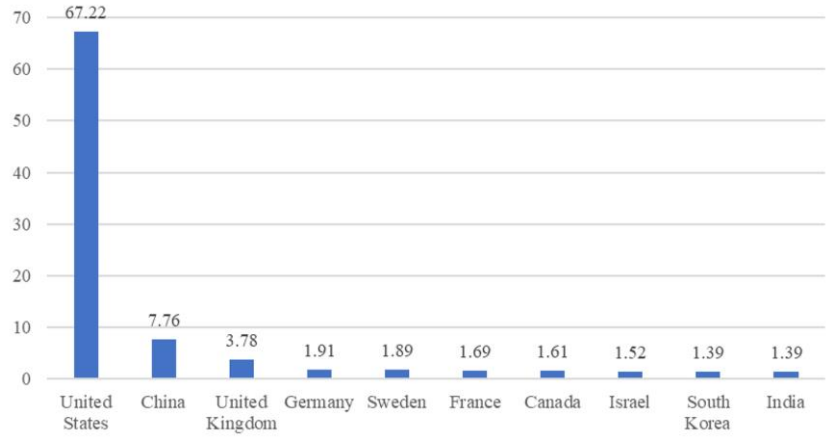

Figure 1. Private investment in AI by country (USD billions), 2023
Source: Stanford University, 2024, p. 247

According to the data in Figure 1, the United States (US) leads by a significant margin, with $67.22 billion in private AI investment in 2023. This overwhelming dominance, nearly nine times that of the next closest competitor, highlights the centrality of the US in the global AI landscape. The presence of major AI firms like *OpenAI*, alongside robust venture capital ecosystems and large-scale corporate investments, has made the US a global hub for AI innovation. Companies such as *Apple*, *NVIDIA*, *Microsoft*, *Google*, and *Tesla*, which have made significant AI-driven advancements, continue to attract both domestic and international investments, consolidating the US's leading position in AI (McKinsey, 2023).

China ranks second with $7.76 billion in private AI investments – a figure that, while considerably lower than the US, reflects China's growing focus on AI as a cornerstone of its national development strategy. China's government-driven initiatives, coupled with private sector efforts by companies like *Baidu*, *Tencent, Alibaba*, and *SenseTime*, are driving AI research and deployment, particularly in areas such as facial recognition, autonomous vehicles, and large language models (Johansson, 2022). Despite trailing behind the US, China's rapid AI growth is positioning it as a key competitor on the global stage.

The United Kingdom (UK) follows with $3.78 billion, indicating a strong presence in the AI sector relative to its size. The UK's AI ecosystem benefits from its well-established financial services industry, strong academic research institutions, and government support for AI-related initiatives (UK Government, 2021). The UK's focus on ethical AI development and AI governance has also contributed to attracting investment, particularly in areas such as AI-driven fintech solutions and healthcare technologies.

Germany, with $1.91 billion in private AI investment, stands as a leader in the EU. Germany's industrial base, particularly in the manufacturing and automotive sectors, has increasingly adopted AI technologies for automation and optimisation, making it a critical player in AI-driven industrial transformation. German companies, including *Siemens* and *Bosch*, have been pivotal in integrating AI into manufacturing processes, contributing to the country's strong AI investment profile.

Sweden and France follow closely with $1.89 billion and $1.69 billion, respectively. Sweden's investment in AI reflects its focus on innovation in sectors such as telecommunications, where companies like *Ericsson* are leveraging AI for network optimisation (Vinnova, 2018). Meanwhile, France has developed a robust AI ecosystem, bolstered by government support for AI research and development through initiatives like the *AI for Humanity program*, making it a key player in Europe's AI landscape (French Government, 2024).

Canada, with $1.61 billion, has emerged as a prominent hub for AI research, particularly in deep learning and natural language processing. Canada's strong academic institutions, such as the University of Toronto and McGill University, have played a crucial role in advancing AI research, attracting substantial private investment and making Canada a leader in AI-driven innovation in North America (Deloitte, 2023).

Israel, known for its thriving tech start-up ecosystem, attracted $1.52 billion in private AI investments. Israel's focus on AI in cybersecurity, defense, and healthcare has positioned it as a leader in niche AI applications. The country's strong venture capital presence and government support for tech start-ups continue to fuel growth in AI-related fields (Scheer, 2019).

South Korea and India both recorded $1.39 billion in AI investments, indicating a growing interest in AI across Asia. South Korea's strength lies in AI applications in electronics and robotics, with companies like *Samsung* leading the charge in AI-powered consumer electronics and industrial automation (Lee, 2024). India, on the other hand, is rapidly expanding its AI capabilities, focusing on sectors such as IT services, healthcare, and agriculture, supported by a growing number of AI start-ups and government initiatives aimed at fostering AI innovation.

Summarising the above, the data in Figure 1 highlights the concentration of AI investments in a few key countries, with the US and China far ahead of the rest. However, the distribution of investment across Europe and Asia indicates a global shift towards increasing AI adoption, with each country leveraging its unique strengths to foster AI innovation. This trend underscores the critical role of private investment in shaping the future of AI and driving economic growth across nations.

Understanding this trend is particularly important for developing economies, which must invest in improving the knowledge and skills of

their citizens to remain competitive in a global environment (Krstić et al., 2016c; Radivojević et al., 2019). As AI technologies become more integrated into various industries, countries that lag in fostering a skilled workforce risk being left behind in terms of innovation and economic growth. By prioritising education and digital literacy, developing nations can equip their populations with the tools necessary to participate in the evolving AI-driven economy. This investment in human capital will be crucial for these countries to attract AI-related investments and create sustainable, long-term growth opportunities (Acemoglu & Restrepo, 2018).

ECONOMIC POWERHOUSES IN GENERATIVE AI: A FOCUS ON TOP START-UPS

Following the analysis of AI investments in leading countries, it is crucial to explore a specific branch of AI that has gained significant attention in recent years – generative AI. Generative AI refers to systems that utilise advanced neural networks to create new content, such as text, images, audio, and video, based on patterns learned from vast datasets (Goodfellow et al., 2016; Lv, 2023). This innovative technology, powered by models like *ChatGPT* and *GitHub Copilot*, is transforming industries by automating creative processes and enhancing decision-making capabilities (Javaid et al., 2023). The rapid advancement of generative AI has not only revolutionised various sectors but also emerged as a critical driver of economic growth and national competitiveness, further solidifying its role in shaping the future of global economies.

Numerous researchers have looked into how generative AI techniques affect productivity in test environments. According to Dell'Acqua et al. (2023), the utilisation of generative AI can substantially enhance the productivity of highly skilled professionals, such as consultants, by as much as 40% when compared to their counterparts who do not adopt this technology. A study by McKinsey (2023) found that generative AI has the potential to significantly boost global productivity, adding an estimated annual sum between $2.6 and $4.4 trillion to the economy across various use cases. This represents a 15% to 40% increase in the overall impact of AI. The study unequivocally showed that generative AI could revolutionise industries like banking, high tech, and life sciences, potentially adding $200 to $340 billion annually in banking alone. The technology's ability to automate up to 70% of current work tasks, particularly those involving natural language processing, highlights its transformative effect on knowledge work. This could accelerate workforce automation, with half of today's work activities potentially being automated by 2045 (McKinsey, 2023).

The following Table 1 presents a comprehensive overview of the top generative AI start-ups by country or region, highlighting the leading players

in terms of total capital raised and their respective year of establishment. This table is designed to emphasise the economic powerhouses in generative AI, revealing the significant financial investments made by countries such as the US, China, and key European nations. The total capital raised by these start-ups demonstrates the critical role that private investment plays in fuelling AI innovation and development. With the US significantly in the lead, followed by China and major European players like France and the UK, the data underscores the strategic importance of AI investments in shaping global competitiveness in this rapidly evolving field.

Table 1. Top generative AI start-ups per country/region, 2024

Country/ region	Company	Total raised (USD millions)	Industry	Year of establish.	Example of product
United States	OpenAI, LLC	11,307	Media, social platforms, marketing	2015	ChatGPT
	Anthropic, PBC	5,563	IT infrastructure and hosting	2021	GPT-3
	Primer Technologies, Inc.	309	Government, security and defense	2015	Primer Automate
China	Baichuan AI	350	IT infrastructure and hosting	2023	Baichuan2-53B
	AI Being	228	Business processes and support services	2020	Zbee
	Memory Connected	44	Financial and insurance services	2019	C funding
EU	Mistral AI	526	IT infrastructure and hosting (France)	2023	Mistral Nemo
	Contents SpA	21	Media, social platforms, marketing (Italy)	2020	Contents. com
	Crunchr	20	Business processes and support services (Netherlands)	2014	Crunchr
United Kingdom	Stability AI Ltd.	126	Business processes and support services	2019	Stable Diffusion 3
	AutogenAI Ltd	60	Media, social platforms, marketing	2022	AutogenAI
	Quill Content Ltd	13	Media, social platforms, marketing	2010	Quill Expertise

Source: OECD.AI, 2024

Based on the data presented in Table 1, the global AI investment landscape in 2024 is characterised by significant disparities across regions, particularly in terms of total capital raised by top generative AI start-ups. The US, China, and leading European countries are at the fore-

front of AI innovation, with firms that have attracted significant financial backing within a short period, particularly those involved in generative AI technologies.

In the United States, *OpenAI*, established in 2015, exemplifies a case where early entry into the AI landscape has led to remarkable financial success. *OpenAI*'s flagship product, *ChatGPT*, a language model capable of performing a range of tasks from natural language processing to coding assistance, has revolutionised AI applications globally. By 2024, *OpenAI* had raised a staggering $11.3 billion, making it a dominant force in the AI sector. This substantial investment can be attributed not only to the firm's early establishment but also to the rapid adoption and commercial success of products like *ChatGPT*, which is widely used in both consumer and corporate settings.

Similarly, *Anthropic*, a more recent entrant founded in 2021, raised $5.6 billion, indicating that firms established in the early 2020s can also attract massive investments quickly, particularly when operating in high-demand sectors such as IT infrastructure and hosting. *Anthropic*'s focus on advanced AI systems, like *GPT-3*, underscores the growing appetite for cutting-edge technologies that provide safer, more steerable AI solutions, which cater to both industrial and governmental needs.

In China, a noteworthy player is *Baichuan AI*, established in 2023. Despite its recent entry, it has already raised $350 million, positioning itself as a fast-growing AI company focused on large language models akin to *OpenAI*'s. Its products, such as *Baichuan2-53B*, demonstrate the Chinese market's strategic interest in developing localised AI models for content generation, which are designed to cater specifically to the Chinese language and cultural context. The rapid financial backing for *Baichuan AI* highlights China's aggressive push in the AI sector, emphasising the country's aim to close the gap with the US in AI research and development.

In Europe, *Mistral AI*, founded in 2023 in France, quickly raised $526 million, highlighting how newly established AI firms in Europe are attracting significant venture capital, particularly in the generative AI space. *Mistral*'s *Nemo* product is set to offer open-AI services, which underscores the trend in Europe of developing scalable, open-source AI tools to support a variety of industries. Meanwhile, firms like Italy's *Contents SpA* and the Netherlands' *Crunchr* illustrate how European firms, while smaller in scale, are diversifying their focus on AI applications such as business process automation and digital content generation.

The relationship between the year of establishment and the total raised points to the increasing speed at which AI start-ups can secure funding, especially when they operate in high-growth areas like generative AI and offer transformative products like *ChatGPT*. The ability of recent entrants, such as *Anthropic* and *Baichuan AI*, to raise significant capital within a short

period also suggests that investors are highly responsive to the potential for rapid scalability and innovation within this sector.

The disparities in investment between the US and other regions highlight both the concentration of capital in certain AI hubs and the potential for growth in other regions, such as Europe and China. The trends suggest that, while the US dominates in AI funding and technological development, other regions, particularly China, are rapidly catching up, leveraging AI to boost competitiveness across a variety of sectors. This growing global landscape underscores the critical role of AI investments in driving technological innovation and economic growth across countries.

In addition to the concentration of capital in certain countries, the rapid financial success of companies such as *OpenAI* and *Anthropic* highlights a growing concern about market dominance in the AI sector, as typical indicators for measuring market concentration would likely reflect a high concentration level (Krstić et al., 2016a; Krstić et al., 2016b). *OpenAI*'s early entry and significant funding, totalling $11.3 billion by 2024, have positioned it in a dominant place, raising alarms about the ability of smaller firms to compete effectively. As these early entrants solidify their market power, the risk of monopolistic behaviour increases, potentially stifling innovation and diversity in AI applications.

THE IMPLICATIONS OF AI INNOVATIONS FOR ECONOMIC GROWTH

The introduction of modern computer science and digital technology in the early 1990s, especially the recent expansion in machine learning and AI, has significantly contributed to productivity and growth rates. Following advancement in new technologies, relevant empirical studies confirmed that technological innovations lower labour costs (Zeira, 1998), and represent an important source of economies of scale (Krstić et al, 2016; Wang et al., 2011; Nchake and Shuaiby, 2022, Todorović & Kalinović, 2022).

AI leverages economic development by stimulating advantages in both demand and supply (Gonzales, 2023). On the supply side, the role of AI in business productivity improvement is reflected in the standardisation and automation of processes and routine tasks, as well as the augmentation of workforce capability and the complementation of existing employees with new AI technologies. On the other – demand side, AI is boosting consumer demand, offering high quality and personalised products and services based on better insights and available consumer data. Although the economic impact of AI is considerable, its outcomes are not uniform across all regions, countries, and sectors. Some sectors experience extremely positive changes, such as manufacturing, health, finance, energy, and transport, while others deal with disruptive effects and chal-

lenges. Sectors that fail to properly and quickly adapt to new technologies struggle with an endangered position on the market. Thus, the precondition for the prosperous implementation of AI technologies is an appropriate infrastructure and data availability, investments in new software, systems and machines, supported by adequate public policies.

McKinsey Global Institute research (2018) proposed several factors of AI-driven contribution to productivity, along with innovations, workforce automation, and new competition. These factors refer to both the micro and the macro impact of AI, including the adoption rate of AI as micro, and labour market structure and the economy's openness as macro factors (Table 2).

Table 2. Net economic impact of AI

Production channels	Augmentation	
	Substitution	*AI technologies substituting existing labor*
	Product and service innovation and extension	*Innovation*
	Competition effect	
Externality channels	Global data flows and connectedness	
	Wealth creation and reinvestment	
	Gross impact	
	Transition and implementation costs	*Disruption to the economy*
	Negative externalities	
	Net impact	

Source: McKinsey Global Institute analysis, 2018

The research focuses on seven potential channels of impact. The first three examine the impact of AI technologies on factors of production and their direct effect on productivity. The remaining four channels are externalities referring to the transition to AI and the wider economic environment. Three of the seven channels stand out: (1) complementing the existing workforce with new AI technology, (2) AI-driven new high quality and personalised products and services, and (3) fierce competition as a result of the implementation of AI technologies and its disruptive effect on companies and employees. In general, the impact of AI technologies is more evident in the recent period considering the accumulated effect of AI innovations generated over time.

PwC estimated (2018) that AI could contribute to a rise in global gross domestic product (GDP) of up to 14%, or 15.7 trillion dollars, by 2030, representing more than the combined current output of China and India. Almost half of this comes from increased productivity (42%), and the remaining 58% refers to advances in consumer demand (PwC, 2018). Although the benefits of AI are global and experienced by all economies,

some of them are dominant in its development, investments, and diffusion, and therefore outcomes. China and North America are likely to experience the biggest benefits from AI (Figure 2).

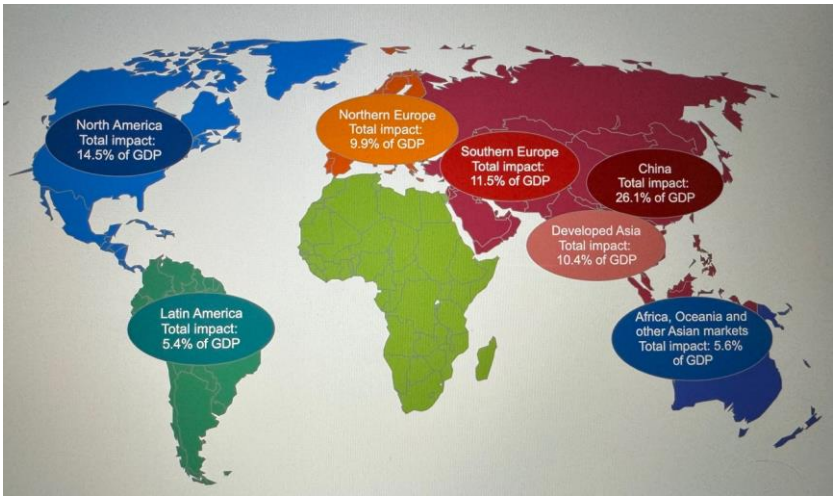

Figure 2. Expected benefits from AI in the world by 2030
Source: The macroeconomic impact of artificial intelligence, PwC, 2018

Based on Figure 2, the biggest gains from AI are likely to be in China, given AI's total impact on GDP, which will amount to 26.1%, or 7 trillion dollars by 2030, which is almost double compared to the next in terms of gains – North America. North America's total impact of AI on GDP is 14.5%, or 3.7 trillion dollars. Europe and Developed Asia will also experience important economic implications from AI-driven advancements (Southern Europe 11.5% of GDP, Developed Asia 10.4% of GDP, Northern Europe 9.9% of GDP). The overall impact of AI in developing countries is expected to be lower due to their low rates of adoption of AI technologies.

Despite multiple gains from new AI technologies, there are some concerns about the effects on economic growth (Trabelsi, 2024). These disruptive effects can be grouped as: (1) *technological* – being still in the experimental phase, some AI technologies do not have a sufficient maturity and do not provide enough information to assess their economic gains; (2) *legal* – cybersecurity and inadequately regulated protection of personal information; (3) *socio-professional* – insufficient workforce skills to apply AI technologies and resistance to companies' changes and adaptation to AI technologies are difficult to assess; (4) *organisational* – AI paradigm is not implemented and integrated into existing management systems to a more significant extent; (5) *institutional* – AI trainings to promote digital technology literacy, lower the digital gap and improve

skills of professionals are not adequately recognised by authorities in most countries; and (6) *market* – unequal ability to invest and adopt AI technologies could potentially enlarge the gap in development between countries, creating monopoly and super firms.

CONCLUSION

Innovations in artificial intelligence existed even fifty years ago, but they came into widespread use in the last ten to twenty years. The great wave of innovations in AI, followed by numerous patent registrations which, tangible or intangible, are consumed daily, proves the impact of AI technologies on the global economic landscape. Technology-driven companies, particularly in e-commerce, have managed to predict consumer behaviour and increase overall revenue based on natural language processing. Multinational companies that experience supply chain challenges, adopt AI technologies aiming to predict scheduling and demand, optimise inventory and risk management, etc. Generally, the evolution of AI technologies has significantly encouraged the modernisation and automation of production processes, and a rise in business productivity and workforce skills, enhancing total consumer demand and revenue streams.

This paper set out to assess the concentration of AI investments on the global level. The distribution of investment across Europe and Asia indicates a global shift towards increasing AI adoption, with each country leveraging its unique strengths to foster AI innovation. Meanwhile, there is also some evidence of the top generative AI start-ups by country or region, highlighting the leading players in terms of total capital raised and their respective years of establishment. There are economic powerhouses in generative AI, revealing the significant financial investments made by countries such as the US, China, and key European nations. The total capital raised by these start-ups demonstrates the critical role that private investment plays in fuelling AI innovation and development.

Finally, the paper assesses the relationship between AI investment and economic growth. AI encourages economic growth by stimulating gains from productivity advancement through the automation of processes and consumption expansion, by offering high quality and personalised products and services. In general, the impact of AI technologies is more evident in the recent period considering the accumulated effect of AI innovations generated over time. Although the benefits of AI are global and experienced by all economies, China and North America are likely to obtain the biggest gains from AI, followed by Southern and Northern Europe, and Developed Asia. Therefore, it can be concluded that countries with the largest investments in AI are those with the biggest economic gains.

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ВЕШТАЧКА ИНТЕЛИГЕНЦИЈА: ИНВЕСТИЦИОНИ МОДЕЛИ И ЕКОНОМСКЕ ИМПЛИКАЦИЈЕ У ВОДЕЋИМ ПРИВРЕДАМА

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Резиме

Вештачка интелигенција представља једну од најважнијих покретачких снага која изузетно утуче на обликовање савремене привреде. Њен велики потенцијал мења инвестиционе услове и економски раст у водећим земљама широм света, те подстиче њихову економску експанзију. Вештачка интелигенција значајно доприноси унапређењу пословне ефикасности, процеса доношења одлука и развоју квалитетнијих и персонализованих производа и услуга, а тиме подстиче већу тражњу потрошача и остварује увећане приходе. Изузетно је велика глобална конкуренција у придобијању бенефита од употребе вештачке интелигенције, а водеће земље имају доминантну позицију у тој конкурентској борби. Иако све привреде остварују користи од вештачке интелигенције, земље које предњаче по улагањима у овој сфери, укључујући Сједињене Америчке Државе, Кину и Европу, користе вештачку интелигенцију како би убрзале напредак кључних сектора. Као покретач економског напретка и друштвеног благостања, у раду се дискутују економске импликације инвестиција у вештачку интелигенцију, првенствено у генеративну вештачку интелигенцију, али и утицај вештачке интелигенције на продуктивност, економски раст, иновације, радну снагу, тржиште рада, итд.

Циљ рада јесте да процени концентрацију инвестиција у вештачку интелигенцију на глобалном нивоу. Распрострањеност инвестиција у вештачку интелигенцију широм Европе, Азије и Израела указује на глобални тренд ка усвајању вештачке интелигенције, при чему свака земља користи своје компаративне предности у подстицању тих иновација. Даље, постоје и извесни докази о најбољим генеративним новооснованим предузећима из области вештачке интелигенције по земљама или регионима, наглашавајући водеће играче са аспекта укупно прикупљеног капитала и године оснивања. Економске снаге генеративне вештачке интелигенције оправдавају значајне финансијске инвестиције од стране земаља као што су САД, Кина и кључне чланице Европске уније. Укупан капитал прикупљен у овим новооснованим предузећима потврђује круцијалну улогу коју приватне инвестиције имају у подстицању иновација на пољу вештачке интелигенције. На крају, у раду се сагледава однос инвестиција у вештачку интелигенцију и економског развоја. Вештачка интелигенција доприноси економском развоју стимулишући раст продуктивности кроз аутоматизацију производних процеса, као и експанзијом потрошње. Генерално, утицај вештачке интелигенције је евидентнији последњих година имајући у виду акумулирани ефекат иновација генерисаних током времена. Иако су бенефити од вештачке интелигенције глобални и остварују их све земље, Кина и Северна Америка доминирају, а одмах после њих и Јужна и Северна Европа, и Азија. Стога, може се закључити да земље које доминирају по инвестицијама у вештачку интелигенцију истовремено остварују и највеће економске користи.

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CONSUMER ONLINE SHOPPING BEHAVIOUR IN THE REPUBLIC OF SERBIA POST-COVID-19

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Abstract

The COVID-19 pandemic has drastically changed the way individuals and companies function. Several authors investigated consumer behavior after the appearance of the virus. However, no study in Serbia examined online shopping patterns after the pandemic, i.e., after the official declaration of the end of the pandemic by the World Health Organization in May 2023 (post-COVID-19). The aim of this paper is to explore whether there is a significant association between purchasing online before and in the post-COVID-19 period, as well as between consumer age and location and purchasing behavior in the post-COVID-19 period. The data of 298 respondents from Serbia was collected during January 2024. The Chi-square test results indicated a relationship between online shopping habits before and after the pandemic, with 73% of previous non-online shoppers adopting e-commerce in the post-pandemic period. However, the results also revealed no significant association between age or location and the decision to shop online after the pandemic. The study suggests that businesses should prioritise enhancing online shopping platforms, as many consumers have continued or begun using them. Furthermore, it recommends that businesses implement broader, more uniform strategies. Moreover, the study provides a theoretical contribution by expanding knowledge on consumer behavior in the post-pandemic period.

Key words: consumer behaviour, COVID-19, purchase, online shopping, post-COVID-19.

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ПОНАШАЊЕ ПОТРОШАЧА ПРИЛИКОМ ОНЛАЈН КУПОВИНЕ НАКОН COVID-19 ПАНДЕМИЈЕ У РЕПУБЛИЦИ СРБИЈИ

Апстракт

Пандемија вируса *COVID-19* значајно је променила начин на који појединци и компаније функционишу. Неколико аутора је истраживало понашање потрошача након појаве вируса, међутим, у Србији није спроведено истраживање које би испитало и упоредило обрасце онлајн куповине после пандемије, тј. у периоду након званичног проглашења завршетка пандемије од стране Светске здравствене организације у мају 2023. године (пост-*COVID-19*). Циљ овог рада је да се истражи да ли постоји значајна повезаност између куповине путем интернета пре и у пост-*COVID-19* периоду, као и између старосне доби и локације потрошача и понашања у пост-*COVID-19* периоду. Подаци о 298 испитаника из Србије прикупљени су током јануара 2024. године. Резултати Хи-квадрат теста су указали на постојање везе између навика везаних за онлајн куповину пре и након пандемије, при чему је 73% ранијих некорисника онлајн куповине усвојило е-трговину у постпандемијском периоду. Међутим, резултати су такође показали да нема значајне повезаности између година и локације и одлуке да се купује онлајн након пандемије. Студија предлаже да предузећа треба да дају приоритет унапређењу онлајн платформи за куповину, јер многи потрошачи настављају или су започели да их користе. Поред тога, препоручује се да предузећа имплементирају шире и униформније стратегије. Такође, студија пружа теоријски допринос проширивањем знања о понашању потрошача у постпандемијском периоду.

Кључне речи: понашање потрошача, COVID-19, куповина, онлајн куповина (куповина путем интернета), пост-COVID-19 период.

INTRODUCTION

In recent years, the world faced a pandemic which began at the end of 2019. The coronavirus disease (COVID-19) was first identified in Wuhan, China, and represented a new strain of coronavirus that had not previously been detected in humans (European Centre for Disease Prevention and Control, n.d.). The severity of the virus is clear, as it had caused 7,031,216 deaths and registered 774,631,444 cases by February 2024 (World Health Organization - WHO, n.d.). To limit the spread of the virus between 2019 and 2023, governments worldwide implemented various measures, including restricting movement, closing malls and bars, enforcing mask mandates in public spaces, and promoting social distancing (Ivanović & Antonijević, 2020). The Republic of Serbia was one of the countries affected by the virus. As of February 29, 2024, Serbia had confirmed 2,473,599 cases, with 17,715 deaths (Ministry of Health of the Republic of Serbia COVID-19, n.d.).

The COVID-19 pandemic significantly altered consumer behavior and reshaped market dynamics. This shift was the result of a complex interplay between individual choices, societal responses, and evolving pub-

lic health measures. The pandemic's influence went beyond changing consumer preferences and also introduced new business challenges and opportunities. Numerous authors have examined the impact of the pandemic on consumer purchasing behavior (Bounie, Youssouf, & John, 2020; Kim, 2020; Hashem, 2020; Jensen, Yenerall, Chen, & Yu, 2021; Shen, Namdarpour, & Lin, 2022). Some studies have found that the COVID-19 pandemic has significantly impacted online shopping behavior, with people preferring the safety of online purchases over the risk of infection in physical stores (Soares et al., 2022; Szymkowiak et al., 2021). Bhatti et al. (2020) found that global online shopping increased due to COVID-19. Similarly, Donthu and Gustafsson (2020) examined how consumer purchasing patterns changed across various countries, revealing global trends such as a surge in online shopping, a shift in spending priorities toward essential goods, and a heightened focus on health and hygiene products. Additionally, a global study by Cruz-Cárdenas et al. (2021) conducted a bibliometric analysis to track the effects of COVID-19 on consumer behavior worldwide, showing how regions adapted to digital technologies and e-commerce platforms during lockdowns. Barrantes-Aguilar, Solís-Rivera and Villalobos (2023) reveal that in a sample of forty countries, digital consumer behavior evolved during the pandemic from a diverse range of characteristics to a more uniform pattern among consumers across different nations. The findings of Asuamah Yeboah (2023) highlight significant changes in consumer behavior in developing countries, including decreased spending on non-essential items, a growing dependence on online shopping platforms, a stronger preference for local and domestic products, and difficulties in maintaining brand loyalty. These shifts reflect the impact of the pandemic on consumption patterns and economic constraints. Gupta and Mukherjee (2022) reveal that those who had a positive experience during the pandemic showed a stronger sustainable self-identity, which led to more sustainable consumption practices and a shift towards online shopping in India. Consequently, individuals need to possess an adequate level of digital skills to effectively use digital services (Bradić-Martinović & Banović, 2018; Lazić, Vukmirović, Banović, Simović, & Paunović, 2023; Jevtić, Vuceković, & Tasić, 2023). Recognising the intricate relationship between consumer behavior and the diverse effects of COVID-19, Ivanović et al. (2020) identified significant differences in purchasing behavior before and during the COVID-19 pandemic in Serbia. The same authors also explored the main motivations for online shopping, the most commonly purchased goods and services, and payment methods. However, there is a lack of studies, both globally and in Serbia, that focus on consumer behavior after the official declaration of the end of the pandemic, creating a gap in understanding the trends in consumer habits. Bashar et al. (2023) conducted a bibliometric analysis of 635 articles on consumer behavior

during COVID-19, emphasising the need for future research to investigate changes in purchasing behavior both before and after the pandemic. Understanding behavioral changes can help businesses adjust their strategies to better meet consumers' needs and preferences. This analysis could also reveal shifts in priorities, spending habits, and the adoption of digital technologies, which are crucial especially for Serbia's future development. Additionally, it provides insights into market resilience and can help predict future trends. This study focuses on the Republic of Serbia, investigating whether consumer behavior changed following the end of the COVID-19 pandemic. The aim is to analyse consumer behavior during the post-declaration phase, after the World Health Organization (WHO) ceased classifying COVID-19 as a global health emergency in May 2023. Specifically, the authors examine whether consumer habits shifted between the pre-pandemic period and the post-declaration phase. Additionally, the study explores the relationship between post-COVID-19 online shopping behavior and socio-demographic variables such as age and location. By comparing key factors like the main motivations for online shopping, the most commonly purchased goods and services, and payment methods before and after the pandemic, this paper addresses gaps in previous research. The study offers a theoretical contribution by expanding knowledge on consumer behavior, and practical implications by providing relevant organisations with insights into individuals' online shopping habits.

LITERATURE REVIEW

Previous epidemics, such as SARS and MERS, have influenced humans by modifying their behavior and contributed to an increase in the number of online purchases. This stand is confirmed by Forster and Tang (2005) through their examination of SARS in Hong Kong. The COVID-19 pandemic significantly accelerated the shift toward online shopping (Asuamah Yeboah, 2023; Gupta & Mukherjee, 2022). Bhatti et al. (2020) and Donthu and Gustafsson (2020) also found a global rise in e-commerce, with consumers prioritising essential goods like food and hygiene products. Cruz-Cárdenas et al. (2021) highlighted how regions adapted to digital technologies during lockdowns, further entrenching online shopping habits. Das et al. (2022) observed increased demand for affordable substitutes in unorganised sectors, driven by financial constraints. Billewar et al. (2022) and Diaz-Gutierrez, Mohammadi-Mavi, and Ranjbari (2023) stated that the pandemic altered consumer behavior in both online and in-store shopping environments. Shen, Lin, and Namdarpour (2022) indicated a significant shift from in-store to online purchasing due to the pandemic. Additionally, Nikolić, Perčić, and Nećak

(2022) confirmed a change in the shopping behavior of Serbian consumers. Based on this, the following hypothesis is formulated:

H1 – There is a significant association between purchasing online before COVID-19 and in the post-COVID-19 period.

According to Slabá (2020), age significantly influences consumer behavior, a finding that was further supported by Truong and Truong (2022). During the initial phase of the pandemic, online shopping activity increased across all age groups in California (Young, Soza-Parra, & Circella, 2022). Furthermore, official data from Statista (2023) and Eurostat (2022) demonstrates differences in online shopping habits among various age groups. Additionally, Shen, Lin and Namdarpour (2022) showed that the elderly population, who previously did not purchase online, started online shopping after the appearance of COVID-19. Baubonienė and Gulevičiūtė (2015) indicate that e-commerce is most commonly used by individuals between the ages of 25 and 34. Other studies have also demonstrated that aging significantly impacts consumer behavior, leading to changes in preferences, attitudes, and decision-making processes (Shukla, 2023). Based on these previous studies, the following hypothesis is formulated:

H2 – There is a significant association between consumer age and purchasing online in the post-COVID-19 period.

Numerous studies have investigated the influence of location on shopping behavior (Widowati & Purwanto, 2014; Bell, 2014; Shobirin et al., 2016; Ariyanti & Fachrodji, 2021). Ren and Kwan (2009) suggest that individuals with limited access to nearby stores are more likely to shop online. Conversely, Adibfar, Gulhare, Srinivasan, and Costin (2022) found that the area of residence (urban/rural) does not significantly impact consumers' e-commerce behavior. Based on this, the following hypothesis is defined:

H3 – There is a significant association between consumer location and purchasing online in the post-COVID-19 period.

In the following section, the authors provide an overview of data from the Statistical Office of the Republic of Serbia. The analysis spans the period before, during, and after the declaration of the end of the pandemic (2018-2023).

Online Shopping in the Republic of Serbia (2018-2023)

Table 1 shows the frequency of online purchases by individuals in the Republic of Serbia in the period between 2018 and 2023 in percentages.

Table 1. Frequency of online purchases of individuals (%) in the period 2018-2023 in the Republic of Serbia

Frequency of online purchases	Year					
	2018	2019	2020	2021	2022	2023
In the last 3 months	30.9	34.2	36.1	42.3	47.8	51.0
More than 3 months (less than 1 year)	14.6	9.7	11.8	10.6	15.7	13.2
More than a year	9.1	13.1	9.1	8.2	9.5	9.2
Never used	45.4	43.0	43.0	39.0	27.1	26.6

Source: Statistical Office of the Republic of Serbia (2023)

It can be observed that during the 2018-2023 period, the share of those who have never purchased online decreased, indicating the popularity of e-shopping. Table 1, which presents statistical data on the frequency of online purchases in Serbia from 2018 to 2023, aligns closely with the results of our study. The table shows a clear increase in the percentage of individuals who reported online purchases in the last three months at the time of completing the survey, rising from 30.9% in 2018 to 51.0% in 2023. This trend reflects the growing adoption of e-commerce, particularly during and after the COVID-19 pandemic.

Our study results are consistent with these statistics, as we observed that a significant number of respondents continued to shop online in the post-pandemic period, with 73.33% of individuals who had not shopped online before the pandemic adopting this behavior after the pandemic. This reinforces the idea that the pandemic catalysed the widespread acceptance of online shopping in Serbia. Additionally, our findings showed that those who were already engaged in online shopping before the pandemic have maintained this habit, further contributing to the upward trend observed in Table 1. The alignment between national statistical data and our survey results enhances the validity of our conclusions, highlighting the long-term impact of COVID-19 on consumer behavior and the need for ongoing improvements to online shopping platforms in Serbia.

Table 2 presents the list of goods or services purchased (ordered) online for private use in the previous year.

Table 2. List of top five goods or services bought (ordered) online for private use in the previous year shown in % of individuals

Goods or services	2018	Goods or services	2023
Clothes, sports goods	55.5	Clothes, shoes, accessories	69.7
Household goods	22.6	Sports equipment	28.1
Electronic equipment	18.3	Furniture, home goods	17.2
Books/magazines/newspapers	12.2	Food Delivery	17.2
Medicines	8	Other	16.6

Source: Statistical Office of the Republic of Serbia (2023a)

It is evident that *clothes we*re the most popular category in both years. These statistics align with U.S. official data (Statista, 2023a), in which clothes and shoes are the two most popular categories for online purchases. After the appearance of COVID-19, ordering food online has become popular among individuals, resulting in a high position of category *Food delivery* (Glovo, Wolt, etc.). Table 3 shows the frequency of individuals' online purchasing. Forster and Tang (2005) stated that besides the increased online shopping due to the epidemic, the most bought products were cleaning and existential products. In the case of MERS in South Korea, Jung et al. (2016) found that the highest share of goods purchased online consists of grocery products.

Table 3. Frequency of online shopping in the previous three months (2018-2021)

Frequency	2018	2019	2020	2021
1-2 times	57	53.2	51	64.1
3-5 times	27.2	30.6	35.1	30.2
6-10 times	10.2	9.4	10.2	4.4
More than 10	5.6	6.8	3.6	1.3

Note: For the years 2022 and 2023, the Statistical office did not provide the same analytics preview, so the authors did not include data in a table.
Source: Statistical Office of the Republic of Serbia (2023)

Based on the available data from Table 3, it can be concluded that during the period between 2019 and 2021, the percentage of those who purchased 1-2 times in the last three months increased at the time of completing the survey, while the share of those who made online purchases more than ten times decreased. Table 4 provides an overview of money spent on online shopping.

Table 4. Money spent by individuals on online shopping in the Republic of Serbia in the previous three months (% of individuals) in the period 2018-2021

Money spent (in EUR)	2018	2019	2020	2021
Less than 50	55.4	59.7	55.6	49.5
50-100	23.4	24.8	22.1	28.5
100-500	17.3	12.6	18.5	15.2
500-1,000	2.1	0.9	1.8	0.7
1,000 and more	0.7	1	0.1	0.1

Note: For 2022 and 2023, the Statistical office did not provide the same analytics, so the authors did not include data in a table.
Source: Statistical Office of the Republic of Serbia (2023a)

Table 4 shows that most individuals bought goods (or services) for less than 50 EUR each year of the observed period. Additionally, more people spent between 50 and 100 EUR in 2021 (compared to 2018-2020). The cause for that could be the financial aid provided to citizens by the government of the Republic of Serbia to reduce the consequences of COVID-19.

METHODOLOGY

The total sample size of 298 respondents from Serbia comprised 82.55% women and 17.45% men. The structure of the sample by age category is shown in Table 5.

Table 5. The structure of the sample by age group (%)

Age group	%
18-24	25.50
25-34	44.97
35-44	14.77
45-54	10.07
55-64	3.36
Other	Below 1%

Source: Authors

The respondents belong mainly to the age groups 25-34 and 18-24. These statistics align with official Statista data (2023), indicating that Instagram users, one of the main survey distribution channels, are predominantly aged between 25 and 34 years (30.3%), and 18 and 24 years old (30.8%).

The primary location of the respondents is Belgrade (77.85%), with other cities that make up a total of 12.15%. That corresponds with the official statistics of the Republic of Serbia (2023), which show that Belgrade is the largest city with approximately ¼ of the total population.

For this study, the authors used the same instrument used in the study conducted in 2020, but with adaptations specific to this research. The reason for using an almost identical online questionnaire is to have consistency in analysis. The questionnaire was distributed via social networks: LinkedIn, WhatsApp, Viber, Facebook, and Instagram.

The questionnaire consists of six socio-demographic questions and questions regarding shopping habits before and after the pandemic, with a detailed examination of the behavior of online shopping users (frequency of buying online, motives for purchase, category of goods/services, payment methods, etc.) and non-users (the reasons for not shopping online). The estimated average time for filling out the survey is less than five

minutes. The survey was distributed in January 2024, i.e., in the post-COVID-19 period (after May 2023).

To examine and determine the significance of the association between the mentioned variables, we used the Chi-Square test with a significance level of 5%.

RESULTS AND DISCUSSION

The results show that most online shopping users purchased clothes and sporting goods (Table 6). Ivanović et al. (2020) also reported similar findings during the pandemic.

Table 6. Category of goods or services that respondents in Serbia purchased or ordered over the Internet (e-commerce) for private use in the post-COVID-19 period

Category of goods	%
Clothes, sports goods	39.79
Books/magazines/newspapers	26.64
Tickets for events	26.27
Other	7.30

Source: Authors

The motives for online purchases in the post-COVID-19 period are outlined in Table 7. The most common reason was the desire to save time compared to in-store shopping, a finding consistent with the observations of Huseynov and Yildirim (2016), and Mittal (2013), who emphasised the significance of time-saving in the context of busy lifestyles. On the other hand, some authors have pointed out challenges in online purchasing, mainly due to the inability to physically interact with products, such as feeling, smelling, or trying them out (Katawetawaraks & Wang, 2011; Al-Debei et al., 2015). Interestingly, laziness was mentioned as a motive, though it accounted for less than 1%.

Table 7. Motives for online purchasing in the post-COVID-19 period (% of respondents)

Motives	%
Saving time	40.92
Better conditions with online ordering	32.62
Lower costs	19.69
More free time	6.15
Lazy to purchase in-store	0.62

Source: Authors

During the pandemic, individuals in Serbia bought online because many stores operated exclusively on the Internet. Additionally, individuals wanted to minimise health risks and save time (Ivanović et al., 2020).

Table 8. Payment methods

Method	%
Cash on delivery	36.69
By card	33.87
M-banking	19.35
E-banking	10.08

Source: Authors

As indicated in Table 8, the predominant payment method is cash on delivery. This finding aligns with previous studies where this method consistently outranked e-payment options (Purwandari, et al., 2022). Halaweh (2018) noted that cash on delivery remains a preferred method due to concerns over online payment security. However, in contrast, countries like the United States experienced a stronger shift toward e-payments during the pandemic (Jensen et al., 2021), reflecting varying levels of trust and digital infrastructure across different regions. The continued preference for this payment approach is attributed to customers' apprehension, stemming from a perceived lack of security and trust in alternative payment methods. Furthermore, a segment of unbanked individuals exclusively use cash for transactions (World Bank, 2021).

The Chi-Square test results are shown in Tables 9, 10, and 11.

Table 9. Chi-Square test of H1

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	52.122	1	.000		
Continuity Correction[b]	48.944	1	.000		
Likelihood Ratio	49.547	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	51.947	1	.000		
N of Valid Cases	298				

Source: Authors' calculation

Results from Table 9 show that the p-value (p=0.000) is lower than the alpha (α=0.05). It means that the null hypothesis is rejected, and it can be concluded that there is a significant association between purchasing online before and in the post-COVID-19 period.

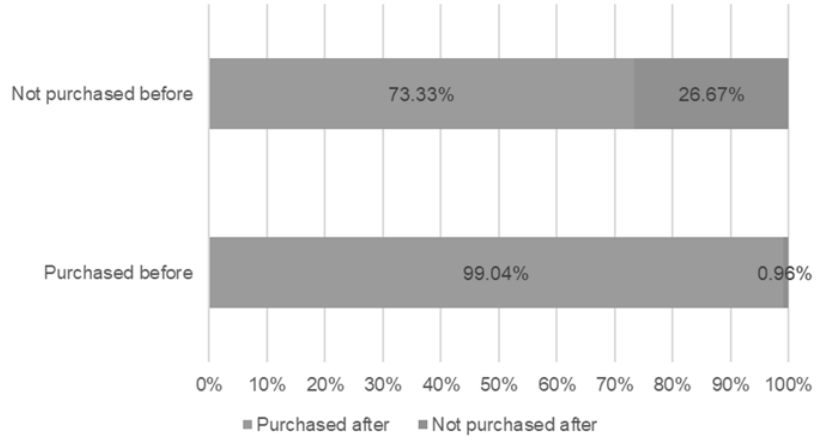

Figure 1. Consumer behavior before COVID-19 and in the post-COVID-19 period

Thus, around 73% of those who had never bought before purchased in the post-COVID-19 period, while 99% of those who purchased before continued purchasing in the post-COVID-19 period (Figure 1).

The result aligns with the findings of Ivanović et al. (2020), considering they found a significant association between consumer behavior before and during a pandemic. Diaz-Gutierrez et al. (2023) found that customers did not fully transition to online purchasing. The study suggests that, following the COVID-19 pandemic, many individuals reverted to in-store purchasing. Kumar et al. (2024) stated that changes resulting from COVID-19 led to a shift towards online purchasing, with more people opting for this method over in-store shopping. Similar findings were reported in other regions, such as the United States, where Jensen et al. (2021) observed a substantial increase in online shopping during the pandemic, which persisted post-pandemic. Similarly, Bhatti et al. (2020) documented a global rise in e-commerce during COVID-19, emphasising that digital transformation accelerated across various sectors, reinforcing our results which show a strong continuation of online shopping. Additionally, respondents who did not shop online after the pandemic (4.4% of the total sample) most commonly cited the following reasons for avoiding online shopping: a preference for seeing products in person (76.9%), uncertainty about product quality (38.5%), and long delivery times (30.8%). These findings are in line with Daroch, Nagrath, and Gupta (2021), Karthikeyan (2016), and Alam and Elaasi (2016).

The results presented in Table 10 show that the p-value is higher than the alpha, indicating a non-significant association between consumer age and online purchasing behavior in the post-COVID-19 period. Ullah et al. (2019) similarly found no significant relationship between consum-

ers' age and purchasing decisions. Although younger demographics are increasingly using the internet and online platforms for shopping (Statista, 2023), older individuals also continue to use these platforms, either as a habit developed during the pandemic or as a more efficient method of shopping. In contrast, Vasudeva (2022) and Slabá (2019) found different results. Vasudeva (2022) observed that age influences consumer behavior in the socio-digital era, while Slabá (2019) concluded that age significantly affects consumer behavior.

Table 10. Chi-Square test of H2

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.311	1	.577		
Continuity Correctionb	.105	1	.746		
Likelihood Ratio	.302	1	.583		
Fisher's Exact Test				.641	.363
Linear-by-Linear Association	.310	1	.578		
N of Valid Cases	298				

Source: Authors

As indicated in Table 11, the p-value surpasses the alpha level (α=0.05), implying no significant association between consumer location and online purchasing in the post-COVID-19 period. This finding aligns with the results of Singhdong and Setyawan (2016), who concluded that customers' location does not influence purchase decisions, while Brata et al. (2017) and Rizal et al. (2017) reported the opposite results. Furthermore, Ren and Kwan (2009) suggested that geographical location, particularly access to physical stores, plays a crucial role in consumers' shopping decisions. Thus, individuals may prefer purchasing online when the store is not so nearby.

Table 11. Chi-Square test of H3

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.228	1	.268		
Continuity Correction[b]	.741	1	.389		
Likelihood Ratio	1.143	1	.285		
Fisher's Exact Test				.321	.192
Linear-by-Linear Association	1.224	1	.269		
N of Valid Cases	298				

Source: Authors

CONCLUSION

The COVID-19 pandemic significantly reshaped consumer behavior, altering market dynamics through a complex interplay of individual choices, societal responses, and evolving public health measures. This study examines online shopping habits before and after COVID-19 and explores the relationship between consumer demographics, such as age and location, and post-COVID-19 purchasing behavior. The findings of this research provide a solid foundation for future studies, as the post-COVID-19 effects on consumer behavior remain underexplored, particularly in the Republic of Serbia.

The Chi-Square test was used to evaluate the hypotheses, revealing a significant association between pre-pandemic and post-COVID-19 behavior. However, neither age nor location showed a statistically significant relationship with post-COVID-19 purchasing behavior. Notably, consumers who purchased online before the pandemic continued doing so afterward. For those who had not previously shopped online, 73.33% changed their behavior and began purchasing online in the post-COVID-19 period.

The study also found that the most frequently purchased items included clothing and sports goods, household items, electronic equipment, and books (magazines and newspapers). A shift in consumer behavior was observed, with consumers focusing on essential goods like groceries and medicines during the pandemic, and transitioning to non-essential, higher-priced items such as electronics and household goods in the post-pandemic period. The primary motives for online shopping after the pandemic were time-saving and better conditions offered by online platforms. The most common payment methods were cash on delivery and card payments. Theoretically, the study contributes to the existing body of knowledge on consumer behavior by providing insights into online shopping habits in Serbia, and by offering a deep understanding of behavior patterns before and after the pandemic. The practical implication is that businesses should prioritise maintaining the quality of their online platforms and develop strategies to attract individuals who do not currently shop online. Companies should therefore adopt a more effective approach to persuade non-users by emphasising the numerous advantages of online shopping. Policymakers should take appropriate steps to enhance trust among individuals, strengthen digital literacy, and increase confidence in e-payment systems, thereby addressing the preference for cash on delivery and encouraging the adoption of secure online payment methods.

There are several limitations to this study. First, the sample size is relatively small, which may limit the generalisability of the findings to the broader population. Future studies should include a larger sample to improve the robustness of the results. Second, women were predominant in the sample, as they are generally more likely to participate in online surveys (Becker, 2022; Smith, 2008). This gender imbalance may skew the re-

sults, so future research should ensure a more balanced gender representation to accurately reflect consumer behavior. Third, distributing the questionnaire via social media platforms, while effective in reaching a large audience, may have introduced selection bias, as social media users tend to be younger and more digitally engaged. Future studies should incorporate a combination of survey methods. Fourth, only two socio-demographic variables are included in the analysis (age and location). Future studies should incorporate a wider range of socio-demographic variables such as gender, income, education level, occupation, marital status, and digital literacy level, to provide a more comprehensive understanding of this topic. Fifth, the study is conducted only on the Serbian population. Conversely, further research should incorporate other countries to compare consumers' purchasing habits. Additionally, longitudinal studies are recommended to provide a more detailed understanding of changes in consumer behavior over time.

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ПОНАШАЊЕ ПОТРОШАЧА ПРИЛИКОМ ОНЛАЈН КУПОВИНЕ НАКОН COVID-19 ПАНДЕМИЈЕ У РЕПУБЛИЦИ СРБИЈИ

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Резиме

Пандемија вируса COVID-19 значајно је променила начин на који појединци и компаније функционишу. Циљ ове студије је да утврди да ли постоји значајна веза између куповиних навика пре и после пандемије, као и да ли постоји повезаност између демографских карактеристика (старост и место пребивалишта испитаника) и понашања потрошача у пост-COVID-19 периоду.

Истраживање је спроведено у Србији на узорку од 298 испитаника током јануара 2024. године. Резултати Хи-квадрат теста показују да постоји значајна повезаност између куповних навика пре и после пандемије. Међутим, старост и место пребивалишта нису имали значајну повезаност са онлајн куповином након пандемије. Откривено је да су потрошачи који су раније куповали онлајн наставили са својом навиком и након пандемије, док је 73.33% оних који претходно нису куповали онлајн почело да купује на овај начин. Доминантне категорије производа које су биле предмет куповине након пандемије укључују одећу, кућне апарате и електронску опрему. Основни мотиви за онлајн куповину након пандемије били су уштеда времена и бољи услови наручивања, а најчешћи методи плаћања били су готовином при достави и плаћање картицом. Студија представља адекватну основу за будућа истраживања о понашању потрошача, узимајући у обзир могућност неочекиваних околности са којима се појединци могу суочити на глобалном нивоу.

APPENDIX – QUESTIONNAIRE

1. Gender
◯ Female
◯ Male

2. Age
◯ Under 18 years
◯ 18-24
◯ 25-34
◯ 35-44
◯ 45-54
◯ 55-64
◯ 65-74
◯ 74+

3. Place of residence
- ◯ Beograd
- ◯ Novi Sad
- ◯ Niš
- ◯ Kruševac
- ◯ Čačak
- ◯ Valjevo
- ◯ Sombor
- ◯ Pančevo
- ◯ Kikinda
- ◯ Subotica
- ◯ Zrenjanin
- ◯ Sremska Mitrovica
- ◯ Užice
- ◯ Šabac
- ◯ Jagodina
- ◯ Kraljevo
- ◯ Kragujevac
- ◯ Bor
- ◯ Požarevac
- ◯ Zaječar
- ◯ Leskovac
- ◯ Pirot
- ◯ Smederevo
- ◯ Vranje
- ◯ Prokuplje
- ◯ Priština
- ◯ Kosovska Mitrovica
- ◯ Gnjilane
- ◯ Peć
- ◯ Prizren
- ◯ Novi Pazar
- ◯ Loznica

4. Before the outbreak of COVID-19 (coronavirus), did you purchase/order products or services online?
- ◯ Yes
- ◯ No

5. Since the end of the pandemic (May 2023), do you purchase/order products or services online?
- ◯ Yes (Proceed to question 6)
- ◯ No (Proceed to question 12)

Behavior since the end of the pandemic - May 2023

6. How frequently do you purchase/order products or services online?
◯ Daily ◯ 2-5 times a week ◯ Once a week ◯ 2-3 times a month ◯ Once a month

7. What are the reasons for your online purchases?
- ☐ Lower prices
- ☐ Time savings
- ☐ More free time
- ☐ Many stores offer better conditions through online ordering
- ☐ Other

8. What do you most frequently purchase/order online?
- ☐ Food and groceries
- ☐ Pharmaceutical and hygiene products
- ☐ Clothing and sports equipment
- ☐ Household items (furniture, toys, etc.)
- ☐ Books, magazines, newspapers
- ☐ Accommodation (hotels, etc.)
- ☐ Electronics
- ☐ Tickets for cultural events
- ☐ Telecommunications services
- ☐ Games
- ☐ Movies and music
- ☐ Hardware
- ☐ Other

9. Please indicate how many times you have purchased the following products:

	Never	Once	Twice	More than twice
Food and Groceries				
Pharmaceutical and Hygiene Products				
Clothing and Sports Equipment				
Household Items (Furniture, Toys, etc.)				
Books, Magazines, Newspapers				
Accommodation (Hotels, etc.)				
Electronics				
Tickets for Cultural Events				
Telecommunications Services				
Games				
Movies and Music				
Hardware				
Other				

10. What is the total amount you typically spend per order for products/services purchased online?
- ◯ Up to 1,000 RSD
- ◯ 1,000-5,000 RSD
- ◯ 5,000-10,000 RSD
- ◯ Over 10,000 RSD

11. How do you make payments?
- ◯ Credit/Debit card
- ◯ Cash on delivery
- ◯ E-banking (via the bank's website)
- ◯ M-banking (via mobile banking app on smartphone or tablet)
- ◯ Other

12. What are the reasons you do not shop online?
- ◯ The process is complicated
- ◯ I am not confident in the quality of the products
- ◯ Long delivery time
- ◯ High shipping costs
- ◯ I prefer to see and try the product in person
- ◯ I do not trust this type of shopping (I do not feel secure)
- ◯ Poor experience
- ◯ Other

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THE IMPACT OF FOREIGN DIRECT INVESTMENTS ON INCOME INEQUALITY IN CEE-11 AND WESTERN BALKAN COUNTRIES

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Abstract

Within Agenda 2030, the United Nations defined seventeen goals of sustainable development, whereby one of these goals is the decrease of inequality, and solving regional and global challenges. International investments (especially in the form of foreign direct investments) are stated as one of the important factors in the fight against economic inequality worldwide. The aim of the paper is the examination of the impact of foreign direct investments (FDI) on inequality in income distribution in CEE-11 and Western Balkan countries. A panel regression model was used as a methodological framework in the research, while the time framework was limited to the period between 1996 and 2020. It has been shown that FDI increase inequality in income distribution in two analysed periods: 1996-2020, and subperiod 1996-2008. Contrary to that, in subperiod 2009-2020, the income of FDI had a positive effect on income inequality, decreasing it. The research distribution is reflected in filling the gaps that exist in literature in this area, given that only a small number of papers examined the impact of FDI on income inequality in CEE-11, including the countries of the Western Balkans (WB).

Key words: income inequality, foreign direct investments, CEE-11 + WB, panel regression.

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УТИЦАЈ СТРАНИХ ДИРЕКТНИХ ИНВЕСТИЦИЈА НА НЕЈЕДНАКОСТ ДОХОТКА У ЕВРОПСКИМ ТРАНЗИЦИОНИМ ЗЕМЉАМА

Апстракт

У оквиру Агенде 2030, Уједињене нације су дефинисале седамнаест циљева одрживог развоја, при чему један од тих циљева јесте смањење неједнакости и решавање регионалних и глобалних изазова. Међународне инвестиције (посебно у облику страних директних инвестиција) наводе се као један од важнијих фактора у борби против економске неједнакости широм света. Циљ рада је испитивање утицаја страних директних инвестиција (СДИ) на неједнакост у расподели дохотка у земљама Централне и Источне Европе и Западног Балкана (CEE-11 + WB). Као методолошки оквир у истраживању, коришћен је панел регресиони модел, док је временски оквир ограничен на период између 1996. и 2020. године. Показано је да СДИ повећавају неједнакост дохотка у два анализирана периода: периоду 1996–2020. и потпериоду 1996–2008. Насупрот томе, у потпериоду 2009–2020. прилив СДИ је имао позитиван ефекат на неједнакост дохотка, смањујући неједнакост. Допринос истраживања се огледа у попуњавању гепа који постоји у литератури у овој области, будући да је мали број радова испитивао утицај СДИ на неједнакост дохотка у CEE-11, укључујући и земље Западног Балкана (WB).

Кључне речи: неједнакост дохотка, стране директне инвестиције, европске транзиционе земље, панел регресија.

INTRODUCTION

Inequality in income distribution represents one of the most common problems both in developed and developing countries. According to the World Inequality Report (2022), 10% of the richest world population possesses 52% of the global income, while the poorest 50% possesses only 8.4% of the global income. It means that the biggest part of the world population is quite poor. Almost 4 billion people in the world survive with less than 6.7 USD daily. As one of the important components of globalisation, foreign direct investments (FDI) can impact income inequality in a host country. On the one hand, economists and policy creators think that FDI can decrease income inequality contributing to the growth and development of a host country, through channels such as transferable managerial skills and modern technology, the access to export markets and human capital development. On the other hand, in spite of the fact they represent an important generator of economic development, FDI can increase income inequalities through the increase of salary inequalities in host countries and repatriation of profit in the home country (Wang et al., 2023).

The subject of this paper is the analysis of FDI impact on income inequality in the so called ‘new’ member countries of the EU (CEE-11) and the countries of the Western Balkans (CEE-11+ WB). In compliance with the chosen research subject, the aim of this paper is to examine,

through theoretical and empirical analysis, whether foreign direct investments have contributed to the decrease in income inequality in CEE-11+ WB. The hypothesis tested in the paper is the following:

H1: Foreign direct investments decrease income inequalities in CEE-11+ WB.

The contribution of this paper is twofold. First, the relation between FDI and income inequality in the CEE-11 and the countries of the Western Balkans is analysed in the paper, by which the gap that exists in literature is being filled. Second, the results of this paper have significant economic and political implications for the analysed countries.

The paper is structured as follows: After the introductory part, an empirical literature review is presented. Methodology gives the review of the model that is used for the empirical analysis and shows the resources of data used in the research. The empirical results demonstrate the impact of foreign direct investments on income inequality. In the concluding considerations, the main results to which we came across in the paper are summed up, and the main limitations of the paper, along with recommendations for future research are indicated.

LITERATURE REVIEW

The concern about a possible connection between FDI and income inequality within a country is often present in current political discourse and academic debates. Despite there being a great number of theoretical and empirical papers related to the examination of the relation between FDI and income inequality, there is no unique attitude regarding this question. In accordance with the so called hypothesis of optimal income disparities, there is a determined level of income inequality that is optimal from the point of view of economic growth. If income inequality is lower than the optimal level, the most productive and most qualified workers are not paid enough, and motivated to completely use their skills and abilities in doing business. When the income of these workers is not significantly different than the income of less qualified workers and is characterised by lower income, they can feel underestimated. This situation leads to a decrease in the efficiency of their work and motivation, as well as their desire for improvement. In this situation, the inflow of FDI can lead to a decrease in the growth of work productivity of the most qualified workers and the increase of their income. In this case, this can lead to the increase in the disparity of a country's income (Lipsey & Sjöholm, 2004). On the other hand, if income inequality is above the optimal level, less qualified workers earn less, which can cause a sense of injustice, exploitation and poverty. As a consequence of this, workers with smaller incomes are prone to think less creatively and are less dedicated to work. In such conditions, the location of FDI in a country due to lower incomes

can increase the incomes of employees and contribute to the decrease of income inequality (Misztal, 2020).

In order to illustrate the complexity of the relation between FDI and income inequality, Huang, Sim, and Zhao (2020), using meta-regression analysis applied on 543 empirical studies, conclude that 41% of the research discovered positive and statistically significant effects of FDI on income inequality, while the remaining 59% of the research stated that there is a negative or insignificant effect. How FDI will affect inequality depends to a great extent on the level of economic development (Shahbaz, Loganathan, Tiwari, & Sherafatian-Jahromi, 2017; Huang, Sim, & Zhao, 2020). Having in mind the aforementioned, the relation between FDI and inequality changes as a country develops (Wu & Hsu, 2012).

Empirical studies on the relation between FDI and income inequality can be classified into four groups. The first group of studies concludes that FDI worsen income inequality in the host country (Wu & Hsu, 2012; de Groot, 2014; Asteriou, Dimelis, & Moudatsou, 2014; Huang, Chen, Bihong, & Yang, 2017; Zulfiu Alili & Adnett, 2018; Khan & Nawaz, 2019; Ma & Ruzic, 2020; Phan, 2022). Some of the reasons for the growth of inequality are financial globalisation (Milanovic, 2005; Azis & Shin, 2015; Furceri & Ostry, 2019) and inequality in salaries between the qualified and the non-qualified work force (Figini & Gorg, 2011). The second group of papers concludes that FDI decrease income inequality (Ulcal, Haug, & Bilgin 2016; Rezk, Amer, Fahti, & Sun 2022) as a result of the improved management of the corporate and public sector (Hecht, Razin, & Shinar, 2002), bigger investments (UNDP, 2017), bigger savings (Beer, 2015), reaching a moderate democracy level (Gossel, 2022), bigger trade openness and infrastructure improvement (Tung, 2022), and a higher level of human capital (Yuldashev et al., 2023). The third group consists of studies that do not find a significant connection between FDI and inequality (Sylwester's, 2006; Franco & Gerussi's, 2013, Im & McLaren, 2015; Fazaalloh, 2019). The last group of papers comes to mixed conclusions. For example, in the research carried out for Latin America states, Calvo and Hernandez (2006) conclude that FDI decrease inequality only if pre-requisite capital and conditions for work favour overflow effects, while Bhandari (2007) concludes that FDI worsen inequality in salaries, but improve capital inequalities. Bogliaccini and Egan (2017), show that the inflow of FDI in the sector of services contributes to an inequality increase, while inflows into primary and industrial sector are not connected with the increase of income distribution inequality. In their research, Cho and Ramirez (2016) show that the inflow of FDI has the tendency to increase inequality in the short term, and decrease it in the long term, emphasising that developing countries should accept the negative impact as a compromise in the process of development. Lee, Lee and Cheng (2020) conclude that the benefits of FDI that decrease inequalities

weaken as countries become financially more developed. Nguyen (2021) concludes that FDI increase income inequality in developed countries, and decrease it in developing countries. Furthermore, in both group of countries, the manner of managing and education decrease inequality, while economic growth increases it. The negative effect of FDI on income inequality in developing countries, and their positive effect in developed countries is also in the paper of Wang et al (2023). Gam, Oanh and Dang (2023) show that FDI increase income inequality in developing countries. However, when FDI reach 99% of the GDP, income inequality decreases. This result shows that the relation between FDI and income inequality has the shape of an inverted-U curve.

When it comes to the relation between FDI and income inequality in transition countries, the literature is pretty scarce and ambiguous (Mihaylova, 2015; Josifidis, Supić & Bodor,, 2020). A positive relation between FDI and income inequality in European transition countries is confirmed in numerous papers (Bandelj & Mahutga, 2010; Grimalda, Barlow, & Meschi, 2010; Halmos, 2011; Asteriou, Dimelis, & Moudatsou, 2014). On the other hand, a negative relation between FDI and income inequality is proven in a significantly lower number of papers (Georgantopoulos & Tsamis, 2011; Braha-Vokshi et al., 2021; Josifidis, Supić, & Bodor, 2021). Bhandari (2007), Franco and Gerussi (2013), and Misztal (2020) do not find a statistically significant relation between FDI and income inequality.

METHOLOGY AND DATA

When choosing the sample, the choice is to observe the countries who are 'new' members of the EU (the CEE-11) and countries of the Western Balkans, for which there is available data. The sample consists of 14 European countries, of which 11 are the members of the EU (Poland, Czech Republic, Slovakia, Estonia, Latvia, Lithuania, Hungary, Slovenia, Bulgaria, Romania and Croatia), and the remaining three countries are EU candidates: the Republic of Serbia, North Macedonia and Albania. The research was carried out for the period between 1996 and 2020, as well as for two subperiods: 1996-2008 and 2009-2020. Secondary data from two data bases is used in the research: the World Bank and the United Nations (a detailed description of used variables is shown in the Appendix, Table A1). Panel data that has the character of balanced macro data is used in the research, and the formed model falls into the group of linear panel models. Bigger possibilities for identifying and measuring effects that cannot be established by using only the comparative data of more units of observation or only the time data of one unit of observation is an advantage of using panel data (Baltagi, 2005). Hsiao (2003) states that the advantages of using panel data are also reflected in the possibility of controlling individual het-

erogeneity, providing more and quality information, bigger variability and less collinearity between variables.

For testing the impact of FDI on income inequality, the following equation has been used:

$$GINI_{it} = \beta + \beta_1 FDI_{it} + \beta_k X_{kit} + \varepsilon_i + \nu_t + u_{it} \quad (1)$$

where: $GINI_{it}$ is a dependent variable and represents Gini index in country i in time t; FDI_{it} is an independent variable and is measured as a leap of FDI inflow as % GDP in country i in time t; X_{kit} represents control variables; ε_i represents individual effects; ν_t represents time effects (t = 1996… 2020); and u_t is an accidental error with null mean value and constant variance.

Control variables X_{kit} include GDP per capita in country i in time t (GDP_{it}), as a traditional measure of economic growth, enrolment in secondary school expressed in % of the total number of citizens (HSE_{it}), final public spending as % of GDP (PS_{it}) and unemployment rate (UR_{it}). The impact of independent variables on the dependent variable is assessed by using a Fixed Effects Model and a Random Effects Model. For the purpose of choosing an adequate and representative model, the choice between Fixed Effects Model and Random Effects Model was made by applying the Hausman test.

After choosing a corresponding model, the existence of autocorrelation and heteroscedascity were also examined, by applying the following tests: the Wooldridge test for autocorrelation problem identifying, and the Wald test for heteroscedascity problem identifying with fixed effects models, and the Breusch and Pagan Langrangian multiplier test for the random effects model.

For the purpose of obtaining a valid statistical conclusion when some of the assumptions of the basic regression model are violated, leaning on the robust standard errors is usual (Hoechle, 2007). Under the condition that residuals are independently distributed, standard errors obtained with the help of this estimator are consistent even if the residuals are heteroscedastic. In Stata consistent, or 'White' standard errors are obtained by choosing option vce (robust).

RESULTS AND DISCUSSION

For the purpose of checking the correlation and nature of the relation between independent variables, Pearson's Coefficient Correlation was used. The results of correlation analysis are shown in Table 1. The results of correlation analysis show that there is a slight or insignificant correlation between the independent variables.

Table 1. Correlation Matrix

	FDI_{it}	GDP_{it}	HSE_{it}	PS_{it}	UR_{it}
FDI_{it}	1.000	-	-	-	-
GDP_{it}	0.5284	1.000	-	-	-
HSE_{it}	0.3907	0.6975	1.000	-	-
PS_{it}	0.0502	0.1656	0.2648	1.000	-
UR_{it}	-0.0663	-0.3446	-0.2512	0.0154	1.000

Source: Authors

On the basis of the analysis of the Hausman test (Table 2), it can be concluded that it is better to apply the Fixed Effects Model than the Random Effects Model in order to assess the impact of the independent variables on the dependent variable in all three of the observed periods.

Table 2. Results from Hausman test

Hausman test	Ho: Cross- section random effects
1996-2020	chi2(4)=17,80, prob>chi2=0,001
1996-2008	chi2(5) = 20,06, prob>chi2 =0.001
2009-2020	chi2(4) = 18,56, prob>chi2 =0,001

Source: Authors

Before interpreting the obtained assessments, the results of testing autocorrelation and heteroscedascity are shown (Table 3). The Wald test was used to test for the presence of heteroscedascity, and the Wooldridge test was used to test for autocorrelation. The results of the Wald test in this research show that the null hypothesis on the non-existence of heteroscedascity is not accepted in all three of the analysed periods, and there is a heteroscedascity, i.e. the variance of residual deviation is not equal. The results of testing for the existence of autocorrelation show that the null hypothesis on the non-existence of autocorrelation is not accepted, and it is concluded that there is autocorrelation, i.e. random errors are mutually correlated in the 1996-2020 and 2009-2020 periods.

Table 3. Results from diagnostic checks

	Wald test for group-wise heteroscedasticity Ho: Homoscedastic variances	Wooldridge test for autocorrelation Ho: No serial correlation
1996-2020	chi2(14)=7890,18 p>chi2 =0,000	F(1,13)=12.958 p>F=0.003
1996-2008	chi2(14)=3100,49 p>chi2 =0,000	F(1,13)=4.808 p>F=0.047
2009-2020	chi2(14)=1231,46 p>chi2 =0,000	F(1,13)=43,730 p>F=0.000

Source: Authors

On the other hand, in the 1996-2008 period, there is no autocorrelation. In cases when some of the assumptions of the basic regression model are violated, relying on the robust standard errors is usual for the purpose of obtaining valid statistical conclusions.

In that sense, we used the vce(robust) estimation of variance. This estimator is robust to some types of misspecification (i.e. heteroscedasticity, autocorrelation) so long as the observations are independent. After putting into control the problems of heteroscedascity and autocorrelation, the indicators obtained within panel regression analysis and regression coefficients are shown in Table 4. Via the analysis carried out for the observed group of countries, the following results were obtained. First, within the observed time period – between 1996 and 2020, there is a statistically significant impact of FDI and GDP per capita on income inequality, while other variables do not have a statistically significant impact on income inequality. An increase of FDI inflow by 1% increases inequality of income by 0.05%, and an increase of GDP per capita by 1% decrease inequality by 0.01%. The chosen model is representative, which is confirmed by the value F of statistics, which amounts to 7.54. The value of determination coefficient of 0.273 implies that 27.3% of the variability of the variable Gini index is explained by the model. Second, in the pre-crisis 1996-2008 period, there is also a statistically significant impact of FDI on income inequality. An increase of FDI inflow by 1% impacts the increase of income inequality by 0.05%. Other analysed variables do not have an impact on income inequality. The chosen model is representative, which is confirmed by the value F of statistics, which amounts to 2.37. The value of the determination coefficient of 0.117 implies that 11.7% of the variability of the variable Gini index is explained by the model. Finally, research results show that even in the post-crisis period between 2009 and 2020, there is a statistically significant impact of FDI on income inequality. Unlike the previous two periods, in this period, the relation between FDI and inequality is inverse, i.e. the growth of FDI by 1% decreases inequality by 0.06%. As in the previous case, other analysed variables do not have a statistically significant impact on income inequality. The value F of statistics, which amounts to 3.69, confirms the representativity of the model, while the value of the determination coefficient of 0.1165 shows that 11.7% of the variability of the variable Gini index is explained by the model. Some points should be made. From 1996 to 2008, the analysed countries were in a transition period, wherein unemployment was high. Foreign direct investments inward in that period only increased economic inequality. It should be said that, at lower levels of human capital and economic development, FDI tends to increase income inequality. That effect was strong, which was also reflected in the entire observation period of this relationship. After the crisis and the recovery of the analysed countries, they achieved a higher level of devel-

opment, and foreign direct investments directed into the economy had a positive effect on the inequality in income distribution. So, after higher levels of human capital and economic development are reached, FDI can even contribute to a reduction of income inequality. In this sense, there are some signals of the existence of the EKC hypothesis, which could be empirically examined in future research.

Table 4. Evaluated model specifications

	$GINI_{it}$		
Variable	FE 1996-2020	FE 1996-2008	FE 2009-2020
FDI_{it}	0.0485**	0.0480**	-0.0593*
	(0.0161)	(0.0196)	(0.0299)
GDP_{it}	-0.0001***	-0.00005	-0.000076
	(0.00003)	(0.0001)	-(0.00007)
HSE_{it}	0.0393	0.0594	0.0379
	(0.0473)	(0.0928)	(0.0638)
PS_{it}	-0.0437	-0.0906	0, 2889
	(0.1003)	(0.2611)	(0.4267)
UR_{it}	-0.0015	0.1322	-0.0228
	(0.0485)	(0.1321)	(0.0615)
Constant	29.8577	26.6687	29.105
	(4.5134)	(10.523)	(11.519)
No. of observations	350	182	168
R^2	0.2732	0.1171	0,1165
F	7.54	2.37	3.69

*Note: standard errors are in brackets, * p<0.1; ** p<0.05; *** p<0.01.*
Source: Authors

CONCLUSION

Along with the growth of income inequality, upon commencing the process of transition, there was an increased inflow of foreign direct investments into these countries, which encouraged the research on this subject of the relation between FDI and income inequality in transition economies. The results of this research show that, in the entire analysed period, larger FDI inflow increases income inequality. The same result was obtained for the pre-crisis period as well (1996-2008). On the other hand, in the post-crisis period – between 2009 and 2020, it has been proven that FDI have a positive effect on income inequality, i.e. they decrease it. In accordance with the aforementioned, the initial hypothesis can be only partially accepted. The increase of income inequalities as a consequence of FDI inflow in the pre-crisis period can be explained by the fact that, during the first years of transition, privatisation represented a key channel for investment. Privatisation led to mass lay-offs, and redirected

wealth to a few members of the 'elites.' Besides, the FDI inflow in transition countries at the beginning of transition was small, since their economic and political surrounding (decline in production, high inflation rate, underdeveloped financial market, and political instability) was not attractive to foreign investors. After 2004, and after several of the analysed countries joined the European Union, there was an increase in employment in the domestic sector, and a decrease in the gap between the foreign and the domestic sector – hence, a decrease in income inequality. A larger scope and better quality of FDI realised due to institutionalised and economic reforms, undertaken for the purpose of joining the EU, also contributed to the decrease of income inequality. Besides, after joining the EU, the countries of Central and Eastern Europe improved their absorption capacities, so that the quality and not the price of work had a more and more important role in attracting foreign investments. Through that, the countries realised the benefits of having an educated work force and technological transfers derived from FDI inflow.

The limitation of this research is reflected in the deficiency of data for certain countries of the Western Balkans, due to which it was not possible to include them in the analysis. Furthermore, the research included the period in which the effects of the global economic crisis and debt crisis were manifested, which had a great impact on the obtained results of the research. In such conditions, there can be significant deviations from the cyclic movement of certain variables in relation to their long-term trend. Besides, the countries of the Western Balkans faced numerous social and political problems during the 1990s, even disputes, which had a great impact on their income, as well as other variables included in the analysis, which explains the obtained results in this research. One of the recommendations for future research is focusing on transmission channels, by means of which FDI manifest the impact on income inequality. Furthermore, it is of great importance for future research to establish sector structures of FDI, i.e. whether and to which extent they are directed to the parts of economy that can lead to the transfer of modern technologies and the creation of well-paid work positions, and in which way they can contribute to the greater economic development of a country.

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УТИЦАЈ СТРАНИХ ДИРЕКТНИХ ИНВЕСТИЦИЈА НА НЕЈЕДНАКОСТ ДОХОТКА У ЕВРОПСКИМ ТРАНЗИЦИОНИМ ЗЕМЉАМА

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Резиме

Доходовна неједнакост се повећала у развијеним и у земаљама у развоју током протеклих деценија, у условима растуће глобализације. Још увек не постоји консензус да ли су стране директне инвестиције као један од главних покретача глобализације допринеле порасту доходовних неједнакости. Утицај СДИ на неједнакост дохотка привлачи пажњу из више разлога. Прво, неједнакост дохотка негативно утиче

на економски раст. Друго, пораст неједнакости у дохотку може угрозити напредак у смањењу сиромаштва. Коначно, људи који су забринути за релативне приходе имају жељу да живе у равноправном друштву. Дакле, ако СДИ повећају неједнакости дохотка, њени позитивни ефеки на економски раст ће бити замењени нижом стопом раста, као и другим социоекономским негативним ефектима. Ово представља посебно велику бригу за земље у развоју, које су у великој мери зависне од СДИ. У овим земљама социјална стабилност игра кључну улогу у економском развоју. У овом раду је анализиран утицај СДИ на доходовну неједнакост у тзв. „новим" земљама чланицама ЕУ (CEE-11) и земљама Западног Балкана. Циљ рада је да испита да ли су СДИ допринеле смањењу неједнакости дохотка у европским транзиционим земљама. У истраживању је коришћен панел регресиони модел. Резултати истраживања се разликују у зависности од временског периода који је анализиран. СДИ повећавају неједнакост дохотка у два анализирана периода: 1996–2020. и 1996–2008. године, а смањују у периоду после кризе 2009–2020. године. Раст неједнакости условљен страним директним инвестицијама пре кризе резултат је чињенице да је у првим годинама транзиције приватицазија представљала кључни облик инвестирања, као и мали прилив СДИ на почетку транзиције због њиховог економског и политичког окружења. Поред повећаног прилива СДИ у ове земље након приступања Европској унији, повећава се и њихов квалитет, чиме се може објаснити позитиван утицај СДИ на неједнакост дохотка након кризе. Осим обима и квалитета СДИ, побољшан је и апсорбциони капацитет земаља Централне и Источне Европе, што је резултирало у томе да квалитет, а не цена рада, постане све важнији приликом привлачења страних инвестиција.

APPENDIX

Table A1: Name of variables, description and source of data

Name of variable	Description	Source
Gini index	Data on income inequality calculated on the basis of available income. All the people were included in the survey and unit of observation is a household.	UNU-WIDER WIID World Income Inequality Database
FDI inflow	Stock of FDI measures total level of direct investments in given moment, usually at the end of a year or quarter. It is expressed as % of GDP.	UNCTAD
Secondary school enrollment	It is measured as the relation of total enrollment of population of all ages and population that officially corresponds to the shown level of education.	World Development Indicators
Final public spending	Shows annual percentage of public spending growth, based on the constant local currency. The aggregates are based on constant (permanent) prices expressed in American dollars.	World Development Indicators
GDP *per capita*	GDP per capita is used in current international dollars and is expressed by the parity of purchase force.	World Development Indicators
Unemployment rate	Refers to the share of work force which is unemployed, but is available on work market and seeks employment.	World Development Indicators

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THE SUBJECTIVE EXPERIENCE OF LIFE MEANING AND IRRATIONAL BELIEFS AS PREDICTORS OF LIFE SATISFACTION

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Abstract

There has been an increasing interest in the study of concepts within the domain of 'positive' psychology within the psychological research in the recent couple of decades. In contrast to the traditional focus on negative emotions such as depression and anxiety, an increasing number of researchers are focusing on the experience of happiness and/or subjective well-being and life satisfaction. The aim of this study is to determine whether the subjective experience of life meaning, rational, and irrational beliefs can predict the level of life satisfaction. The research was conducted online in 2022 and involved 189 participants of both genders, ages 18 through 70, from the general population. The instruments used were the Meaning of Life Scale (MOLS) to examine the sense of life, the Irrational and Rational Beliefs Scale (IRBS-16) to examine rational and irrational beliefs, and the Temporal Satisfaction with Life Scale (TSWLS) to measure the level of life satisfaction. The results confirm that the level of life satisfaction can be predicted based on the subjective experience of life meaning ($F=145.631$, $p<0.01$), as well as that the subjective experience of life meaning has a positive effect on the level of life satisfaction ($\beta= 0.662$, $p<0.01$). Furthermore, a negative impact of irrational beliefs ($\beta= -0.149$, $p<0.05$) and a positive impact of rational beliefs ($\beta= 0.252$, $p<0.01$) on overall life satisfaction were confirmed. It has also been shown that the level of life satisfaction can be predicted based on irrational and rational beliefs ($F=8.758$, $p<0.01$).

Key words: life satisfaction, irrational beliefs, rational beliefs, meaning of life, quality of life.

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СУБЈЕКТИВНО ИСКУСТВО СМИСЛЕНОСТИ ЖИВОТА И ИРАЦИОНАЛНА УВЕРЕЊА КАО ПРЕДИКТОРИ ЗАДОВОЉСТВА ЖИВОТОМ

Апстракт

Последњих пар деценија у психолошким истраживањима је приметно све веће интересовање за изучавање концепата у домену „позитивне" психологије. Супротно традиционалном усмерењу на негативне емоције, попут депресије и анксиозности, све већи број истраживача се фокусира на изучавање доживљаја среће и/или субјективног благостања и задовољства животом. Циљ овог истраживања јесте да се утврди да ли субјективно искуство смислености живота, те рационална и ирационална уверења могу да предвиде ниво задовољства животом. Истраживање је спроведено онлине, током 2022. године и обухватило је 189 испитаника оба пола, старости од 18 до 70 година, из опште популације. Коришћени су инструменти Скала смисла живота (ССЖ) за испитивање смисла живота, Скала ирационалних и рационалних уверења (ИРУ-16); и Скала темпоралног задовољства животом (TCWЛС) за мерење нивоа задовољства животом. Добијени резултати потврђују да се на основу субјективног искуства смисла живота може предвидети ниво задовољства животом ($F=145.631$, $p<0.01$), као и да субјективно искуство смислености живота остварује позитиван ефекат на ниво задовољства животом ($\beta= 0.662$, $p<0.01$). Даље је потврђен и негативан утицај ирационалних уверења са једне стране ($\beta= -0.149$, $p<0.05$), а позитиван утицај рационалних уверења са друге ($\beta= 0.252$, $p<0.01$), на укупан ниво задовољства животом. Уједно се показало и да се на основу ирационалних и рационалних уверења може предиктовати ниво задовољства животом ($F=8.758$, $p<0.01$).

Кључне речи: задовољство животом, ирационална уверења, рационална уверења, смисленост живота, квалитет живота.

INTRODUCTION

The meaning of life is a concept that was originally developed in existential psychology and is often examined in research in the field of modern positive psychology. The significance of the meaningfulness of life for positive psychological functioning was first theoretically stated by psychologists such as Allport (1954), Maslow (1962) and Frankl (1972). An increasing number of research dealing with the study of the mentioned concept is noticeable, where the results of a significant number of studies indicate a strong connection between the meaning of life and the general well-being.

According to Adler, the meaning of life is an involuntary and innate concept, which develops in the early years of life. Frankl (1963) rejects the deterministic nature of free will, which postulates that the individual is free to find and apply the meaning of life even if his freedom is significantly limited on objective circumstances. Frankl (2010) defines the meaning of life as a basic motive that every person innately possesses.

The meaning of life, therefore, as a concept, is not connected to specific subjects but to all life events. Frankl suggests that every life experience is associated with meaning on different levels and should therefore be explored. As such, the meaning of life is influenced by an individual's knowledge, abilities, experiences, desires, beliefs, and values (Frankl, 1963).

According to Frankl (1963), the notion of the search for meaning implies that there is a meaning to be discovered, not created. To understand how that meaning can be discovered, Frankl (1963) identifies four broad categories of values in which most people find meaning, including: (1) creative pursuits; (2) life experiences; (3) attitudes towards successes and challenges; and (4) transcendent pursuit of one's ultimate purpose in life. The creative value represents what individuals can give to the world, including volunteering, work, and other contributions. The experiential value represents what individual's experience, such as love, friendship, beauty and other positive experiences. The behavioural value represents an individual's approach to triumphs and challenges, such as acceptance, understanding, and other attitudes. The ultimate value refers to an individual's awareness that his life serves a greater purpose. This ultimate value represents the most existential dimension of the meaning of life because it exceeds the intellectual capacities of the individual (Frankl, 1963).

Maslow's theory of needs (Maslow, 1962) is also often applied in the literature on the meaning of life, with the suggestion that when basic, physiological needs are satisfied, higher needs such as finding meaning can be sought.

Baumeister (1991) proposes a motivational theory based on the assumption that four specific needs for meaningfulness – purpose, efficacy, value/justification and self-worth – act as catalysts for the search for meaningfulness. Peterson and colleagues (Peterson et al., 2005) give a general definition of a meaningful life - a life in which people feel connected to something greater than themselves, and Reker's definition of the meaning of life as "the realization of order, coherence and purpose in existence, the pursuit and achievement of worthwhile goals, and the accompanying feeling of fulfilment" (Reker, 2000), is often cited.

The results of previous research indicate that the subjective experience of the meaning of life increases during the lifespan (e.g. Steger et al., 2011), whereby changes in the subjective experience of the meaning of life are observed as a result of a continuous revision of personal values and belief systems. Elder individuals have been found to report greater purpose compared to younger individuals, who focus more on achieving future goals (Steger et al., 2009).

In addition to age, the motivation to search for meaning can also be influenced by culture (Steger et al. 2009). Culture shapes goals, values, and expectations that can influence emotional experiences, life trajectories, and the way individuals see themselves and their relationships with

the world. Thus, culture can also influence how individuals develop and experience the presence and the search for meaning.

Life satisfaction is identified as a distinctive construct representing the cognitive and global evaluation of an individual's quality of life (Pavot & Diener, 1993); hence, life satisfaction represents an evaluative judgment – a value judgment (Diener, 2000). As a component of well-being, life satisfaction is related, albeit moderately independent, to affective aspects of well-being (Lucas, Diener, & Suh, 1996); thus, a comprehensive assessment of subjective well-being requires the assessment of both life satisfaction and affective components (Diener, 2009).

Rational and irrational beliefs influence subsequent psychological events. Rational beliefs are characterised as useful, logical, realistic, preference-based, and pragmatic, leading to functional emotions, feelings, moods, and adaptive behaviours (Ellis, 1994).

Contrary to rational beliefs, irrational beliefs are characterised as inflexible, illogically coherent, useless, unrealistic, absolutistic, dogmatic beliefs leading to dysfunctional emotions, feelings, moods, and maladaptive behaviours. Ellis initially identified fourteen different types of irrational beliefs in his therapeutic cognitive model (Ellis, 2004).

In order to understand why "some people are happier than others, we must understand cognitive and motivational processes that serve to maintain or enhance both enduring happiness and transient moods" (Lyubomirsky, 2001, p. 240). The available literature highlights that rational and irrational beliefs contribute differently to the psychological adjustment of individuals. Individuals typically, though not always, generate and construct healthy emotions by believing in rational beliefs, and they typically generate self-defeating emotions and behaviours by constructing and creating irrational beliefs (Ellis, 2003). Considering the above, it is assumed that rational beliefs contribute to experiencing adaptive emotions, while irrational beliefs, on the other hand, contribute to experiencing maladaptive emotions.

The above assumptions have been confirmed in numerous studies. Specifically, irrational beliefs have been significantly related to various indicators of psychological maladjustment in previous research. Irrational beliefs have been significantly positively associated in previous studies with various types of psychological distress, such as general distress, anxiety, depression, anger, aggression, and guilt (Gündogdu et al., 2018; Strobel et al., 2008; Visla et al., 2016), with research indicating that interventions aimed at modifying irrational beliefs effectively affect improving psychological adjustment (e.g., González et al., 2004; Şahin, & Türk, 2021).

Specifically, the results of a study by Froh and colleagues (Froh et al., 2007), which aimed to investigate the relationship between interpersonal relationships, irrational beliefs, and life satisfaction, suggested that interpersonal relationships are significant predictors of life satisfaction,

while global irrationality, measured by the Rational Behaviour Inventory (Rational Behaviour Inventory; Shorkey & Whiteman, 1977), was indirectly related to life satisfaction, measured by the Satisfaction with Life Scale (SWLS; Diener et al., 1985), with interpersonal relationships acting as a mediator of the relationship between irrationality and life satisfaction. Based on the results obtained, the authors conclude that in addition to changing irrational beliefs in clients, it is necessary to carefully assess their social functioning and work on improving interpersonal relationships to increase life satisfaction.

The significant results of Spörrle and colleagues' study (Spörrle et al., 2010) are cited, which aimed to investigate the incremental validity of irrational thinking in predicting various aspects of subjective well-being – life satisfaction and subjective happiness, while controlling the influence of personality traits from the Big Five model (Costa & McCrae, 1992). The results of the study indicated that irrational beliefs have validity in predicting life satisfaction relative to personality traits, but not in predicting subjective happiness. Specifically, significant contributions to the prediction of subjective happiness were made only by personality traits in the mentioned study. The authors explain the obtained results by considering different aspects of subjective well-being assessed in the study. Namely, the Life Satisfaction Scale (Diener et al., 1985) was used to assess one aspect of subjective well-being in the study, aiming to evaluate life in general. The authors emphasise that cognitive processes, such as irrationality, likely directly influence such evaluative judgments due to their cognitive nature. On the other hand, the Subjective Happiness Scale (Lyubomirsky & Lepper, 1999) yields global assessments of happiness, which are more closely associated with temperamental and dispositional components of subjective well-being, leaving less variance in subjective happiness that can be explained by cognitive processes like irrationality. Based on the obtained results, the authors conclude that irrationality cannot be fully explained by personality traits of the Big Five model and possesses incremental validity in predicting life satisfaction relative to these personality traits.

The results of the aforementioned study by Spörrle and colleagues (Spörrle et al., 2010), besides theoretical, have very important practical implications. Namely, irrationality, which has been shown multiple times to be modifiable through therapeutic interventions, shows variable value in predicting life satisfaction beyond the influence of personality traits, which are significantly less amenable to interventions, indicating the possibility of using REBT interventions and training as an effective method to increase individuals' life satisfaction. In addition to other interventions in the field of positive psychology aimed at increasing life satisfaction, methods used in the REBT to reduce irrationality and, consequently, maladaptation, can also be very effective in enhancing individual life satis-

faction. The authors highlight that working on central irrational thoughts such as absolutistic demands, through self-talk, debates, and group discussions during training or sessions, is an appropriate way to increase individual awareness of the destructive power and illogical origin of such beliefs. Therefore, such interventions provide the basis for the successful modification of irrational beliefs, which in turn leads to fewer cognitive, affective, and behavioural responses to unpleasant events which reduce life satisfaction.

As previously mentioned, individuals have significant experiences throughout much of their lives that give meaning to it and significantly impact their well-being (Lavigne et al., 2013). Specifically, the relationship between the subjective experience of life meaningfulness and positive psychological well-being has been generally established in previous research. There is substantial evidence that the subjective experience of life meaningfulness is an important foundation of psychological well-being and overall health, and that a sense of meaninglessness represents a risk factor for psychopathology. Consistent with the foregoing, researchers in previous studies have focused on the positive outcomes of experiencing life as meaningful, as well as on the negative outcomes of perceiving life as meaningless. Numerous variables are associated with the subjective sense of life meaningfulness, with measures of well-being and its various components, such as happiness and life satisfaction, being significantly positively correlated with this construct (Diener et al., 2012; Mascaro & Rosen, 2008).

While previous research has identified a significant positive correlation between the subjective sense of life meaning and life satisfaction (Diener et al., 2012; Mascaro & Rosen, 2008), the pursuit of meaning in life in previous research has been shown to be associated with poorer well-being and psychological functioning (Park et al., 2010). However, the available literature also highlights a certain degree of complexity in the way life satisfaction is associated with the pursuit and presence of meaning, thus those who have already established a sense of life meaning and seek additional meaning tend to experience greater life satisfaction compared to individuals who are searching for meaning but have not yet established a stable sense of life meaning (Steger et al., 2011).

Contrary to the aforementioned, perceiving life as meaningless in previous research has been significantly positively related to psychopathology (Park et al., 2010), with individuals who experience life as meaningless being at greater risk of disorders such as depression and anxiety (Mascaro & Rosen, 2008), and having higher rates of suicide and substance use (Tan et al., 2018). Finally, it is necessary to emphasise that the subjective experience of life meaning is more strongly related to positive dimensions of well-being (life satisfaction and positive affect) than to negative dimensions (psychological stress and negative affect.

As previously stated, the subjective experience of the meaning of life has proven to be a complex construct, representing a significant capacity of an individual that can influence rational and irrational beliefs and life satisfaction. There is a certain degree of complexity in the way life satisfaction is related to the search for the meaning of life, rational and irrational beliefs, hence the question arises of whether they can predict the level of life satisfaction in the research sample.

The Problem and the Aim of the Research

The main problem of the research can be defined as examining the influence of the subjective experience of life meaning, rational and irrational beliefs on the level of life satisfaction. The aim of the research is to determine whether the subjective experience of life meaning, rational and irrational beliefs can predict the level of life satisfaction.

By reviewing the available literature and numerous studies on life satisfaction, a smaller number of studies dealing with variables such as one's own perception can be observed. The subjective experience of the meaning of life was chosen as a construct because it is closely related to life satisfaction and mental health, and is a frequent topic in psychotherapy and psychological practice.

METHODS

Sample of Respondents

The research sample was of a convenient type and consisted of 189 respondents of both sexes (male 49.2%; female 50.8%), ages 18 through 73 (M=37 years) from the general population. According to the respondents' place of residence, respondents who live in urban settlements (95.2%), and in suburban settlements (4.8%) are the most represented. Respondents with completed secondary education are represented by 27.0%, higher school/faculty by 51.3%, and master's/doctoral studies by 21.7% respondents. In the sample, the most represented respondents are employed (73.0%), unemployed and not looking for a job by (16.9%), and unemployed looking for a job by (16.9%). The most represented respondents are married (47.6%), in a partner relationship (29%), and without partner (20%).

Sample of Measuring Instruments

To assess the subjective experience of life meaning, the Life Meaning Scale (LMS) was used (Vulić-Prtorić & Bubalo, 2006). Given that it represents an adapted form of the PIL scale, the adaptation process occurred in three phases: 20 items from the first part of the original scale

were translated into Croatian, the response format from the original questionnaire was changed to a five-dimensional Likert-type scale in the second phase, and in the third phase, certain items were removed to avoid the repetition of items with the same or similar content. After the statistical analyses, 23 items remained that assess the emotional and cognitive aspects of life meaning. Participants were required to indicate their level of agreement or disagreement with statements on a five-dimensional scale ranging from one to five, with ten items scored in reverse. This is a one-dimensional scale, and the result is obtained by summing the scores on all statements, with a higher number of points indicating a higher level of subjective experience of life meaning. The authors note that this scale has a high reliability of 0.892.

To assess irrational and rational beliefs, the Irrational and Rational Beliefs Scale (IRU-16; Tovilović & Popov, 2009) was used, which assesses evaluative cognitions, or the frequency of occurrence of irrational and rational beliefs defined by the REBT theory. It consists of 16 items, with eight items related to rational beliefs, which are logical, flexible, pragmatic, and reality-based, while the remaining eight items are related to irrational beliefs, which are rigid, absolutist, and harmful to the individual. Participants evaluated how often they think in this manner using a five-dimensional Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Life satisfaction was measured using the Temporal Satisfaction with Life Scale (TSWLS). The scale consists of 15 items divided into 3 subscales. Five items measure past satisfaction, five items measure current satisfaction, and five items measure expected future satisfaction with life. Participants were asked to rate their agreement with each individual statement on a five-dimensional Likert-type scale (from 1 = not at all true to 5 = completely true). The total score represents the sum of rounded scores, with higher scores indicating greater satisfaction. The authors note that this questionnaire, with its subscales, demonstrates satisfactory psychometric characteristics and high reliability.

A sociodemographic questionnaire was created for the purposes of this research, consisting of questions about the gender, age, education, place of residence, as well as the marital and employment status of the participants.

The reliability of all scales used in the research was tested using Cronbach's alpha reliability coefficient. The results are presented in the following table. It is noticeable that all scales have satisfactory reliability, as indicated by high values of reliability coefficients.

Table 1. Reliability of measurement instruments

Scale	Number of Items	Reliability
Meaning of Life Scale (MOLS)	23	.888
Temporal Life Satisfaction – Past	5	.849
Temporal Life Satisfaction – Present	5	.900
Temporal Life Satisfaction – Future	5	.833
Overall Life Satisfaction	15	.881
Irrational Beliefs	8	.824
Rational Beliefs	8	.857

Statistical Data Processing

The data obtained in the study was analysed using the SPSS 25.0 (*Statistical Package for Social Sciences*) software package. Before proceeding with the analysis, data preparation, logical data inspection, examination of missing values and invalid entries were conducted. The following statistical methods were used:

- descriptive statistical techniques: minimum, maximum, mean, and standard deviation, to determine the degree of expression of the basic research variables; and
- linear regression analysis - to predict criteria.

RESULTS

The research results will be presented as follows, organised in several segments for easier navigation according to the defined research hypotheses. The results are presented in textual, tabular form.

Table 2. Descriptive statistics

	Min	Max	Mean	SD
Rational beliefs	10	39	28.7	5.66
Irrational beliefs	9	39	19.0	5.47
MOLS	60	113	91.9	11.25
TSWLS-past	5	25	16.5	4.37
TSWLS-present	5	25	16.8	4.58
TSWLS-future	5	25	16.5	3.87
TSWLS	15	74	49.7	11.04

MOLS - Meaning of Life Scale, TSWLS- Temporal Satisfaction with Life Scale

It is observed that rational beliefs (M=28.7; SD=5.66) are much more expressed among the respondents than irrational beliefs (M=19.0; SD=5.47). Furthermore, it is noted that the participants have a high average score on the meaning of life scale (M=91.9; SD=11.25 ; min=60.0 ; max=113.0). Life satisfaction is quite consistent for all three aspects

(past, present, and future). All values are around the average, i.e., within the expected ranges.

Table 3. Model evaluation

R	R^2	Adjusted R^2
.662*	0.438	0.435

**The criterion variable observed is the total level of life satisfaction, while the predictor is the subjective experience of life meaning.*

The R2 and adjusted R2 values show that around 40% of the variance in life satisfaction can be explained by the meaning of life.

Table 4. Model significance

	Degrees of freedom	Mean square	F	Sig.
Regression	1	10023.274	145.631	.000
Residual	187	68.826		
Total	188			

Table 4 displays the significance of the model tested by the ANOVA test. Based on the F value ($F=145.631$; $p<0.05$), we can determine that the constructed model is statistically significant, indicating that the level of life satisfaction can be predicted based on the subjective experience of life meaning.

Table 5. Predictor coefficients in the model

	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	B		
Constant	-9.947	4.979		-1.998	0.047
MOLS	0.649	0.054	0.662	12.068	0.000

The predictor is statistically significant ($p<0.05$), meaning that the subjective experience of life meaning significantly determines the level of life satisfaction. This effect is positive, indicating that as the subjective sense of life meaning increases, so does the level of life satisfaction.

Table 6. Model evaluation

R	R^2	Adjusted R^2
.293*	0.086	0.076

* criterion: overall level of life satisfaction, predictors: irrational and rational beliefs

The coefficient of determination indicates that a small percentage of the dependent variable, around 8% of the level of life satisfaction, can be explained by the predictors in the model.

Table 7. Model significance

	Degrees of freedom	Mean Square	F	Sig.
Regression	2	985.150	8.758	.000
Residual	186	112.492		
Total	188			

The model's performance, tested by ANOVA, shows that the model, although explaining a small variance, is statistically significant ($F= 8.758$; $p<0.05$). The level of life satisfaction can be predicted based on irrational and rational beliefs.

Table 8. Predictor coefficients in the model

	Unstandardised coefficient		Standardised coefficient	T	Sig.
	B	Std. error	B		
Constant	41.281	4.826		8.554	0.000
Rational beliefs	0.492	0.137	0.252	3.601	0.000
Irrational beliefs	-0.301	0.141	-0.149	-2.132	0.034

Upon examining the table showing the contributions of each predictor individually, we can notice that both predictors stand out as statistically significant. Specifically, both rational and irrational beliefs significantly determine the level of life satisfaction. The coefficients indicate that rational beliefs have a positive effect ($t=3.601$, $p<0.05$), while irrational beliefs ($t=-2.132$, $p<0.05$) have a negative impact on the level of life satisfaction. Thus, it can be concluded that with an increase in rational beliefs, the overall level of life satisfaction rises, whereas it declines with an increase in irrational beliefs.

DISCUSSION

Through the presented analysis, the obtained results indicate that the subjective experience of life meaningfulness has a statistically significant positive effect on the level of life satisfaction, and that the level of life satisfaction can be predicted based on the subjective experience of life meaningfulness. A standard linear regression analysis was conducted. A model was constructed where the criterion was the overall level of life satisfaction, and the predictor consisted of the subjective experience of life meaningfulness. The research results showed that the constructed

model is statistically significant and that the subjective experience of life meaningfulness explains 40% of the variance in life satisfaction, which can be considered a high level, given that there is only one predictor in the model. When considering the predictor's contribution to the model, besides statistical significance, the direction of this influence is also important. The obtained coefficient is positive, indicating that with an increase in subjective life meaning, the level of life satisfaction also increases. Since the results showed that the established model is statistically significant and that the predictor positively influences life satisfaction, the obtained results confirm the relationship that has already been established. Numerous studies have shown a positive relationship between life satisfaction and subjective sense of life meaning, as presented in studies by Diener et al. (2012), and Mascaro and Rosen (2008), where measures of well-being and its various components, such as happiness and life satisfaction, are significantly positively correlated with the subjective sense of life meaning. There are confirmations that life meaning is an important element of psychological well-being and overall life experience, meaning that individuals who have established a sense of life meaning also exhibit higher life satisfaction.

Next, the relationship between irrational and rational beliefs and life satisfaction was examined. Similarly, a linear regression was conducted. The constructed model contained the overall level of life satisfaction as the criterion, and irrational and rational beliefs as predictors. The results showed that the established model is statistically significant but explains very little variance; only 8% of the variance in the level of life satisfaction can be explained by rational and irrational beliefs. Both predictors stand out as statistically significant, with rational beliefs making a slightly greater unique contribution. When observing the signs of the obtained coefficients, rational beliefs positively, and irrational beliefs negatively influence the level of life satisfaction. Thus, it can be concluded that with an increase in rational beliefs, the overall level of life satisfaction rises, whereas it declines with an increase in irrational beliefs. Although to a small extent, the level of life satisfaction can be predicted based on rational and irrational beliefs, and irrational beliefs have a negative, while rational beliefs have a positive effect on life satisfaction. As previously mentioned, research focusing on specific cognitions as predictors of subjective life satisfaction is limited. However, it is well-established in the available literature that rational and irrational beliefs contribute differently to people's psychological adaptation. It is important to note the theoretical premise that individuals generally construct healthy emotions by believing in rational beliefs, while they develop mostly self-defeating emotions by forming irrational beliefs (Ellis, 2003). Thus, it is justified to assume that rational beliefs positively, and irrational beliefs negatively contribute to life satisfaction. Perhaps here we can refer to

some mentioned studies, such as the research by Spörrle et al. (2010), which indicated that irrational beliefs are valid in predicting life satisfaction in relation to personality traits. It is significant to note that irrational beliefs are susceptible to change, as shown, for example, in the research by Froh et al. (2007), as well as in the aforementioned study by Spörrle and a few others (e.g., González et al., 2004; Şahin & Türk, 2021), suggesting that interventions aimed at changing irrational beliefs can effectively influence the improvement of life satisfaction.

CONCLUSION

This study attempted to demonstrate the nature of the relationship between life satisfaction, subjective life meaning, and rational and irrational beliefs, as well as the possibility of predicting life satisfaction based on these variables. Rational and irrational beliefs were selected because, as part of the REBT theory, they encompass multiple aspects of people's behaviour, including cognition, emotions, and actions, and their interaction. According to this theory, irrational and rational beliefs are the most important factors in psychological events and experiences. Therefore, we were interested in their relationship with life satisfaction. The subjective experience of life meaning was chosen as a construct because it is closely related to life satisfaction and mental health, and is a common topic in psychotherapy with significant practical implications.

The study started from the goal and problem of investigating whether the subjective experience of life meaning, as well as rational and irrational beliefs, can predict the level of life satisfaction. We concluded that the subjective experience of life meaning has a statistically significant positive effect on the level of life satisfaction. Irrational beliefs have a statistically significant negative effect on the level of life satisfaction, while rational beliefs have a statistically significant positive effect on the level of life satisfaction.

The obtained results largely align with existing theory and with the results of previous research conducted on similar topics, providing additional encouragement to continue research in this direction. In this manner, more factors explaining life satisfaction could be identified, thereby contributing to helping people realise their true potentials, achieve levels of optimal functioning, and improve their quality of life.

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СУБЈЕКТИВНО ИСКУСТВО СМИСЛЕНОСТИ ЖИВОТА И ИРАЦИОНАЛНА УВЕРЕЊА КАО ПРЕДИКТОРИ ЗАДОВОЉСТВА ЖИВОТОМ

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Резиме

Последњих пар деценија у психолошким истраживањима је приметно све веће интересовање за изучавање концепата у домену „позитивне" психологије. Супротно традиционалном усмерењу на негативне емоције, попут депресије и анксиозности, све већи број истраживача се фокусира на изучавање доживљаја среће и/или субјективног благостања и задовољства животом. Циљ овог истраживања јесте да се утврди да ли субјективно искуство смислености живота, рационална и ирационална уверења могу да предвиде ниво задовољства животом. Велики број истраживања задовољства животом бавио се негативним стањима (на пример, анксиозношћу, депресијом) и њиховим утицајем на задовољство животом, као и економским и социо-демографским показатељима, односно објективним индикаторима, док је број оних истраживања која се баве позитивним аспектима и оним варијаблама које су заправо повезане са срећом - у мањини. Из тог разлога истраживања у испитивању задовољства животом последњих година све више истичу субјективну компоненту, односно сопствену перцепцију. Постоји велики број дефиниција и одређења задовољства животом, и овај сложени конструкт се разлаже на више компоненти: емоционалну, когинитивну, евалуативну као и на повезаност са објективним и субјективним индикаторима. У овом истраживању дат је покушај да се покаже природа међуодноса задовољства животом, субјективног искуства смислености живота и радионалних и ирационалних уверења, као и могућност предикције задовољства животом на основу поменутих варијабли. Рационална и ирационална уверења су одабрана зато што као део РЕБТ теорије обухватају више аспеката понашања људи, односно обухвата когницију, емоције и деловање, то јест понашање као и њихову интеракцију. Ирационална и рационална уверења, према овој теорији су најважнији чиниоци на психолошке догађаје и доживљаје. Стога нас је интересовало у каквом су односу са задовољством животом. Субјективни доживљај смислености живота је одабран као конструкт јер је уско повезан са задовољством животом и менталним здрављем, и честа је тема у психотерапији, те се види велика примена у раду са људима. Истраживање је спроведено онлајн, током 2022. године и обухватило је 189 испитаника оба пола, старости од 18 до 70 година, из опште популације. Коришћени су инструменти Скала смисла живота (ССЖ), (Вулић-Прторић & Бубало, 2006) за испитивање смисла живота, Скала ирационалних и рационалних уверења (ИРУ-16; Товиловић и Попов, 2009), за испитивање рационалних и ирационалних уверења и Скала темпоралног задовољства животом (TCWЛС) за мерење нивоа задовољства животом. Добијени резултати потврђују да се на основу субјективног искуства смисла живота може предвидети ниво задовољства животом, као и да субјективно искуство смислености живота остварује позитиван ефекат на ниво задовољства животом. Даље је потврђен и негативан утицај ирационалних уверења са једне стране, а позитиван утицај рационалних уверења са друге, на укупан ниво задовољства животом. Уједно се показало и да се на основу ирационалних и рационалних уверења може предиктовати ниво задовољства животом.

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CONTEMPORARY THEORETICAL DEBATES ON ECONOMIC POLICY: LESSONS FOR THE POST-PANDEMIC PERIOD

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Abstract

Following the Global Financial Crisis of 2007, intense scrutiny on the validity of the mainstream macroeconomic model (New Consensus Macroeconomics) and its economic policy implications emerged in the academic community. The crisis revealed significant flaws in the traditional understanding of economic dynamics, especially regarding financial market regulation and systemic risk management. Additionally, the unprecedented impact of the COVID-19 pandemic on the global economy served as another test for the current macroeconomic paradigm. The pandemic-induced economic crisis exposed vulnerabilities in the global economic system, highlighting deep-rooted inequalities and structural weaknesses. Once again, doubts arose about the applicability of current macroeconomic models in addressing such complex challenges. This paper seeks to assess the ongoing theoretical debate surrounding the effectiveness of economic policies and discuss their implications for the post-pandemic period. It argues that the macroeconomic role of fiscal policy should be respected, not only when economic disorders occur but also in periods of economic stability. However, the risks associated with increased indebtedness in both advanced and emerging economies are linked to fiscal and financial dominance issues, which may escalate in the future. Therefore, this paper contends that economic policymakers should apply the proper economic-policy mix to address the current and future economic challenges.

Key words: economic policy, New Consensus Macroeconomics, fiscal dominance, COVID-19 pandemic.

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САВРЕМЕНЕ ТЕОРИЈСКЕ РАСПРАВЕ О ЕКОНОМСКОЈ ПОЛИТИЦИ: ПОУКЕ ЗА ПОСТПАНДЕМИЈСКИ ПЕРИОД

Апстракт

Након Глобалне финансијске кризе настале 2007. године, покренута је интензивна академска дебата о валидности доминантног макроекономског модела (Нови консензус у макроекономији) и његових импликација за економску политику. Криза је открила значајне недостатке у традиционалном схватању економске динамике, посебно у погледу регулисања финансијског тржишта и системског управљања ризицима. Поред тога, утицај пандемије COVID-19 на глобалну економију, који је био без преседана, представљао је још један тест за важећу макроекономску парадигму. Економска криза изазвана пандемијом разоткрила је рањивост глобалног економског система, наглашавајући дубоко укорењене неједнакости и структурне слабости. Сумње у применљивост постојећих макроекономских модела у решавању овако сложених изазова су поново присутне. Овај рад настоји да процени текућу теоријску дебату о ефикасности економске политике и размотри њихове импликације у периоду након пандемије. У раду се истиче да је потребно уважавати макроекономску улогу фискалне политике, не само у условима економских поремећаја, већ и у периодима економске стабилности. Међутим, ризици повезани са повећаном задуженошћу напредних и економија у развоју повезани су са проблемима фискалне и финансијске доминације, који могу ескалирати у будућности. Стога, у раду се тврди да креатори економске политике треба да примене одговарајућу комбинацију економске политике како би одговорили на садашње и будуће економске изазове.

Кључне речи: економска политика, Нови консензус у макроекономији, фискална доминација, пандемија COVID-19.

INTRODUCTION

The development of contemporary economic thought was characterised by many convergent and divergent streams, whereas establishing a broader consensus was relatively rare. The first such case was related to the famous Neoclassical synthesis, as a connection between neoclassical and Keynesian economic theories. The emergence of stagflation in the 1970s and the constraints in Keynesian economic policy measures both resulted in abandoning this synthesis. The second situation was during the 1990s, when the New Consensus Macroeconomics (hereafter: NCM) emerged. NCM amalgamated Monetarism, New Classical Macroeconomics, New Keynesianism, and Real Business Cycles theory (Mihajlović & Marjanović, 2020).

The dominant approaches to economic policy aimed to stabilise the economy were also changing during the development of contemporary macroeconomic theory. These changes were the corollary of the shifts in dominant macroeconomic paradigms, most commonly as a consequence of the economic crises. For instance, the domination of Keynesian eco-

nomic policy was interrupted, *inter alia*, due to the economic crisis induced by the supply-side shocks in the 1970s.

In the 21st century, two global economic crises occurred: the Global Financial crisis (2007) and the economic crisis induced by the COVID-19 pandemic. The validity of the NCM paradigm was questioned in both crisis events. The stance on economic policy effectiveness was also under suspicion by the academic community and policymakers around the globe.

Accordingly, this paper aims to evaluate the theoretical controversies which followed the evolution of the economic policy approach to date, focusing on how the last two global economic crises shaped the dominant macroeconomic paradigm about economic policy effectiveness. It also seeks to enrich the ongoing discourse among scholars and policymakers regarding the strategies for conducting economic policy to attain macroeconomic stability in the aftermath of the pandemic, while also acknowledging the distinctions between advanced and emerging economies.

ECONOMIC POLICY DEBATES IN THE CONTEXT OF THE GLOBAL FINANCIAL CRISIS (2007)

Favourable macroeconomic conditions in developed economies, spanning from the mid-1980s until the onset of the Great Recession in 2008 (so-called Great Moderation), led the majority of mainstream economists to believe that significant economic disruptions were a thing of the past. It was widely held that both short-term and long-term macroeconomic objectives could be attained with adequate economic interventions, primarily through monetary policies. The NCM model, also known as the New Neoclassical Synthesis, was considered a good basis for the successful conducting of economic policy since the period from its establishment was characterised by macroeconomic stability.

However, the financial crisis in 2007, which a year later spilt over into the real sector, resulted in the Great Recession, as the most serious crisis after the Great Depression of the 1930s. The financial crisis arose in the mortgage market of the United States of America, with the 'bursting' of a speculative bubble, as a result of a sudden drop in real estate prices after a multi-year trend of growth. Combined with financial liberalisation, these processes enabled the introduction of a wide range of financial instruments intended for the so-called securitisation of deposits and multiplication of mortgage loans (Wray, 2008). The absence of effective financial regulation, coupled with an overly expansive monetary policy, led to a systemic financial crisis and severe recession.

The optimism of the NCM model proponents and the creators of economic policy suddenly subsided as the essential fragility of the financial and economic system was observed. It has been shown that the key flaw of NCM model lies in the incorrect treatment of the financial sector

since it was assumed that restrictions on the financial market only increase the impact of disturbances originating from other sources (Mihajlović, 2023). Consequently, the valuable financial indicators, which could indicate the unsustainability of the situation that preceded the crisis, were omitted from the NCM model.

Since the interest rates in the majority of economies were low, the solution had to be found in the strong fiscal expansion. The real interest rates were also low or even negative due to relatively low inflation rates; these rates were at the so-called effective lower bound – the rate which ensures a kind of equilibrium but with excessive savings (r_L rate in Figure 1). For investments and savings to be equal the real interest rate should equals equilibrium interest rate (r_0^*). As it is apparent from Figure 1, r_L rate is still above r_0^* and the intersection between IS and LM curves lies below the potential output (Y^*) in point A. Expansionary monetary policy can only move LM curve to the right and the economy to point B where negative output gap still persisting. Accordingly, a massive fiscal expansion should be implemented to move the IS curve to the right and to establish the equilibrium at the potential output level (point E).

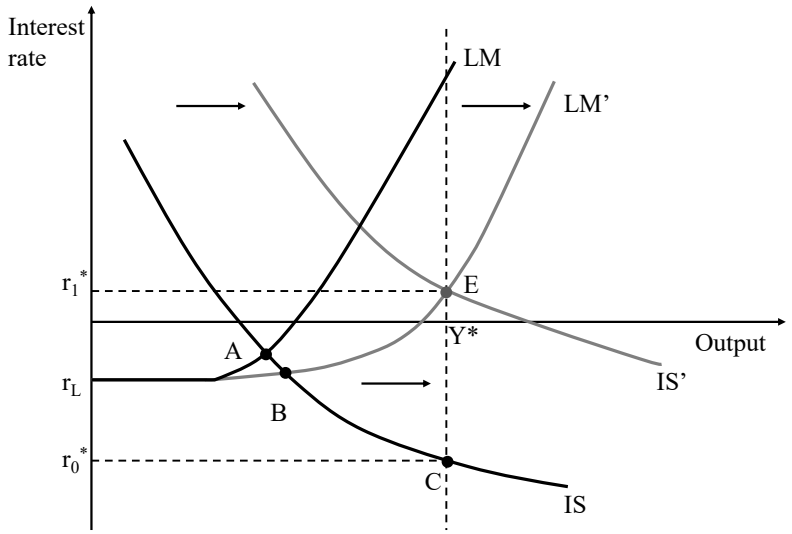

Figure 1. Effective Lower Bound and the combination of monetary and fiscal policy
Source: Buti and Papaconstantinou (2021), p. 5

The crisis emphasised the importance of monetary and financial policy coordination, with a focus on implementing measures to stabilise financial markets. This was encapsulated in the *macroprudential* policy framework, aiming to reduce risks and macroeconomic consequences of

financial instability. Monitoring credit, liquidity, and capital levels at micro and macro levels became key instruments. Macroprudential policies offered quicker implementation than fiscal policies and could be tailored to specific financial sector risks, mitigating adverse effects on economic activity (Lim et al, 2011). In cases where conventional monetary policy had been ineffective, such as low inflation, macroprudential measures were more effective in stabilising the economy. Challenges with discretionary fiscal policy have led to a shift towards fiscal rules, mirroring monetary rules, aiming to ensure fiscal stability through efficient, rational, and transparent public expenditure reduction.

THE ECONOMIC CRISIS INDUCED BY COVID-19 PANDEMIC AND ECONOMIC POLICY CONTROVERSIES

Unlike the previous global economic crisis, the COVID-19 crisis resulted from the shock outside the economy (health crisis), but with serious economic consequences (economic downturn, rise in unemployment and inflation, deterioration in external and fiscal position). One of the significant corollaries of the pandemic was the enormous fall in aggregate demand due to social distancing measures and lockdowns. In addition, the aggregate supply was also dramatically reduced since a number of firms stopped business activity or provided only minimal levels of production.

The economic effects of the pandemic could be divided into short- and long-run effects. Some of the significant short-run effects were as follows:

- The reduction in the general level of spending due to distancing measures and the uncertainty about the future events connected with the pandemic. The enterprises faced a significant drop in sales and started to hoard the goods in inventories (Carlsson-Szlezak, 2020). Although there were cases of panic buying of some goods (Prentice, Chen, & Stantic, 2020), the net effect was a decrease in spending;
- The financial markets disorders which were transferred to the economy. One of the results of these disturbances was the reduction of households' wealth and, consequently, the fall in spending (Ullah, 2023);
- The supply chain disruptions, either by slowing or temporarily stopping the flow of raw materials and finished goods, thus inducing manufacturing disruption as well (Moosavi, Fathollahi-Fard, & Dulebenets, 2022). These changes were also connected with the labour demand decline and the rise of unemployment, with significant socio-economic consequences (Coibion, Gorodnichenko, & Weber, 2020).

On the side of the long-run economic effects of the pandemic, one can underline several important consequences, which Stiglitz (2021) referred to as a hysteresis effects. First of all, the widespread bankruptcies due to the aggregate demand decline resulted in the long-run loss of human, organisational and informational capital which cannot be restored in the short term. The pandemic also resulted in the investment decline with the long-lasting effects on the output dynamics. Finally, the increased uncertainty induced the rise in precautionary savings, which aggravate the chances for investment-savings balance in the long term.

The fiscal response to the pandemic in most economies was ample and has reached almost unprecedented levels (Figure 2). In the advanced economies, the general government debt levels reached their historical peaks during World War II. In emerging economies, the public debt exceeded 60 percent of the GDP which was the historically highest level. In addition, the monetary policy (especially in advanced economies) was highly accommodative, with the interest rates almost reaching the zero lower bound.

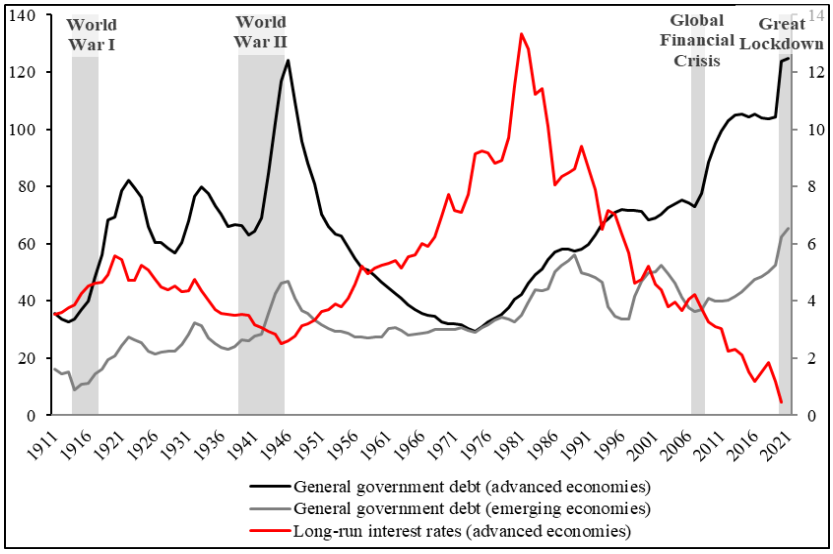

Figure 2. Historical patterns of general government debt (% of GDP, left scale) and interest rates (right scale)

Note: The aggregate public-debt-to-GDP series for advanced economies and emerging market economies is based on a constant sample of 25 and 27 countries, respectively, weighted by GDP in purchasing power parity terms.

Source: Author, based on the data from International Monetary Fund (https://www.imf.org/en/Publications/FM)

It was clear that deficit spending was unavoidable to stimulate aggregate demand and prevent the pandemic's economic consequences from being more severe. The classical approach to public debt management, based on sound finance and fiscal discipline, had to be temporarily abandoned. Policymakers around the globe resorted to Keynesian measures of fiscal expansion, hoping that the increases in public spending would have expected multiplier effects on economic activity (Mihajlović, 2023).

A more liberal approach to public debt management also contributed to the reaffirmation of some of the neglected theoretical concepts, such as the theory of functional finance and Modern Monetary Theory, both founded in the Post-Keynesian theory. The concept of functional finance (Lerner, 1943) predicts that the state should primarily take care of economic stability and that the balance of the state budget may be disturbed in the short and medium term. The government utilises fiscal tools such as taxation and spending to regulate economic activity and achieve desired outcomes. This approach suggests that deficits or surpluses should be used strategically to meet economic objectives, such as promoting growth, reducing unemployment, or controlling inflation. Short- and medium-run deviations from a balanced budget are only a *means* to achieve these fundamentally important goals in the long-run (Skott, 2016). Abba Lerner proposed several principles of functional finance that harmonise public spending and tax revenues to achieve the level of aggregate demand necessary to achieve full employment. As long as an economy has unused resources, such as unemployed labour or idle production capacity, the government can pursue deficit spending to stimulate demand and put these resources to work. Conversely, during periods of inflation or excessive demand, the government can implement fiscal measures to reduce spending and cool down the economy (Skott, Costa Santos, & Oreiro, 2022).

Modern monetary theory assumes that the state faces a different budget constraint than households. If the state has a monopoly on issuing its own currency (monetary sovereignty) there will be no financial restrictions for the implementation of fiscal policy (Tymoigne & Wray, 2015; Tymoigne, 2021). The only issue for the state is to create sufficient public debt necessary for accomplishing the macroeconomic goals – full employment and adequate investment level. The employed production capacity in the economy determines the capacity for money absorption, meaning that inflation will be relatively low as long as the economy is below its potential output (full employment level). MMT also argues that the interest rates will not increase with the rise in budget deficit since the money from public spending will be transferred to the private sector and finally to the banking system. If the economic subjects' investment decisions are impacted by the future economic outlooks rather than the price of borrowing money (interest rate), the changes in the interest rates will not significantly affect economic activity (Taylor, 2019).

As the pandemic led to a significant rise in unemployment, some other points of the MMT theory also became the subject of academic debate. One of them is related to the job guarantee system, as a form of countercyclical automatic stabiliser (Mitchell & Wray, 2004). The government should act as the employer of last resort and provide a job for everyone able and available to work and cannot find a job in the labour market. According to the MMT advocates, the government can provide full employment by following job guarantee schemes even in periods of low aggregate demand.

While financing public spending through money creation might seem advantageous during exceptional circumstances like the current pandemic, such actions can bring significant limitations. One prominent concern is the potential for inflation, especially when the money supply grows rapidly, possibly escalating into hyperinflation. The recent uptick in inflation across many economies has largely been attributed to temporary factors like surging energy prices, supply chain disruptions, and geopolitical tensions such as the Ukrainian crisis. These factors are not directly influenced by raising interest rates, which partly explains the delay in monetary authorities' response in that direction. However, regardless of the inflation's root cause, there is a genuine risk that it could fuel demands from labour unions for higher wages, thereby perpetuating further price increases and sparking an inflationary cycle.

The ongoing discourse surrounding the legitimacy of Modern Monetary Theory (MMT) is notably contentious. Within academia, there exist both advocates (for instance, Tymoigne, 2021; Kotilainen, 2022;) and critics (e.g. Prinz & Beck, 2021; Drumetz & Pfister, 2021). However, some academic economists argue that there still exist some fundamental assumptions shared by both mainstream macroeconomics and the concept of functional finance and MMT (Jayadev & Mason, 2018):

- Short-term output is determined by aggregate demand;
- In the short term, unemployment decreases as output increases, while inflation tends to rise;
- There exists an equilibrium level of output where both inflation and unemployment are at acceptable rates – potential output or full employment. Deviations below this level result in higher unemployment and deflation, while deviations above lead to lower unemployment but higher inflation, as described by the Phillips curve relationship;
- Aggregate demand is influenced by factors such as the interest rate and the budget position. Lower interest rates and larger fiscal deficits typically stimulate higher aggregate demand and output, and *vice versa*;
- Changes in the debt-to-GDP ratio over time are determined by the current fiscal position (primary balance), the interest rate on existing public debt, and the nominal GDP growth rate.

Hence, it seems that both models share the common objectives of macroeconomic policy: closing the output gap (where unemployment is low and the inflation rate is stable) and maintaining sustainable public debt (ensuring the debt-to-GDP ratio remains at or below its current level). However, the primary distinction lies in which policy—monetary or fiscal—should be employed to achieve these goals. In the mainstream perspective, monetary policy is seen as the tool for stabilising output, while fiscal policy is geared towards managing debt. Conversely, functional finance and MMT advocate for the opposite approach: fiscal policy should handle aggregate demand management, while monetary policy should focus on ensuring public debt sustainability (Jackson, Jackson & Lerven, 2022). This is particularly relevant in high-debt environments since the disinflation policy by increasing interest rates would necessitate cutting public spending to prevent further debt accumulation, which could exacerbate economic contraction. In such cases, fiscal contraction alone is often deemed the more prudent solution.

THE IMPLICATIONS OF THEORETICAL DEBATES FOR ECONOMIC POLICY IN A POST-PANDEMIC PERIOD

After the Global Recession, and especially during the pandemic crisis, policymakers viewed fiscal policy measures as the most powerful solution to alleviate severe economic contraction. Undoubtedly, extensive public expenditures across nearly all nations played a role in mitigating the adverse effects of the pandemic. Although the severity of the crisis justified a 'whatever it takes' approach, the effects of the implemented measures may have long-lasting effects and result in negative tendencies in the post-pandemic era.

One of the problems that could arise is related to the negative effects of applying increasingly popular approaches to economic policy, such as MMT, in developing countries. For instance, one of the main tenets of the MMT is that a government with control over its own currency cannot default in that currency. Although it can be accepted in principle, the government can still face default in foreign currency and may resort to austerity measures to rectify external imbalances, which especially holds for developing countries. To manage foreign-currency debt and prevent external crises that could necessitate domestic austerity, exports must outpace interest payments on foreign debt (Vernengo & Pérez Caldentey, 2020).

Another limitation of MMT is its applicability primarily to economies with monetary sovereignty, such as the USA, Great Britain, or Japan, where the government can issue and borrow in its own currency. The European Central Bank operates differently from the central banks of Japan or the USA, functioning as a supranational institution responsible for a unified monetary policy, while fiscal policy remains within the purview of national

authorities in member states (Begg, 2021). Additionally, as the world's reserve currency, the U.S. dollar enjoys more advantages than the euro, resulting in different economic implications for public debt monetisation.

One of the most important implications of the MMT for economic policy in advanced economies is related to the public expenditure financing through substantial fiscal deficits and the accumulation of public debt. This concept can be challenged from mainstream macroeconomics point of view (Boone, Fels, Jorda, Schularick, & Taylor, 2022). For instance, the traditional Phillips curve theory (as well as the New Keynesian variant, embraced by NCM) provides an empirically founded explanation that fiscal stimulus can lead to overheating in both goods and labour markets, resulting in upward pressure on prices (Lastauskas & Stakėnas, 2020; Hooper, Mishkin & Sufi, 2020). This effect could be more pronounced in emerging economies due to lower market flexibility. The second problem of the MMT-based economic policy occurs when extensive debt levels constrain central banks from implementing tighter monetary policies to counter inflation, leading to higher risk of public debt monetisation and so-called *fiscal dominance*. As a consequence, monetary and fiscal expansions exacerbate cyclical pressures and inflationary expectations, thus driving up the actual inflation rate. The concept of fiscal dominance also leads to another perspective on debt-driven inflation, known as the fiscal theory of the price level (Woodford, 1994; Leeper & Zhou, 2021; Sakai, 2024), which proposes a direct correlation between government debt and inflation. According to this theory, whether increasing fiscal deficits lead to higher inflation hinges on whether the private sector believes the government will eventually balance its budget by running surpluses in the future.

In addition, central banks, notably in advanced economies, face pressure to hike interest rates to address inflation, leading to a conflict between their dual objectives of managing both inflation and financial stability. The private sector heavily relies on central bank liquidity, resulting in a situation where concerns about financial stability limit the effectiveness of monetary policy, a phenomenon termed *financial dominance*. This situation implies that tightening monetary policy could disrupt the financial sector and heighten the economy's vulnerability to minor disturbances (Benigno, Canofari, Di Bartolomeo, & Messori, 2021). The extent of this financial reliance depends on the adequacy of private banks' capitalisation and the efficiency of private bankruptcy proceedings, thereby complicating the task of central banks in reducing inflation without precipitating a recession and somewhat undermining their practical independence.

The recent experience indicates that fiscal policy is essential for macroeconomic stabilisation when interest rates are low. Yet, even if full employment is attainable with a certain fiscal approach, there is a risk that very low interest rates could lead to excessive borrowing and jeopardise financial stability. These perspectives mark a departure from orthodox viewpoints, suggesting that countries may have more flexibility in fiscal

space as fiscal expansions can enhance sustainability by boosting GDP more than debt and interest payments.

CONCLUSION

The Global Recession and the COVID-19 pandemic have challenged conventional wisdom regarding economic policy advocating fiscal prudence and neutrality. The severity of these crises necessitated a paradigm shift, leading policymakers to embrace expansive fiscal measures as a means of mitigating economic downturns.

The pandemic highlighted the potency of fiscal policy in combating severe economic contractions. Governments worldwide deployed unprecedented levels of public spending to alleviate the adverse impacts of the crisis. Yet, while these measures were crucial at that moment, their long-term implications merit careful consideration.

The rise of alternative economic paradigms, such as Modern Monetary Theory (MMT), presents both opportunities and challenges for economic policymaking, especially in developing countries. MMT's applicability varies across economic systems, with its principles more readily adaptable to economies with monetary sovereignty. However, challenges arise in regions lacking such autonomy, where external factors and geopolitical dynamics play significant roles in shaping fiscal and monetary policy. Additionally, concerns persist regarding the potential inflationary consequences of extensive public expenditure financed through fiscal deficits and increased debt levels. Furthermore, the interplay between fiscal and monetary policy complicates efforts to address inflationary pressures without jeopardising financial stability. Central banks face a delicate balancing act in managing inflation while ensuring the resilience of the financial sector. The recent experience underscores the importance of fiscal policy in macroeconomic stabilisation, particularly in environments where traditional monetary tools may prove ineffective.

Looking ahead, confidence in government institutions will be paramount in navigating the economic challenges posed by mounting debt levels and inflationary pressures. Advanced economies with robust institutions and a history of low inflation may have more leeway to sustain deficits and invest in long-term growth-enhancing initiatives. However, maintaining fiscal discipline and addressing structural imbalances will remain critical to ensuring economic resilience and sustainability in the post-pandemic era. The evolving landscape of fiscal policy necessitates a nuanced approach that balances short-term stabilisation measures with long-term sustainability goals. While the COVID-19 pandemic has underscored the importance of fiscal intervention in times of crisis, a careful consideration of the broader economic implications is essential to fostering stable and resilient economies in the years to come.

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САВРЕМЕНЕ ТЕОРИЈСКЕ РАСПРАВЕ О ЕКОНОМСКОЈ ПОЛИТИЦИ: ПОУКЕ ЗА ПОСТПАНДЕМИЈСКИ ПЕРИОД

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Резиме

Економски поремећаји током 21. века у више наврата су доводили у питање валидност приступа економској политици у оквиру главног тока економске мисли. Глобална финансијска криза настала 2007. и, последично, Велика рецесија 2008., разкриле су недостатке доминантног макроекономског модела (Нови консензус у макроекономији) у погледу регулисања финансијског тржишта и системског управљања ризицима. У условима ниских каматних стопа, монетарна политика је испољила своје слабости, па се решење нашло у фискалној експанзији. Економска криза узрокована пандемијом COVID-19 поново је покренула академску дебату о исправности важеће макроекономске парадигме и на њој засноване економске политике. Снажна фискална експанзија довела је до раста јавног дуга у напредним економијама и у земљама у развоју, намећући додатне проблеме и отварајући нова питања.

Измена приступа економској политици као одговор на економску кризу услед пандемије довели су до афирмације неких од претходних теоријских приступа, као што су концепт функционалних финансија и Модерна монетарна теорија. Оба приступа заговарају интензивну фискалну експанзију и напуштање принципа „здравих" финансија ради постизања макроекономске стабилизације. Међутим, ограниченост примене ових концепата у земљама у развоју, као и у већини развијених земаља које немају монетарни суверенитет, сужава могућност да ови приступи обликују начин вођења економске политике у савременим условима.

Сходно томе, у раду се евалуира приступ економској политици заснован на моделу Новог консензуса у макроекономији у контексту последње две глобалне економске кризе. Овај приступ, који се, у зависности од околности, кретао између кејнзијанског и неокласичног екстрема, претрпео је извесне модификације под утицајем економских поремећаја. Једна од најзначајнијих је реафирмација значаја фискалне политике, која представља ефикасно средство регулисања привредних токова, а не само решење које треба применити током кризе, када је дејство монетарне политике ограничено. У раду се разматрају и проблеми везани за примену експанзивне фискалне политике у циљу спречавања дубље рецеције услед пандемије, а који су везани за проблем раста јавног дуга и настанак фискалне доминације. Истиче се да овај проблем, између осталих, представља значајно ограничење за ефикасну регулацију инфлаторних притисака. На основу тога, износе се аргументи у прилог примени адекватне комбинације монетарне и фискалне политике која би превазишла све недостатке појединачних мера.

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POLICE SCIENCE IN THE 21ST CENTURY: BUILDING THEORETICAL AND METHODOLOGICAL FOUNDATIONS

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Abstract

Police science in the 21st century is an academic field on the rise, whose methodological and theoretical foundations are increasingly evolving. This paper explores the process of constituting police science as a separate interdisciplinary field, analysing the key factors contributing to its scientific foundation. A special focus is placed on defining the subjects of police science, their theoretical paradigms and methodological approaches, and the application of empirical research in the analysis of police work. It also discusses their relationship to related disciplines, such as law, criminology, sociology, and management. Through analysing contemporary trends and challenges, the paper emphasises the need to establish a scientifically based, evidence-based approach to studying police phenomena, thus confirming the academic legitimacy and practical relevance of police science.

Key words: police science, methodology, theoretical frameworks, interdisciplinarity, evidence-based policing.

ПОЛИЦИЈСКЕ НАУКЕ У 21. ВЕКУ: ИЗГРАДЊА ТЕОРИЈСКИХ И МЕТОДОЛОШКИХ ТЕМЕЉА

Апстракт

Полицијске науке у 21. веку представљају академску област у успону, чије се методолошке и теоријске основе све интензивније развијају. Овај рад истражује процес конституисања полицијских наука као засебне интердисциплинарне области, анализирајући кључне факторе који доприносе њиховом научном утемељењу. Посебан фокус стављен је на дефинисање предмета полицијских наука, њихове теоријске парадигме и методолошке приступе, укључујући примену емпиријских истраживања у анализи полицијског рада. Такође, разматра се њихов однос према сродним дисциплинама, попут права, криминологије, социологије и

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менаџмента. Кроз анализу савремених трендова и изазова, рад наглашава потребу за успостављањем научно заснованог, evidence-based приступа у изучавању полицијских феномена, чиме се потврђује академска легитимност и практична релевантност полицијских наука.

Кључне речи: полицијске науке, методологија, теоријски оквири, интердисциплинарност, evidence-based policing.

INTRODUCTION

Police Science is an interdisciplinary field that studies the organisation, functioning, and development of the police, its working methods, social roles, and professional standards. However, although the term 'police science' is increasingly used in academic and professional circles, there is still debate about its status as a scientific discipline in its own right. This debate stems from the complexity of police work, its normative, sociological and managerial character, and the different theoretical and methodological approaches used to research police phenomena.

The modern concept of police science increasingly relies on empirically based research methods (evidence-based policing), which enable the systematic examination of the effectiveness of police strategies and procedures. Also, the development of this scientific field implies the integration of legal, sociological, criminological, psychological, and managerial perspectives, thus justifying the need for its formal constitution as an academic discipline. This paper discusses the epistemological and methodological foundations of police science and its relevance to the theoretical and practical analysis of police work.

THE CONCEPT OF POLICE SCIENCE

The term 'police science' (the existing literature also uses the terms 'police sciences,' 'police as a scientific discipline,' etc.) is not entirely uniformly defined, which is understandable given the complexity and multidisciplinary nature of this field. In different countries, legal traditions, and academic contexts, researchers and practitioners of the police profession often give various definitions of the term, its limits, and its methodological approach.

In the German tradition, the term 'Polizeiwissenschaft' originally referred to the science of the police as part of the state administration, where the police were viewed more broadly as a system of supervision and management in the interests of the public good (Foucault, 2007; Emsley, 2010). The term encompassed public order and peace, social policy, public health, etc. In early criminological and legal research, the police were generally treated as an organ of repression or a mechanism for enforcing criminal justice (Bittner, 1970). Thus, police science was un-

derstood primarily as a segment of criminalistic or criminology, emphasising forensic methods and the fight against crime. With the development of the sociology of the police and the formation of the modern sociology of crime, broader definitions emerged. Authors such as Banton (1964) and Reiner (2010) point out that police science cannot be reduced only to 'catching offenders' and the technical-operational side, because it also includes the examination of the social role of the police, relations with citizens, as well as the analysis of institutional culture (the so-called police subculture). With the strengthening of the concept of governance of the police system and under the influence of public policies during the second half of the 20th century, a framework emerged in which police science was defined through the prism of police management, organisational structure, human and material resource planning, and models of policing (Goldstein, 1979; Bayley, 1994).

The most common approach in contemporary literature is to respect multidisciplinarity—from legal and security aspects through sociological, psychological, and criminological components, to managerial and IT components (O'Neill et al., 2008). At the same time, the idea is being developed that police science should be empirical, i.e., evidence-based, based on scientific research (Lum, Koper, & Telep, 2011; Butorac & Solomun, 2013).

Many authors have tried to define police science based on these approaches. For example, in the book *Fundamentals of Police Tactics* (Milojević & Janković, 2022, p.2), the authors describe police science as "a scientific field that, by integrating legal, organisational, criminological and other knowledge, forms the basis for the professional work of the police." In "Police Occupational Culture: New Debates and Directions" (published in Sociology of Crime, Law and Deviance) (O'Neill, Marks, Singh, 2007, p.54), the authors argue that police science is a framework that seeks to encompass "cultural, institutional, and operational understanding of policing, through empirical research and theoretical concepts of sociology, psychology, and law." In the book *Community Policing: A Police-Citizen Partnership* (Palmiotto, 2011, p.33), police science is linked to community policing and empirically studies the relationship between citizens and police to advance practice. Lum, Koper, and Telep (2011, p.6), in "The Evidence-Based Policing Matrix" (Journal of Experimental Criminology), emphasise the concept of 'police science,' which involves the establishment of evidence-based policies and practices through the continuous testing of strategies and the evaluation of their effects.

When we talk about a definition that would also take into account the conditions in the Republic of Serbia, it is necessary to take into account the following. (1) The legal order and organisation of the state – the police in Serbia operates within the Ministry of the Interior, whose work

is regulated by the Law on Police and other laws and bylaws (Milojević & Janković, 2022). Police Science, in this respect, should include the analysis of current regulations, the functioning of the police within the state administration, as well as the obligations arising from the process of European integration and international standards. (2) Transitional and reform experiences – the police in Serbia, as well as in other countries in the region, went through periods of transition and reform, with the aim of democratisation and improvement of professional standards (Gajić, 2008). Therefore, part of the definition should also include the reform component of police science, which examines how standards of transparency, accountability and the protection of human rights are gradually being introduced. (3) Regional and cultural aspects – the historical, political and cultural context of Serbia has a significant impact on the development of police practice and the perception of police in the community. Police science, therefore, should also look at the specifics of mentality, the degree of trust of citizens, attitudes towards authority, traditional norms and customs (Kuribak, 2007). (4) Institutional and academic framework – in Serbia (as well as in the region) there are several higher education institutions and institutes dealing with security sciences, criminology and police work (e.g. University of Criminal Investigation and Police Studies, Centre for Security Studies, etc.). Requests for improving work methodology, curricula, scientific journals and conferences are part of the ongoing development of police science in the national framework.

Accordingly, it can be stated that police science (1) is a separate and specialised scientific field that studies police institutions, processes and phenomena, but is profoundly multidisciplinary and includes knowledge from several related disciplines (criminology, law, sociology, management, psychology, information technology, forensics, etc.); (2) has a dual objective: (a) descriptive and analytical – to explain the functioning and transformations of the police, and (b) normative and practical orientation – to improve police practice and the quality of security and human rights protection; and (3) in the context of the Republic of Serbia, they should be harmonised with national legal frameworks, police reform processes, European standards, as well as with the values of a society that strives for democratic principles and the rule of law.

Bearing in mind the previous elaborations, a definition can be derived that combines these multiple perspectives: Police Science is a set of scientific disciplines that, through a multidisciplinary and empirically based approaches, studies the organisation, functioning, and development of the police to strengthen security, the rule of law, and the respect for human rights. It pays special attention to the social, cultural, and legal context, and international policing standards. Such a designation credibly reflects the complexity and challenges of modern police practice, while providing a clear theoretical and methodological framework for further research and improvements.

THE CONSTITUENTS OF POLICE SCIENCES

In the modern system of sciences, especially when discussing scientific disciplines within the social sciences, it is crucial to recognise the subject, theory, method and language (terminology) as the fundamental constituents of any science. If a sufficiently precise and harmonised subject of study, accepted theoretical frameworks, developed research methods and relatively stable professional terminology are formed in a scientific field, then we can speak of the constitution of a separate scientific discipline (Kuhn, 1962; Laudan, 1977; Milošević & Milojević, 2000; Milojević, Milojković, & Janković, 2012; Milašinović & Milojević, 2016).

The Subject of Police Science

In police science, the question of their object of study, i.e. what is considered the fundamental thematic core of this scientific discipline, is crucial for proving and justifying their independence and purposefulness. The subject of police science can be defined as the entirety of phenomena, processes and institutions related to the functioning of the police and police work, including (1) the organisation and structure of police bodies; (2) the methodology and strategy of policing; (3) the police's relations with the community; (4) the administrative and legal context; (5) the ethical, sociological and psychological dimensions of police work; and (6) technological and IT support for police work. Understood in this way, the subject of police science is not exclusively criminological (as in criminology), or exclusively related to security in the broadest sense (as in security sciences), but encompasses a complex and multidisciplinary framework that is constitutively focused on the police as an institution and activity (Porada et al., 2006).

The police is a specific state authority and professional service with the authority to use force in the civilian domain (Bittner, 1970; Reiner, 2010). Regarding their organisational culture and social role, the police differ from the military, the judiciary, or private security services. This peculiarity lies in the need to study exclusively police phenomena, processes, and strategies of action, thus forming an irreplaceable thematic field—an independent subject of police science.

Although police science is closely related to law, criminology, sociology, psychology, management, forensics, and technology, its thematic core (policing) cannot be fully encompassed in any of these sciences individually. Jurisprudence deals with norms, criminology with the aetiology and phenomenology of criminality, and sociology with social groups and their relationships, while police science synthesises all these points of view in the unique context of policing (Emsley, 2010; Milojević & Janković, 2020).

Policing goes far beyond criminal law response and forensic investigation; it also includes (1) the protection of law and order, (2) participating in emergencies, (3) supporting citizens, and (4) cooperating with international organisations. No other discipline deals with the totality of this activity from a scientific point of view in the way that characterises police science (Bayley, 1990; Stenning, 2009).

Police science directly contributes to the development of doctrinal and strategic bases for: shaping the police action policy at the state level; the standardisation of police practice (instructions, instructions, protocols, personnel training); and the creation of indications for the reform and improvement of the police (democratisation, transparency, professionalism).

The independence of the subjects of police sciences is also reflected in the fact that they are theoretical and applied sciences which actively deal with evaluating and improving actual police practice (Reiner, 2010; Banović & Amanović, 2019).

Although police science relies on other disciplines, its subject – policing and police institutions – is not and cannot be fully 'covered' by other sciences. Police science is an independent field that examines what and how the police do, how they are regulated, and how they impact society (Bayley, 1994; Emsley, 2010; Bruno, 1989).

The existence of numerous journals (e.g. Police Quarterly, Policing & Society, Policing: A Journal of Policy & Practice) and scientific conferences (e.g. the international conference Days of Archibald Reiss in Belgrade) confirms that police science creates its own theoretical and empirical material, independent of, but compatible with other fields (Porada et al., 2006; Stenning, 2009; Lum et al., 2011; Milašinović & Milojević, 2016; Banović & Amanović, 2022). This indicates that the subject of police science is already sufficiently clearly defined and recognised in international academic and professional circles.

Given the unique social role of the police, a scientific approach is necessary that takes a unified view of all these activities as a single subject. This is precisely the essence and the main argument for the autonomous existence of police science (Milojević & Janković, 2022; Milašinović & Milojević, 2016). The independent existence of this subject (i.e. police institutions, activities, methods, strategies and relationships) argues the development of police science as a separate scientific discipline, shows the expediency of their separation from related sciences, and underlines the importance of this area of knowledge for modern society.

The Theory of Police Science

When we speak of a theory as a constituent of a scientific discipline, we mean a set of general ideas, conceptual and categorical frameworks, principles and laws that enable a coherent interpretation, explanation and prediction of phenomena within the subject area (Kuhn, 1962;

Laudan, 1977). In the case of police science, theory represents a system of thought and instruction about the structure and functioning of the police, perceiving it as a comprehensive social phenomenon with different segments and layers (Milošević & Milojević, 2000; Milašinović & Milojević, 2016; Milojević & Janković, 2022).

The theory of police science can be defined as a system of thought and principles that: (1) includes key terms and categories necessary for understanding and explaining police activities; (2) identifies the main principles and laws governing the structure and functioning of police bodies; (3) coordinates and systematises various facts and findings from empirical research, bringing them into a coherent relationship with the basic idea of the police as a social institution (Bayley, 1990; Reiner, 2010); and (4) includes guidelines and instructions (normative and practical) for improving the professional work of the police, i.e., for creating and implementing police strategies, procedures and reforms (Goldstein, 1979; Palmiotto, 2011).

In this way, the theory of police science is not reduced to a mere description of facts (empirical findings). However, it directs and interprets them as unified, forming a single whole to understand and rationally regulate police phenomena.

The theory of police science is based on the definition of basic concepts and categories, without which it would not be possible to precisely consider the structure and functioning of the police, i.e. it is based on the conceptual and categorical apparatus. The conceptual and categorical apparatus consists of concepts and categories of different levels of generality. They are arranged systematically, analogous to the phenomena and processes that make up the content of the activities of police bodies. This conceptual apparatus constitutes the 'language' of the theory of police science, through which various segments of the police system are described and understood.

The theory of police science includes the general principles that underpin and guide policing, for example: the principle of legality (the police must act within the framework of the constitution, law and established procedures); and the principle of accountability and legitimacy (police work must be controlled, evaluated and aimed at protecting common interests).

When taken together with the conceptual framework, these principles create a unique and guiding basis, which various authors have also called the doctrine of the police (Banton, 1964; Reiner, 2010).

Although the term 'law' is less commonly used in the social sciences in the same sense as in the natural sciences, there are certain regularities in the functioning of the police described in the scientific literature (e.g., the 'law of escalation of the use of force' due to inadequate control mechanisms, statistical regularities regarding the distribution of crime and

police interventions, etc.) (Loftus, 2010). These regularities, verified by empirical research, form part of the theoretical framework, as they help to predict and explain certain phenomena in police work.

The theory of police science is not just a set of fragmentary knowledge but a coherent structure whose parts reinforce and connect. The basic idea is that the police is a social mechanism (or institution) that has: (1) its structure (organisation, hierarchy, competencies); (2) its functions (preventive, proactive, repressive, advisory, intelligence, etc.); (3) its responsibility towards society and the legal order; and (4) its value basis (ethical principles, legitimacy, freedoms and rights of citizens). All individual facts (research findings) must be consistent with and complementary to this overall idea (Bayley, 1994; Palmiotto, 2011; Milašinović&Kešetović, 2018).

There are numerous scientific papers and monographs dedicated exclusively to the theoretical foundations of police work (e.g. the works of Egon Bittner, Harold Goldstein, Michael Banton, David Bayley, Robert Reiner, Saša Milojević, Srđan Milašinović, Boban Milojković, and others), which, each in their way, develop and deepen theoretical insights into the nature of the police, its social role and ways of functioning (Bittner, 1970; Goldstein, 1979; Reiner, 2010; Milašinović & Milojević, 2016; Milojković, 2020; Milojević & Janković, 2022).

Within the framework of police science, unique theoretical paradigms have developed, such as: community policing (Palmiotto, 2011); problem-oriented policing (Goldstein, 1979);

intelligence-led policing (Ratcliffe, 2008); and evidence-based policing (Lum, Koper & Telep, 2011).

Each paradigm has its fundamental concepts, values, postulates, and methods, which are studied within the framework of police theory and adapted to the contemporary challenges of police work.

The development of police terminology – from defining basic concepts such as police legitimacy, professional ethics, police management, and the use of force to more complex concepts such as polis-gemeinschaft, trust-building measures, and predictive policing – shows that in the world of academic and professional publications on the police, there is a relatively stable and recognisable conceptual framework. This framework is not present in criminology, classical security studies, or other related disciplines to the same extent, thus confirming the autonomy of the theory of police science.

Police science theory is speculative or normative, and strongly practice-oriented, indicating its development and relevance (Stenning, 2009). For example, strategic documents that rely on problem-oriented policing methodology or evidence-based policing are widely used in police reforms, the development of procedures for patrol work in the securi-

ty sector, the organisation of criminal investigations, etc. (Bayley, 1990; Milojević & Janković, 2022; Buturac&Solomun, 2013).

Thus, the theory of police science, understood as a thought and instruction on the structure and functioning of the police, is an integral component (constituent) of this scientific discipline. Based on a unique conceptual and categorical apparatus, the agreement of several empirical and normative facts with the basic idea of the role and function of the police, the presence of principles and postulates on police work, as well as on practical and professional application, the theory of police science represents a solid foundation (constituent) of its scientific essence.

The Method of Police Science

Within any scientific discipline, a method represents the way, i.e., the ways and procedures of the cognition of its subject. Unlike subject and theory, which science's relatively more stable constituents can experience, method is often considered the most dynamic element of scientific inquiry (Kuhn, 1962; Laudan, 1977). The development of science depends mainly on developing and adapting the methodology, as it opens up new perspectives and possibilities for a deeper and more precise understanding of the research subject. In the case of police science, the essence is not to have exclusively one's 'own' methods that no other discipline possesses but to ensure an adequate and adapted application of existing scientific methods to a specific subject of police science – the police and phenomena related to it (Bittner, 1970; Reiner, 2010; Milošević & Milojević, 2000; Milašinović & Milojević, 2016). It is this ability to thoughtfully use universal but also specific methodological procedures that confirms the development of police science and points to the fact that the police, as a phenomenon and institution, can be successfully investigated by any (-one's) methods, provided that they are adapted to the peculiarities of police work.

The method of police science can be defined as a set of scientific procedures, techniques, and instruments applied to gain knowledge about the organisation, functioning, effects, and transformations of the police. This method: (1) includes both qualitative and quantitative approaches; (2) may use general (universal) scientific methods, as well as specific procedures adapted to the subject of police science; and (3) ensure the reliability, objectivity, and reproducibility of results, to the extent possible in the social sciences (Bayley, 1994; Stenning, 2009; Milošević & Milojević, 2000; Milašinović & Milojević, 2016). Understood in this way, the method is a key instrument for scientific validation of claims about police phenomena: the operation of police services, the relationship between the police and the community, the use of force, crime prevention, cooperation with other institutions, the development of police ethics, etc. (Alimpić, 2018).

Because police science is highly interdisciplinary, its researchers draw on methodological advances from: legal sciences (analysis of legal norms, comparative methods, interpretation of cases and case law); criminology (statistical analysis of crime rates, creation of criminological profiles, longitudinal research of manifestations of forms of crime); sociology (surveys, interviews, observation, field research, case studies); psychology (psychometric testing, interviews, experimental design in the study of stress in police officers); management (studies of organisational structure, performance evaluation, analysis of management effectiveness, performance measurement); and information technology (digital forensics, analysis of large databases, use of GIS technologies in crime analysis).

Using these universally recognised methods, police science adapts existing methodological tools to the specific subject of policing. For example, observing a police patrol 'in action' (the so-called ride-along research) uses the classic qualitative observation method. However, its operational application is adapted to the security and ethical constraints of police work (Loftus, 2010).

With the development of the concepts of problem-oriented policing (Goldstein, 1979), community policing (Palmiotto, 2011), intelligence-led policing (Ratcliffe, 2008) and evidence-based policing (Lum, Koper & Telep, 2011), new research strategies are emerging that police scientists are beginning to develop and apply: (a) the comparative research of community policing models between different countries and communities; (b) experimental design in evidence-based policing (e.g., randomised controlled trials of the effectiveness of police interventions); (c) hot spots policing methodology (geospatial distribution of criminal hotspots using GIS technology and statistical models); and (d) qualitative observation of police subculture, communication, and citizen relations (Loftus, 2010). These methodological practices testify that, in police sciences, methods of other sciences are applied and creatively improved or adapted, confirming this discipline's development and independence (Bayley, 1994).

The scientific methods used in police science are universally known in the social sciences, but in police sciences: (1) they are adapted to the working conditions of police institutions (the need for security and protection of secrecy, ethical restrictions, the possibility of exposure to risky situations during field research, etc.); (2) combine into specific methodological approaches (e.g., problem-oriented policing combines quantitative analyses of crime with qualitative insights into the local causes of the problem); and (3) develop new instruments (special questionnaires, observation protocols, geocoded databases) adapted to police environments (Lum et al., 2011). This confirms that police science is a 'case-by-case method' in that universal scientific tools are specifically employed to provide the most effective and accurate insight into the reality of policing (Bayley, 1994).

Thus, police science consists of general and specific scientific procedures that are proven to apply to the study of police institutions and phenomena. Its development stems from (1) interdisciplinarity (the use of methods from law, sociology, criminology, psychology, management, IT sciences, etc.); (2) adaptation to the police context (security restrictions, ethical procedures, specific forms of fieldwork); and (3) the results of numerous empirical research and studies (Bittner, 1970; Goldstein, 1979; Emsley, 2010). In police science, we see a continuous improvement of the methodological approach, especially in the areas of community policing, intelligence-led policing and evidence-based policing, where new approaches and evaluation techniques are intensively experimented with (Palmiotto, 2011; Lum et al., 2011; Kesić, 2013). Not only is the 'authentic method' of police science sought, but it is pointed out that the universal and most valuable methods of social sciences can be applied in police science, and these methods are partially modified according to the specifics of the police field (Loftus, 2010; Milošević & Milojević, 2000; Milašinović & Milojević, 2016). This interaction between the universality of the methods and the specificity of the subject shows the scientific maturity and development of police science. Therefore, the method of police science, as one of the key constituents, has been developed to a sufficient extent to enable the systematic, reliable and empirically based research of police phenomena. This testifies to the high scientific value and autonomy of police science within a broader set of social and interdisciplinary sciences.

The Language of Police Science

Within police science, language is often the least controversial constituent since it mainly relies on the terminology of the police's day-to-day operational work. However, a deeper look reveals that the language of police science contains complex aspects and barriers that affect the precision of scientific expression and communication.

The language of police science can be defined as a unique system of terminological and linguistic means (words, phrases, symbols, abbreviations) that enable professional communication, the exchange of information and the construction of theoretical concepts in the field of police and related security disciplines (Emsley, 2010; Milojević & Janković, 2022). This language was developed: (1) operationally-practically – through everyday police practice, the formation of professional terms, codes, commands and abbreviations for effective communication between members of police forces; and (2) theoretically – through the development of scientific approaches and concepts (such as community policing, problem-oriented policing, evidence-based policing, etc.) that required a clear articulation of specific terms and definitions (Goldstein, 1979; Palmiotto, 2011). The conceptual-categorical apparatus is considered to be the foundation of the theory of scientific discipline, and language is inextricably linked to it

(Milošević & Milojević, 2000; Milašinović & Milojević, 2016). When a certain number of concepts and categories are crystallised in police science (e.g., police legitimacy, police powers, police subculture, use of force, criminal tactics), a corresponding terminological apparatus is established that 'translates' this conceptual system into concrete words and expressions.

Language is crucial for exchanging ideas, theoretical concepts, and empirical findings. If a term is not clearly defined and generally accepted, ambiguity or misinterpretation can occur, calling into question the validity of scientific research (Loftus, 2010). For example, different terms for a special police unit or the powers of police officers can create confusion when conducting comparative research in multiple countries or regions (Bayley, 1994; Stenning, 2009).

The development of the theoretical foundations of police science is closely related to the linguistic form in which the theory manifests itself (Goldstein, 1979; Reiner, 2010). Language is the medium by which researchers formulate hypotheses, conceptualise phenomena, and discuss results. The theory remains vague, with diffuse ideas without adequately developed language – with agreed terms, definitions, and explanations (Laudan, 1977). In the police, language is traditionally concise and operational, oriented towards a quick exchange of commands, encrypted notifications and incredibly defined terms. However, scientific thinking about police phenomena requires a more detailed and comprehensive expression, leading to some 'metalinguistic' research and language upgrading (Milojević & Janković, 2022).

Starting from the premise that the language of police science is sufficiently communicative, concise and precise, in practice, we encounter four specific characteristics that complicate its use:

1. Conventional origin of terms – many terms are derived from practice or borrowed from other languages and disciplines and do not necessarily have a logical basis in literary language (Bittner, 1970). For example, names such as stop and frisk, intelligence-led policing, or abbreviated unit names (SWAT, OSA, PTJ) are often Anglicisms or specific slang words. As a result, these terms may be inadequate for precise scientific expression, especially when switching from one language to another and losing sight of the local convention that created them (Bayley, 1994);
2. Different naming conventions in different countries – due to the conventional origin of specialised words and phrases, the same phenomenon can have a completely different name or the same name is used for other concepts (Emsley, 2010). In the context of translation and the international exchange of theoretical texts, this creates a discrepancy between the word's literary and local specialised meanings. This results in difficult comparisons

and slower knowledge transfer, which reduces the transparency of international research and can lead to miscomparisons (Loftus, 2010);

3. Concise (operational) language vs. scientific language – in police practice, conciseness is valued as efficiency ('short and clear,' 'no superfluous words'), which can lead to the formation of 'operational jargon' (Milojević & Janković, 2022). In contrast, scientific expression requires a broader range of words that connect terms, provide definitions, and contextualise concepts (Laudan, 1977). This leads to the fact that the language of police science may lack the vocabulary necessary for nuances of meaning and elaboration of complex concepts, so there is a need for metalinguistic research and the expansion of terminology;
4. A large number of marginal concepts – in police science, there are several 'marginal concepts' – those that partly belong to another term or are located on the border of different disciplines (e.g. terms between criminology, psychology and policing). Many do not have adequate expressions in literary language, so they are interpreted arbitrarily (Stenning, 2009). This introduces confusion in the terminological apparatus and reduces the accuracy of scientific communication, which slows down the progress of police science at the international level (Reiner, 2010).

Despite the abovementioned problems, we can argue that the language of police science undoubtedly exists and plays a constitutive role for the following reasons:

1. A conceptual-categorical apparatus has been formed: concepts such as police legitimacy, police discretion, police ethics, use of force, organisation and management in the police show that a set of concepts and categorical distinctions characteristic of police science has been established (Goldstein, 1979; Emsley, 2010);
2. There is a specific terminology: in scientific journals dedicated to police studies, several professional terms are regularly used that are understandable only in the context of police work and theory (Lum, Koper & Telep, 2011);
3. Development of metalinguistic research: experts in the field know the difficulties of conventional and operational language, so they research terminological harmonisation, translation and standardisation (Stenning, 2009). These efforts indicate that police science is constantly upgrading and improving its linguistic apparatus;
4. Functionality in the scientific and practical domains: although the terms are sometimes concise and operational, they are nevertheless supplemented with definitions and clarifications in the scientific domain. Thus, the language of police science enables

a sufficiently successful exchange of information and the construction of theories despite limitations (Milašinović & Milojević, 2016; Milošević & Milojević, 2000);

5. Parallel use of professional jargon and scientific terminology: in practice, short and clear expression is maintained, while in scientific papers, authors increasingly introduce precise definitions and equivalents in international literature, thus establishing a two-layer language – operational-professional and academic (Reiner, 2010; Milojević & Janković, 2022).

Thus, the language of police science undoubtedly exists as a functional and theoretical set since it encompasses numerous terms, expressions, and symbols that describe, understand, and research police activity. This confirms the independence of police science, since the terminological apparatus is very different from the languages used by other disciplines (criminology, law, sociology, and security sciences in a broad sense).

Despite its partial conventionality and conditional localisation, the language of police science is sufficiently developed and specific to be recognised as a mandatory and independent element (constituent) of this scientific discipline. Its dual character (operational-conceived and scientifically supplemented) shows that it is a living, dynamic language that adapts to the needs and challenges of both police practice and scientific research.

THE POSSIBILITY OF SCIENTIFIC RESEARCH IN POLICE SCIENCES

Whether phenomena related to the police and their activities are suitable for scientific research is inextricably linked to the debate on the existence and development of police science as an independent discipline. Contemporary literature and research in recent decades convincingly show that police phenomena and practices are open to empirical verification, theoretical reflection and multidisciplinary research (Bayley, 1994; Reiner, 2010). Complex tasks carried out by the police require comprehensive consideration from various angles: legal, sociological, psychological, managerial, and even technical. Therefore, the phenomenon of police and police work has an interdisciplinary character, one of the peculiarities of modern sciences. Contemporary social sciences today do not limit their subject matter to narrowly defined theoretical systems but tend to explore critical social issues in an integrative way – which the police undoubtedly are (Bittner, 1970; Bayley, 1994).

Police science possesses theoretical models and concepts (paradigms) that enable scientific explanation and prediction of police phenomena. These paradigms show that the police can be studied descriptively and theoretically, aiming to generate, test and advance scientifically based hypotheses and explanations about its operation (Reiner, 2010).

Police practice can be examined using different scientific methods – quantitative, qualitative, comparative and experimental. Modern advances in information technologies (GIS, big data, analytical software platforms, virtual reality, artificial intelligence) enable the more precise and comprehensive collection and processing of empirical data, allowing policy-related phenomena to be explored even more deeply and broadly (Ratcliffe, 2008).

A common criticism is that phenomena related to the police have a strong 'subjective' and 'situational' component. Each situation is specific, and there are different political, cultural and organisational determinants, so the question arises as to whether the results can be objective and repeatable (Bittner, 1970). However, it is a challenge that also exists in all social sciences (sociology, psychology, political science) and not only in the context of the police. With well-defined variables and indicators (e.g. measures of citizens' trust, effectiveness of criminal measures, legitimacy, rate of overreach), the following can be carried out: (a) comparative studies between different police systems; (b) longitudinal research within an organisation over time; (c) evaluation of reforms; and (d) controlled case studies (Bayley, 1994), etc. This allows for objectivity and reproducibility, with methodological awareness of the social context and cultural differences (Emsley, 2010).

Of course, police science faces certain limitations and challenges, which, nevertheless, are not only inherent in them but also occur in other social disciplines:

1. Data sensitivity – many investigations into police practice require confidentiality, security clearances, or sensitive information. This can slow down the scientific process or limit it (Stenning, 2009);
2. Research ethics – investigations of police phenomena must strictly adhere to ethical standards, especially when it comes to observing fieldwork, interviewing victims or delicate cases (Loftus, 2010);
3. Political influence and pressures – sometimes, scientific findings on the police do not fit into current political agendas or are considered undesirable for public disclosure (Reiner, 2010);
4. Comparative problems – Differences in professional terminology, competencies, and organisation of police institutions in different countries make international research difficult, which requires the additional standardisation of concepts and indicators (Emsley, 2010).

Nevertheless, these difficulties do not negate the possibility of a scientific approach but only emphasise the need to carefully plan research designs and improve methods.

Is it possible to conduct a scientific investigation into the police and their activities? The answer is unequivocally – yes, for the following reasons:

1. The existence of a defined subject: the police is a complex social institution with specific powers and functions, which can be precisely defined and studied (Bittner, 1970; Reiner, 2010);
2. Formed theoretical and methodological frameworks: decades of research have brought to light various scientific approaches, models and paradigms, indicating that the police study is quite suitable for scientific analysis (Goldstein, 1979; Palmiotto, 2011; Lum et al., 2011);
3. Empirical verifiability: police phenomena can be analysed statistically, qualitatively, experimentally, and comparatively, allowing hypotheses to be tested and knowledge to accumulate (Bayley, 1994; Milašinović & Milojević, 2016);
4. Relevance for practice and society: the results of scientific research on police issues affect not only the improvement of policing but also the protection of human rights, transparency, relations with the community and security in general (Ratcliffe, 2008; Reiner, 2010).

Scientific work in the field of police science is growing year by year, as evidenced by numerous journals, monographs, and conferences dedicated exclusively to police issues. Despite the ethical, political, and practical challenges, scientific research dealing with policing in modern society continues to evolve and improve. Thus, the answer to the question about the science of studying police phenomena is positive – it is possible, not only in theory but also in practice, to achieve objective and systematic research into police activity.

CONCLUSION

Police science has developed as a multidisciplinary field integrating various academic disciplines to understand and advance policing. Although they were previously considered part of legal and criminological studies, modern research points to the need to separate them as a scientific discipline. This need stems from the specifics of policing, its complex social function, and the increasing reliance on scientific methods in the decision-making process. Empirical research, concepts such as problem-oriented work, police work in the criminal hotspot, evidence-based policing and the development of new methodological approaches show that police science is not only a theoretical field but also a practically applicable discipline that contributes to the professionalisation of the police and the improvement of security policies. Therefore, a clearly defined subject of research, theoretical frameworks, scientific methods and lan-

guage confirm the justification for the existence of police science as an autonomous academic domain with a significant impact on modern security strategies and social processes.

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ПОЛИЦИЈСКЕ НАУКЕ У 21. ВЕКУ: ИЗГРАДЊА ТЕОРИЈСКИХ И МЕТОДОЛОШКИХ ТЕМЕЉА

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Резиме

Рад "Полицијске науке у 21. веку: Изградња теоријских и методолошких темеља" анализира полицијске науке као самосталну интердисциплинарну академску област. Аутори истражују конституисање полицијских наука кроз дефинисање њиховог предмета, теоријских парадигма и методолошких приступа, са посебним нагласком на примену емпиријских истраживања и evidence-based приступа у анализи полицијског рада.

Полицијске науке проучавају организацију, функционисање и развој полиције, укључујући њену друштвену улогу и професионалне стандарде. Ова област се разликује од сродних дисциплина попут права, криминологије и социологије по специфичности свог предмета изучавања, који обухвата полицијске институције и процесе. У раду се истуче мултидисциплинарни карактер полицијских наука, који интегрише правне, социолошке, криминолошке, психолошке и менаџерске перспективе.

Теоријски оквири полицијских наука обухватају парадигме као што су community policing, problem-oriented policing, intelligence-led policing i evidence-based policing Ове парадигме дефинишу основне принципе и методе полицијског рада, наглашавајући потребу за емпиријским проверавањем ефикасности полицијских стратегија и процедура.

Методолошки, полицијске науке користе како квантитативне, тако и квалитативне приступе, прилагођене специфичностима полицијског рада. Методи укључују анализу правних норми, социолошка истраживања, психометријска тестирања, менаџерске евалуације и употребу информационих технологија попут ГИС-а и дигиталне форензике. Ова методолошка разноврсност потврђује научну зрелост и аутономност полицијских наука.

Рад такође разматра језик полицијских наука као систем терминолошких средстава који омогућава стручну комуникацију и теоријско промишљање. Развој специфичне терминологије и појмовно-категоријалног апарата доприноси прецизности научног изражавања и унапређењу теоријских концепата.

Аутори аргументовано бране потребу за конституисањем полицијских наука као засебне научне дисциплине. Ова потреба произилази из јединственог предмета изучавања, развијених теоријских и методолошких оквира, као и практичне релевантности за унапређење полицијске праксе и безбедносних политика. Рад показује да полицијске науке не само да интегришу сазнања из различитих дисциплина, већ и развијају сопствене теоријске оквире и методологије, чиме се потврђује њихова академска легитимност и практична релевантност.

Закључак рада истуче да су полицијске науке изградиле чврсте теоријске и методолошке темеље који омогућавају систематско, поуздано и емпиријски засновано истраживање полицијских феномена. Тиме се потврђује њихова улога аутономне академске области са значајним утицајем на савремене безбедносне стратегије и друштвене процесе.

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THE SECURITY CHALLENGES OF ENVIRONMENTAL MOVEMENTS

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Abstract

Modern ecological movements, while being key actors in the positive global initiative for environmental protection and the fight against climate change, face challenges that can potentially undermine security and political stability. The radicalisation of certain factions within these movements, their connections with extremist groups, and the possibility of negative, subversive instrumentalisation by foreign actors pose serious threats to both the public order and the constitutional system. This paper, aiming to provide a scientific contribution to social ecology as a branch of sociology, analyses the dynamic relationship between ecological activism and national security. It explores how and under what conditions ecological movements, engaged in the protection of natural resources, might endanger political stability in democratic societies. This is achieved through the study of current techniques for identifying and preventing security threats. Special emphasis is placed on counterintelligence protection and the challenges posed by radicalised ecological activists. By analysing both international and domestic cases, the paper examines threats to the constitutional order as well as strategies for achieving the necessary balance between, on the one hand, the right to free assembly and ecological activism, and, on the other hand, the right to national security.

Key words: ecological movements, security, radicalisation, constitutional order, counterintelligence protection, counterterrorism, democracy.

БЕЗБЕДНОСНИ ИЗАЗОВИ ЕКОЛОШКИХ ПОКРЕТА

Апстракт

Савремени еколошки покрети, иако су кључни актери у позитивној глобалној иницијативи за очување природне средине и борби против климатских промена, суочавају се са изазовима који се могу трансформисати у потенцијално нарушавање безбедности и политичке стабилности. Радикализација одређених фракција унутар ових покрета, повезаност са екстремистичким групама, као и могућност негативне,

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субверзивне инструментализације од страних актера, представљају озбиљне претње како за јавни ред, тако и за уставни поредак. Овај рад, чији је циљ пружање научног доприноса социјалној екологији као грани социологије, анализира динамичан однос између еколошког активизма и националне безбедности и истражује како и под којим условима еколошки покрети, који се баве питањима заштите природних ресурса, могу угрозити политичку стабилност у демократским друштвима, што се постиже проучавањем актуелних техника за препознавање и превенцију безбедносних претњи. Посебан нагласак стављен је на контраобавештајну заштиту, као и на изазове које представљају радикализовани еколошки активисти. Кроз анализу међународних и домаћих примера, разматрају се опасности по уставни поредак, као и стратегије за постизање неопходног баланса између, са једне стране, права на слободно окупљање и еколошки активизам и, са друге стране, права на националну безбедност.

Кључне речи: еколошки покрети, безбедност, радикализација, уставни поредак, контраобавештајна заштита, контратероризам, демократија.

INTRODUCTION

Environmental movements, as organisations and initiatives dedicated to environmental preservation, have played a significant role in raising ecological awareness and initiating legislative changes worldwide. Their core mission—protecting natural resources, combating climate change, and ensuring sustainable development—has become a priority in modern society. However, in recent decades, these movements have faced challenges related to the radicalisation of certain factions and potential security threats (Klein, 2014; McCright & Dunlap, 2010), as well as accusations of employing violent methods, sabotage, and blockades, and fostering social instability and other challenges to democratic processes (Giddens, 2011) in order to highlight real or artificially generated and exacerbated systemic deficiencies in addressing environmental issues. These activities, though carried out by a small fraction of these structures, undermine the legitimacy of entire movements and create space for intelligence agencies' disruptive actions and the emergence of threats to the constitutional order of states. Connections with foreign actors further complicate the situation, as some environmental movements become instruments of political strategies directed against national interests. These tendencies reflect a broader security context, encompassing not only physical security but also the protection of fundamental state functions. The national context in which these movements operate is a crucial factor in shaping their relationship with state institutions. For example, Finland has developed a 'comprehensive security' model that involves cooperation between state agencies and civil society to address multiple challenges. This model demonstrates how a multidisciplinary approach can respond to threats linked to ecological crises while also highlighting the difficulties in implementing such policies (Räisänen et al., 2021).

In this study, radicalisation is examined as a political, social, psychological, and group process that leads to circumstances where certain political beliefs are accompanied by individuals' and groups' willingness to engage in violent extremism and terrorist acts (Jugović & Živaljević, 2021). Radicalisation, as a socio-political and security phenomenon, and thus in the context of the misuse of environmental movements, is often associated with social crises that result in a loss of trust in institutions (Živaljević, 2022). These crises erode the core of every society and significantly influence the emergence of socially negative phenomena and processes. Such conditions create confusion in individuals' moral consciousness, leading to societal disorientation in the search for socially desirable behaviour patterns, which in turn weakens social control and fosters mass deviant behaviour (Merdović & Živaljević, 2020).

Social crises that spill over into state institutions often slow down systemic responses to urgent problems. Simultaneously, radicalisation within movements usually stems from citizens' deep frustration, particularly when institutions fail to provide adequate responses to pressing environmental issues. Environmental movements, although initially and declaratively focused on protecting natural resources, become susceptible to radicalisation due to the sense of urgency arising from increasingly severe climate change and other topics of the so-called environmental agenda. This sense of urgency can be based on objective circumstances but can also be artificially induced and exaggerated to create conditions for fostering and escalating crises in a state targeted by foreign intelligence and subversive actions (Parezanović, Željski, Stajić, 2024). In such cases, these social crises can be exploited by foreign actors to intensify the destabilisation of ruling structures and support political factions opposed to the existing constitutional order. By presenting examples of environmental movement radicalisation, this study provides a detailed analysis of counterintelligence protection challenges in the context of preventing and responding to the misuse of environmental activism by foreign actors and/or extremist groups.

ENVIRONMENTAL MOVEMENTS: GENESIS, GOALS, AND CONTEMPORARY FRAMEWORK

Environmental movements have evolved throughout history from local initiatives aimed at preserving natural resources to global movements focused on addressing key issues in modern society, such as climate change, biodiversity loss, and environmental degradation. This evolution has been driven by changes in social, economic, and political circumstances, as well as by an increasing awareness of the importance of environmental protection for the survival of human civilization (Nadić, 2020). Environmental movements have their roots in the Industrial Revolution,

when scientists and social reformers began highlighting the negative consequences of accelerated industrialisation on the environment. In the 19th century, pioneering movements such as naturalist societies in the United Kingdom and the United States sought to promote nature conservation through education and political engagement (Guha, 2000). Early examples of these movements in the U.S. included initiatives for forest and wildlife protection led by pioneers like John Muir and Gifford Pinchot (Dryzek et al., 2003).

Modern environmental movements gained prominence during the 20th century, particularly after the publication of *Silent Spring* in 1962, which drew attention to the negative effects of pesticides on ecosystems (Carson, 1962). In Europe, similar movements developed in the mid-20th century, focusing on issues such as industrial pollution and nuclear energy, exemplified by the anti-nuclear movement in Germany during the 1970s (Rootes, 2004). Global awareness of environmental issues during this period further increased, leading to the expansion and diversification of these movements, including international organisations such as the World Wildlife Fund (WWF), Greenpeace, and Friends of the Earth (FOTE). These movements focused on direct action and political pressure on governments and corporations. In recent decades, environmental movements have undergone significant transformation (Marković, 2015). Rather than focusing solely on local issues, modern movements now address global concerns such as climate change and sustainable development. At the same time, digitalisation has enabled greater mobilisation, networking, and coordination of activities, making these movements even more influential and organised. The digital age has facilitated the global reach of these movements, which has increased both their capacity to mobilise broader social groups and the risk of radicalisation (Tufekci, 2017).

THE GOALS AND METHODS OF ENVIRONMENTAL MOVEMENTS

Environmental movements aim to achieve a variety of objectives, including the preservation of natural resources, combating climate change, reducing greenhouse gas emissions, protecting biodiversity and natural habitats, and promoting sustainable development and renewable energy sources. Their goals also depend on the regional context. While in industrialised nations the focus is on reducing carbon dioxide emissions, in developing countries, priorities include forest conservation and sustainable use of natural resources (Martinez-Alier, 2002), particularly freshwater sources. Methods of action range from traditional approaches such as educational campaigns, lobbying, and peaceful protests, to more radical tactics, including direct action, protests, blockades, and other forms of civil disobedience. Examples of peaceful protests include global climate marches organised by movements like Fridays for Future, while more

radical actions, such as those carried out by the international 'nonviolent' civil disobedience movement – Extinction Rebellion – often involve traffic blockades or the occupation of public spaces (Klein, 2014), such as squares, the perimeters of key state institutions, and symbols of authority. Although these approaches are fundamentally nonviolent, certain segments resort to more extreme methods, including sabotage of industrial facilities, blockades of critical infrastructure, and cyberattacks on corporations violating environmental standards (McCright & Dunlap, 2010), and in some cases, this also includes vandalising buildings in which certain institutions or organisations are located and marked as 'hostile.'

Radical factions may also exploit legitimate platforms of larger organisations to pursue their goals, complicating the formation of appropriate security responses. This strategy allows them to conceal their activities within broader legitimate structures, making it more difficult to identify potential threats. Legitimate platforms are an integral part of globalisation, which has significantly influenced environmental movements both positively and negatively. On one hand, global connectivity has enabled the exchange of knowledge and resources between organisations, making movements more effective. On the other hand, global economic interests, in certain cases, conflict with the objectives of environmental initiatives, creating additional challenges (Nadić, 2021). Instead of merely addressing the consequences of environmental problems, movements are increasingly focusing on prevention through the promotion of renewable energy sources, circular economies, and green technologies (Hajer, 1997).

SECURITY CHALLENGES: CONNECTIONS WITH FOREIGN INTELLIGENCE SERVICES AND EXTREMIST GROUPS

As previously mentioned, a serious challenge associated with environmental movements is the potential for their instrumentalisation by foreign intelligence services or extremist groups. According to a Europol report from 2021, certain radical environmental organisations have connections with groups promoting anarchism or other forms of extremism, while some foreign intelligence services use environmental issues to destabilise the political systems of targeted countries (Europol, 2021). Examples include propaganda campaigns aimed at undermining trust in democratic institutions under the guise of supporting environmental goals. These activities have been particularly visible in recent decades and have further complicated efforts by governments to maintain internal stability and protect the constitutional order. Foreign intelligence services and extremist organisations increasingly use radicalised environmental movements or encourage their radicalisation and extremism in order to destabilise political systems through subversive activities, as well as to jeopardise the economic and energy security of countries perceived as ri-

vals. Such agendas are often part of what is known as the aggressive foreign policy discourse of many states (Šuvaković, 2009). Examining the functioning of social movements, including environmental groups, within a political and cultural context, along with forms of radicalisation within social protests, Meyer and Tarrow emphasise that this instrumentalisation often includes funding radical factions, spreading propaganda, and manipulating information to provoke internal conflicts (Meyer & Tarrow, 2018). For example, Russian intelligence services have been accused of supporting certain environmental groups in Europe to weaken the energy policies of the European Union (EU) (Polyakova, 2022), although such accusations typically remain vague and are not supported by adequate evidence. On the other hand, intelligence services and powerful corporations, either in collaboration or independently, may encourage the destructive actions of 'environmental extremists' to undermine certain large-scale business ventures, often to disrupt competition and clear the path for entities they control or support. In this context, mass protests escalating into violence, as well as large-scale blockades of energy facilities, supported by foreign factors, can jeopardise key elements of the constitutional order, including the rule of law. They may cause political destabilisation, disrupt the functioning of state systems and critical infrastructure, economic disruptions, and social conflicts, further eroding trust in state institutions (Giddens, 2011).

CHALLENGES IN GOVERNMENT RESPONSES

Democratic governments face a range of complex challenges when responding to security threats arising from the radicalisation of environmental movements. On one hand, protecting citizens' rights to freedom of expression and assembly is a cornerstone of democratic societies. On the other hand, maintaining public order, stability, and national security requires strong yet proportionate measures to address violent activities from radical groups. One key challenge lies in balancing the legitimate right to protest with the need to prevent activities that escalate into violence. For instance, protests organised by the group Extinction Rebellion often involve road blockades and occupying public spaces. While these actions generally do not involve direct violence, their consequences, such as economic losses and traffic disruptions, along with legitimate dissatisfaction from citizens who suffer collateral damage, can provoke a response from the authorities that is often perceived by environmental activists as excessive, further polarising public opinion.

Moreover, the challenge of identifying the line between legitimate activism and potential radicalisation remains. Radicalized groups, such as the Earth Liberation Front (ELF), often operate in a grey area where their activities range from civil disobedience to criminal acts like sabotage and

arson. According to the FBI, these forms of 'ecoterrorism' are directed at corporations and infrastructure projects, thereby disrupting public order and security, while simultaneously appealing to moral and environmental justice (Jarboe, 2002).

Although democratic governments face numerous challenges in curbing radical behaviour within environmental movements, modern technologies offer new opportunities for monitoring and analysing threats. Data repositories and artificial intelligence enable the identification of behavioural patterns and networks connected to radical groups. Software solutions, such as predictive models for risk recognition, are employed to monitor online communications and identify potential security challenges. However, the use of these technologies raises concerns regarding privacy and the potential misuse of data. Critics argue that excessive use of such tools could erode citizens' trust in the government, especially if these technologies are used in ways that are not transparent or are not under democratic control (Zuboff, 2019).

Another aspect of the challenge is international cooperation. Environmental movements, in the current context, increasingly transcend national borders and operate across them, necessitating coordination between different countries and international organisations. Europol has identified networks using environmental movements to spread extremist ideologies and destabilise entire regions (Europol, 2021). However, differing legal frameworks and political agendas among the involved and interested countries make it difficult to align efforts to address these issues, potentially leading to an ineffective collective response to transnational threats.

Authorities also face the challenge of crafting a narrative that clearly distinguishes legitimate environmental demands from radical or violent activities. Failing to communicate these distinctions adequately can lead to the generalisation and stigmatisation of entire movements, potentially fuelling further radicalisation among their members. In the United States, for instance, labelling certain environmental groups as threats to national security has sparked controversy and debates about the political instrumentalisation of security discourse (Monbiot, 2017). Similar reactions are present in Serbia, where security services and other state bodies' actions against radical actions from movements with an ecological agenda are often interpreted as political misuse. Addressing these challenges requires a balanced approach that includes developing a legal framework that clearly defines the line between legitimate protest and activities that threaten security; transparency in the use of modern technologies for monitoring and analysing threats; strengthening international cooperation in monitoring and neutralising transnational threats; and enhancing communication between authorities, citizens, and environmental movements to avoid mistrust and escalation of conflict.

EXAMPLES FROM DOMESTIC AND INTERNATIONAL PRACTICES

An Attempt to Instrumentalise Environmental Protests in Serbia

The protests against lithium mining in Serbia, which became a central point of ecological and political tensions, triggered not only local but also international reactions. The mining project planned by the multinational company Rio Tinto in the Jadar region sparked significant ecological resistance, and the protests grew larger and more organised during 2021 and 2022. Through these protests, environmental activists expressed concerns about the potential environmental damage that the mining project could cause, but doubts also arose about the existence of external interests behind the organisation of these protests (Lanlan & Yuwei, 2024). The protests in Serbia against the lithium mining project have become one of the most prominent issues in recent years, both politically and in terms of security, to the extent that two new terms were introduced in this context: 'politicisation of ecology' and 'post-politicisation of ecology.' The politicisation of ecology refers to the use of environmental issues for short-term political gains, while post-politicisation denotes the transformation of environmental movements into traditional political movements (Nadić, 2022). At the core of the protests is the issue of the environmental risks of mining, but many analysts argue that these protests have begun to attract broader political and geopolitical interests. There are strong indications that some of these protests have been attempted to be instrumentalised by foreign actors, who used the opportunity to destabilise the political system of Serbia and influence internal political dynamics. Media reports indicated that certain foreign factors, including foreign governmental agencies and non-governmental organisations, directly supported these protests with the aim of influencing internal political decisions in the country, particularly regarding mining projects and political stances towards the West (Euronews, 2024). The protests against lithium mining in Serbia were linked to global environmental movements, which, although largely peaceful, sometimes resort to controversial actions and methods, appearing as actors or instruments in different, usually antagonistic geopolitical interests. Certain foreign entities used these protests to channel citizens' discontent against the Serbian government, resulting in increased political tensions and disagreements within the country. Additionally, analyses note that influential and globally present foreign media, such as Reuters and The Guardian, played a significant role in shaping international views on Serbia in the context of these protests. Due to the high degree of international interest, these protests gained a much broader political dimension, with foreign influence being directed at Serbia's domestic issues through support for environmental protests, while simultaneously attributing even deeper political and geopolitical significance to these events.

In this way, environmental movements in Serbia, although based on real environmental issues, face serious challenges in terms of protection from external instrumentalisation, which complicates the positioning of protests as purely domestic civil movements, rather than as potential tools in the political games of major international powers. Furthermore, this situation complicates the issue of security and the protection of constitutional order for security services, which recognizse foreign malign influence aimed at undermining political stability in the country.

Protests against the Adani Mine in Australia

The protests against the construction of the Adani coal mine in the Australian state of Queensland represent one of the most significant environmental movements of the past decade. Activists argued that the mine would contribute further to global warming and threaten the Great Barrier Reef. Non-violent methods, such as traffic blockades and protests, were dominant, but some more radical actors resorted to sabotage of construction equipment (Colvin, 2020). The Australian government responded with increased law enforcement, including higher penalties for blocking public spaces and specialised measures to monitor protest groups. This sparked a debate on the balance between protecting the right to protest and maintaining public order. This case highlights the tension between environmental concerns and economic development (Šuvaković & Nadić, 2012), as well as the vulnerability of democratic procedures in the face of pressures from environmental movements.

The 'ZAD' Movement in France: Notre-Dame-des-Landes

One of the most well-known examples of radicalisation in the environmental movement is the 'ZAD' (Zone à Défendre) movement in France. This movement formed in reaction to plans to build an airport in Notre-Dame-des-Landes, which, according to the activists' view, would threaten the local ecosystem and agricultural land. Activists occupied the site and declared it a 'zone of defence,' predominantly using non-violent methods, but occasionally resorting to violence to prevent police interventions (Vanderschelden, 2023). This led to the French government eventually abandoning the project in 2018, which was interpreted as a victory for the movement. However, this case raised questions about the legitimacy of so-called occupations and the long-term consequences of radical environmental methods on the legal order and social cohesion. The ZAD case is often cited as an example of the success of grassroots movements, but also as a warning about the risks of radicalisation within environmental activist groups (Almeida, 2019).

COUNTERINTELLIGENCE AND SECURITY PROTECTION

Counterintelligence protection is a key component of national security, aimed at safeguarding the constitutional order from external and internal subversive and intelligence activities. There are various definitions of counterintelligence protection. Some authors think that counterintelligence protection involves activities focused on identifying and neutralising foreign intelligence operations that may threaten national security, including espionage, subversion, and terrorism (Lowenthal, 2017). It represents a comprehensive process aimed at protecting state interests through information control, threat identification, and the neutralisation of hostile intelligence activities, both in peacetime and during conflict (Herman, 2009). *In essence, counterintelligence protection involves a range of activities and measures undertaken by the services responsible for state security to detect, monitor, and neutralise threats from foreign intelligence services, internal extremist and secessionist groups, and other actors seeking to undermine the constitutional order and the integrity of key state institutions.*

The primary objectives of counterintelligence protection include safeguarding confidential information, preventing espionage, subversion, and terrorism, protecting against cyber threats, and defending against hybrid and asymmetric attacks (Parezanović, Željski, Jevtić, 2020). The rise of environmental movements has been accompanied by accusations of potential abuse by foreign actors aimed at destabilising the constitutional order. Environmental movements, due to their role in society, often straddle the line between legitimate environmental preservation efforts and activities that may jeopardise public order, internal security, or political stability. In this context, the need to establish and analyse potential links between environmental movements and intelligence agencies becomes critical to ensure the protection of political, economic, and social stability. In this regard, counterintelligence and security protection play a crucial role in identifying and neutralising potential threats that arise from radicalised factions within environmental movements or their connections with foreign services and extremist organisations. New challenges in this area require a broad range of activities from state security services, including monitoring foreign influences, identifying extremist groups, and implementing security measures. The function of the counterintelligence apparatus in this regard is primarily preventive, but it also has a strong reactive component.

Once environmental movements become the target of foreign intelligence services seeking to exploit their social and political power to destabilise democratic systems, they must be monitored by the services responsible for national security protection. Their involvement in this context requires a multidisciplinary approach, including intelligence gathering, financial flow analysis, surveillance of communication channels, in-

ternational connections of intelligence-relevant individuals or groups, and/or radical elements, as well as the continuous monitoring of public protests to identify possible subversive factors. According to an analysis by the International Institute for Strategic Studies, the main challenge in this process is distinguishing legitimate environmental activities from those that have been instrumentalised for political purposes (IISS, 2022). Counterintelligence agencies play a crucial role in these activities.

Key methods include coordination between different security services and transparent communication with the public to avoid the perception of repression. For example, events in France in 2018 related to the 'Yellow Vests' demonstrated how ignoring the demands of civil movements can lead to conflict escalation, while a measured, balanced, highly professional, and decisive approach reduces tensions and enables effective crisis management.

ENVIRONMENTAL MOVEMENTS, SOCIAL INSTITUTIONS, AND ARTIFICIAL INTELLIGENCE

Contemporary environmental movements, like other important societal segments, have recognised the significance and opportunities that digital platforms and the advancements in artificial intelligence (AI) offer for more effective action. In the current period, amid the 'race' between major global players such as the U.S. and China, and other interested parties, AI technologies are reaching unprecedented dimensions and applications.

By providing a wide range of possibilities for rapid and effective data collection, analysis, synthesis of vast amounts of valuable information, and their distribution and further utilisation, AI tools have given environmental movements an exceptional opportunity to expand their societal influence and visibility, both on national and international levels. A direct, fundamentally positive outcome of this has been the increase in overall ecological awareness within our civilization, which is a fundamental prerequisite for engaging in mass actions. Furthermore, AI and digital platforms have significantly contributed to the easier creation of global alliances among environmental movements and made the coordination of their actions far more efficient, including organising environmental protests and increasing their visibility to the public through various media and social networks.

However, these technologies can also be misused, leading to polarisation and the spread of disinformation about environmental issues (McCright & Dunlap, 2010), serving as a powerful tool for manipulation by malicious actors, including some intelligence and security agencies, lobbying groups, etc. In this context, the use of AI brings a broad spectrum of challenges, primarily related to ethics, as their algorithms reduce transparency and obscure the accountability or culpability of those apply-

ing them (Spalević & Ilić, 2024: 747). This is especially relevant when AI is used for negative or subversive purposes aimed at undermining the legitimate and democratically organised state and social order. In such cases, AI can be instrumentalised to create a radical atmosphere within a society, where, from a sociological perspective, institutions are not merely state creations but also socially responsible entities that must prevent the problems caused by the advent of such highly automated tools, which stimulate concerns regarding human rights protection (Škorić & Galetin, 2024: 566). In this context, propaganda, or the spreading of disinformation, forms part of psychological operations conducted by foreign intelligence services. The goal is to cause specific psychological effects in the target, such as fear, heightened tensions, or indecisiveness, which, in various situations, can have a determining influence on their behaviour (Miljković & Pešić, 2019: 1084). Recently, significant actors include radicalised environmental movements, which, by disseminating unverified information about certain projects and strategies, undermine the integrity of state institutions.

The use of relevant databases and available innovative tools, such as social media analytics software, predictive models, and, more recently, artificial intelligence, alongside other state and socially responsible institutions, also enables security services to identify potentially radical groups before their activities escalate into violence (Tufekci, 2017). This is of paramount importance for appropriately directing the responses of relevant state bodies and coordinated actions aimed at preventing the infiltration of destructive elements into a given environmental movement, with the intention of taking influential positions to implement their radical plans.

CONCLUDING CONSIDERATIONS: THE CHALLENGES OF COUNTERINTELLIGENCE PROTECTION

In line with globalisation and significant technological advancements, the activities of anti-state structures have become more sophisticated, posing considerable challenges for modern counterintelligence protection, including digital threats, hybrid warfare, and the globalisation of environmental issues (Nadić, 2023). Strategic documents, such as the United States National Counterintelligence Strategy (2020), emphasise the risks associated with the misuse of social movements for political and intelligence purposes, as well as the growing concerns regarding potential threats related to the influence of foreign organisations on domestic state processes (National Counterintelligence Strategy, 2020).

In modern defence systems, which incorporate various security services, sometimes with overlapping jurisdictions, their full cooperation remains a challenge and, often, a practical problem, representing a root cause of significant security risks. In this regard, the effective integration

of a state's counterintelligence capabilities and establishing functional cooperation with various security agencies, such as joint intelligence centres and teams, significantly enhances efficiency in countering threats from so-called ecological radicalism. Examples such as the FBI's Joint Terrorism Task Force in the U.S. have proven successful in combating domestic and international terrorist networks (War Room, 2021), and a similar principle could be applied to extremist elements within environmental movements.

What should be particularly noted is that counterintelligence protection mechanisms may sometimes be non-functional due to deep foreign involvement in domestic legal regulations, which makes domestic security services vulnerable and 'unequipped' for modern security challenges. Furthermore, diplomatic activities of states without adequate strategic directions and coordination with relevant domestic security bodies may result in the 'legal' outflow of crucial data through ongoing bilateral or multilateral diplomatic cooperation. Similarly, an inadequately managed line of international cooperation between domestic security services and foreign, so-called partner agencies could lead to vulnerabilities in the state's counterintelligence mechanisms, failing to detect a strong foreign strategic presence, which, as previously emphasised, may also manifest through the actions of various environmental organisations. Considering this dimension and the potential of environmental movements, especially in times when destructive consequences may be significantly amplified by the use of sophisticated modern technological tools and software, including artificial intelligence, security services must develop new, effective responses in a delicate, highly professional, and thoughtful manner, always starting from the inherently positive nature of these movements and the need to uphold the highest degree of respect for human rights and freedoms.

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БЕЗБЕДНОСНИ ИЗАЗОВИ ЕКОЛОШКИХ ПОКРЕТА: СОЦИЈАЛНО-ЕКОЛОШКИ ПОГЛЕД

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Академија за националну безбедност, Београд

Резиме

Еколошки покрети, као кључни актери у глобалној иницијативи за очување животне средине, суочавају се са изазовима инструментализације усмерене ка нарушавању безбедности и политичке стабилности. Иако је суштина деловања ових покрета везана за еколошки одржива решења, њихова радикализација може представљати безбедносни изазов за државне институције. Са циљем пружања научног доприноса социјалној екологији као грани социологије, овај рад анали-

зира динамичан однос између еколошког активизма и националне безбедности, акцентирајући важност коришћења адекватних техника за препознавање и превенцију безбедносних претњи. У раду се посвећује пажња генези развоја еколошких покрета, те њиховим циљевима и модалитетима деловања. Кроз призму савремених безбедносних изазова, обрађује се повезаност еколошких покрета са страним специјалним службама и екстремистичким групама. У актуелном друштвеном контексту, ови субјекти неретко користе легитимне платформе већих организација како би прикривено спровели своје деструктивне циљеве, што додатно компликује формирање адекватних одговора безбедносних служби. Са једне стране, глобална повезаност је омогућила размену знања и ресурса између организација, чинећи покрете ефикаснијим. Међутим, са друге стране омогућила је да се овим алатима индоктринирају и радикализују фракције покрета. Приказом примера из домаће и међународне праксе, у раду су истакнути сложени изазови са којим се сусрећу демократске владе широм света приликом решавања ситуација радикализације еколошких покрета. Ове активности су биле нарочито видљиве током последњих деценија и додатно су компликовале напоре власти да одрже унутрашњу стабилност и заштите уставни поредак. У том процесу деструктивног деловања укључују се и пропагандне кампање усмерене на подривање поверења у демократске институције под маском подршке еколошким циљевима. Један од кључних изазова у одговору држава на овакве процесе лежи у балансирању између легитимних права на еколошки активизам и потребе да се спрече активности које ескалирају у насиље, односно идентификацији границе између легитимног активизма и потенцијалне радикализације. У контексту ових изазова, контраобавештајна заштита представља кључну компоненту националне безбедности. Сходно томе, од тренутка када постану циљ страних обавештајних служби, еколошки покрети морају бити предмет интересовања служби задужених за заштиту националне безбедности, чије ангажовање у том контексту захтева мултидисциплинарни приступ. Узимајући у обзир комплексност и потенцијал еколошких покрета, нарочито у временима када деструктивне последице могу бити далеко веће услед употребе софистицираних модерних техничких средстава и софтвера, укључујући и вештачку интелигенцију, службе безбедности су дужне да и саме развијају нове делотворне одговоре на високо професионалан и промишљен начин, увек полазећи од изворно позитивног предзнака тих покрета и потребе очувања највишег степена поштовања људских права и слобода.

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Corrigendum

In the Journal Teme, Vol. XLVIII, No 1, January - March, 2024, in the article:
Dina Živković, Danijela Stošić Panić
THE CONCEPTUAL FRAMEWORK FOR RESEARCH ON SERVITIZATION STRATEGY IN MANUFACTURING COMPANIES

TEME, XLVIII, No. 1, January - March 2024, pp. 149-166
https://doi.org/10.22190/TEME230329008Z

the online and printed PDF versions of this article contain incorrect versions of the abstract and keywords in Serbian.

Therefore, the editor-in-chief has decided to publish a corrigendum to this article, i.e. the correct versions of the abstract and keywords in Serbian.

Апстракт

Као стратегијско опредељење произвођача да своју понуду обогате укључивањем услуга, сервитизација постаје све значајнији феномен како у пракси, тако и у истраживачкој заједници. Полазећи од чињенице да се ради о младом истраживачком пољу у ком раде различите истраживачке заједнице, циљ овог рада је да се систематизацијом постојећих резултата истраживања и знања понуди јединствени концептуални оквир за истраживачки обухват феномена сервитизације. Рад је теоријског карактера и његова главна публика су истраживачи којима понуђени оквир треба да олакша идентификовање истраживачких питања и позиционирање сопственог истраживања овог сложеног, мултидисциплинарног феномена.

Кључне речи: стратегија, производња, услуге, оквир за истраживање.

Link to the corrected article:
https://doi.org/10.22190/TEME230329008Z

INSTRUCTIONS FOR AUTHORS ON PAPER PREPARATION

Formatting. Papers should be sent as *Microsoft Office Word* files (version 2000, 2003, 2007), font *Times New Roman*, font size 12. Page setup margins should be 2.5 cm (top, bottom) and 2.5 cm (left, right), paper size A4 (210 mm x 297 mm).Paragraphs should be formatted with line spacing 1.5, and justified (Format, Paragraph, Indents and Spacing, Alignment, Justified). Do not break words at the end of the line.

Paper length. Research papers should not exceed 37.000 characters (spaces included), and reviews should not be longer than 8.000 characters (spaces included).

Language, alphabet. The languages of publication in the TEME is English (font *Times New Roman*). Contributions be rejected if the language is not at the appropriate level of correctness and style. If the authors wish to increase the visibility of their papers, they are supposed to submit Serbian version of the article as well (as Supplementary file - Word format, using the Cyrillic alphabet).

PAPER

The author should remove from the text of the paper all the details that could identify him/her as the author. Authors must enter all the necessary data during the electronic submission of the paper.

PAPER STRUCTURE

- **Paper title in English**
- **Abstract in English** 100 to 250 words, followed by 5 key words.
- The title and the abstract of the paper should be directly linked to the paper content, with no information that would identify the author(s) of the paper.
- **Paper title in Serbian**
- **Abstract in Serbian**, followed by 5 key words.
- The paper should follow the **IMRAD** structure (Introduction, Methods, Results and Discussion), when it presents an empirical study
- **Paper body** should not contain more than three levels of sub-division into *sections* and *sub-sections*. Level one sections should be introduced by headings printed in *Italic* and in *CAPITAL LETTERS*, formatted as centred. Level two sections should be introduced by headings in *Italic*, with the initial capital letter, formatted as centred. Level-one and level-two headings should be separated from the previous text by one line. Level three sections should be introduced by a heading printed in *Italic*, but placed as a regular paragraph, separated by a full-stop from the text that follows.

Each paragraph should have the first line indented (1 cm).

In-text citations: Whenever referring to a source (monograph, article, statistical source), the author should cite the source in the text, using the

author-date system (Surname, year of publication, pages referred to, all in brackets) – Please, refer to the table at the end of these *Instructions*.

▪ When referring to several works by the same author, provide all the years of publication chronologically after the author's name. If there are several works by the same author published the same year, provide further specification using letters (a, b,...) after the year of publication: "...confirming this hypothesis (Wuthnow, 1987a, p. 32)...".

▪ When referring to several works by different authors, provide the authors' names in brackets following the alphabetical order, separating authors by semi-colon: "... several studies were central to this question (Jakšić, 1993; Iannaccone, 1994; Stark and Finke, 2000)."

Direct quotations can be included in the text if not longer than 20 words. Longer quotations should be given as separate paragraphs, spaced-out from the previous and following text, and with the following formatting: Format, Paragraph, Indents and Spacing, Left 1 cm, Right 1 cm, Line spacing – Single; for instance:

To explain how "culture through language affects the way we think and communicate with others of different background" (Gumperz, 2001, p. 35), Gumperz states:

> "Conversational inference is partly a matter of a priori extra-textual knowledge, stereotypes and attitudes, but it is also to a large extent constructed through talk" (Gumperz, 2001, p.37)."

It is crucial that the in-text citations and references should match the literature listed at the end of the paper. All in-text citations and references must be listed in the References, and the References must not contain sources not referred to or cited in the text. The bibliography listed at the end of the paper should contain author names and source titles in original languages and alphabets, without translation.

Tables, graphs, and figures. Tables, graphs and figures should be numbered (sequentially), with captions explaining their content. Captions should precede tables, but follow graphs and figures. Graphs and figures must be clearly visible in the text, so they should be provided in 300dpi resolution. Graphs and figures must be single objects (no Drawing elements added). Where necessary, mathematical formulas should be added to the text using Microsoft Equation Editor.

Appendices. should be marked by *letters* (sequentially), e.g. Appendix A, Appendix B etc., and should contain a title describing the content of the appendix. When there is only one appendix, no letters are necessary in its title (only "Appendix").

➢ **Literature (References).** A complete list of references should be provided as a separate section at the end of the paper. The references should be listed in accordance with the **APA Style**. The references should be listed alphabetically, by the authors' last (family) names. For publication titles in Serbian, the English translation should also be

provided in brackets. The works by the same author should be listed chronologically (from the most to the least recent ones). Wherever possible, provide the DOI number, too, in addition to other reference data.

- **Summary in Serbian.** Please provide a summary at the end of the paper, after the References section. The summary should not be longer than 1/10 of the paper (i.e. 2,000 to 3,700 characters). The summary should be formatted as Italic, with single line spacing.

EXAMPLES OF SOURCE QUOTING AND REFERENCING:

Journal papers and articles – 1 author

In-text citation:

(Manouselis, 2008), i.e. (Manouselis, 2008, p. 55)

In 'References':

Manouselis, N. (2008). Deploying and evaluating multiattribute product recommendation in e-markets. *International Journal of Management & Decision Making, 9*, 43-61. doi:10.1504/IJMDM.2008.016041

Journal papers and articles – 2 to 6 authors

In-text citation:

First reference: (Uxó, Paúl, & Febrero, 2011)

Subsequent references: (Uxó et al., 2011)

In 'References':

Uxó, J., Paúl, J., & Febrero, E. (2011). Current account imbalances in the monetary union and the great recession: Causes and policies. *Panoeconomicus*, 58(5), 571-592.

Journal papers and articles – more than 6 authors

In-text citation:

(Cummings et al., 2010, p. 833)

In 'References':

Cummings, E., Schermerhorn, A., Merrilees, C., Goeke-Morey, M., Shirlow, P., & Cairns, E. (2010). Political violence and child adjustment in Northern Ireland: Testing pathways in a social–ecological model including single-and two-parent families. *Developmental Psychology, 46*, 827-841. doi: 10.1037/a0019668

Book – 1 author

In-text citation:

(Heschl, 2001, p. 33)

In 'References':

Heschl, A. (2001). *The intelligent genome: On the origin of the human mind by mutation and selection*. New York, NY: Springer-Verlag.

Book – edited volume

In-text citation:

(Lenzenweger & Hooley, 2002)

In 'References':

Lenzenweger, M. F., & Hooley, J. M. (Eds.). (2002). *Principles of experimental psychopathology: Essays in honor of Brendan A. Maher*. Washington, DC: American Psychological Association.

Paper or chapter in an edited volume

In-text citation:

(Cvitković, 2007)

In 'References':

Cvitkovic, I. (2007). Katolicizam [Catholicism]. U A. Mimica i M. Bogdanović (Prir.), *Sociološki rečnik* [*Dictionary of Sociology*] (str. 226-227). Beograd: Zavod za udžbenike.

Encyclopaedia entry

In-text citation:

(Lindgren, 2001)

In 'References':

Lindgren, H. C. (2001). Stereotyping. In *The Corsini encyclopedia of psychology and behavioral science* (Vol. 4, pp. 1617-1618). New York, NY: Wiley.

Papers in Conference Proceedings

In-text citation:

(Bubanj, 2010)

In 'References':

Bubanj, S., Milenković, S., Stanković, R., Bubanj, R., Atanasković, A., Živanović, P. et al. (2010). Correlation of explosive strength and frontal postural status. In: Stanković, R. (Ed.): *XIV International Scientific Congress FIS Comunications 2010 in Sport, Physical Education and Recreation* (191-196). Niš: University of Niš, Faculty of Sport and Physical Education.

PhD Dissertations, MA Theses

In-text citation:

(Gibson, 2007)

In 'References':

Gibson, L. S. (2007). *Considering critical thinking and History 12: One teacher's story* (Master's thesis). Retrieved from https://circle.ubc.ca/

Institutions as authors

In-text citation:

(Републички завод за статистику, 2011)

In 'References':

Републички завод за статистику. *Месечни статистички билтен*. Бр. 11 (2011).

Laws

In-text citation:

(Закон о основама система васпитања и образовања, 2004, чл. 5, ст. 2, тач. 3.)

In 'References':

Закон о основама система васпитања и образовања, Службени гласник РС. Бр. 62 (2004)

Legal and other documents

In-text citation:

(Legal Consequences for States of the Continued Presence of South Africa in Namibia (South West Africa) notwithstanding Security Council Resolution 276, 1971)

In 'References':

Legal Consequences for States of the Continued Presence of South Africa in Namibia (South West Africa) notwithstanding Security Council Resolution 276, (1970), ICJ Reports (1971) 12, at 14

Please refer to:

Publication Manual of the American Psychological Association, 6th Edition, 2009;

http://www.library.cornell.edu/resrch/citmanage/apa

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