



30th International Scientific Conference

Strategic Management

and Decision Support Systems
in Strategic Management

Proceedings

SUBOTICA, SERBIA
03 October, 2025



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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE CHANGING WORK ENVIRONMENT BASED ON THE VIEWS OF INDIVIDUALS IN SLOVAKIA - A PILOT STUDY

Abstract: The aim of the research is to investigate the opinions of employees working at Slovakian enterprises with different educational backgrounds, work type and job positions about the impact of artificial intelligence on business in the near future. A questionnaire survey was used to explore the opinions of the subjects in spring of 2024. The questionnaire was created on the Limesurvey platform and sent out online, receiving 311 responses. Finally, 260 responses were received in the course of the present research. SPSS software was used to evaluate the results. The effect of job position (H1) was assessed on the statements about AI (Likert scale). The results showed that differences in the opinions of people in different job positions (owner, manager or employee) were observed for some items (H1). The research is a pilot study to raise awareness of the importance of this topic and to stimulate further research in the management professional community.

Keywords: artificial intelligence, challenges, changing work environment, the future effects

1. INTRODUCTION

The rapid development and spread of artificial intelligence (AI) is fundamentally changing the world of work around the world. Automation, data-driven decision making and machine learning are becoming more widely used not only in the technology sector, but also in traditional industries (Babashahi et al., 2024). For businesses, the use of AI has many benefits; AI-driven decision-making systems can increase organizational efficiency, reduce operational costs and drive innovation. The application of AI also has implications for human resource management (Berber et al., 2018), which is becoming increasingly "technology-intensive" (Rimac Bilušić & Pološki Vokić, 2025) and more efficient (Blahušiaková, 2023). Since AI is constantly evolving and has an infinite number of applications in many different fields (Kostin, 2018), in the near future companies may find the right type of AI for every task, the challenge is to recognize in time the benefits they can gain by using these tools (Raskovich et al, Automation and AI will have a significant impact on the structure of the workplace, and although many new jobs will be created, the automation of low-skilled tasks may lead to the exclusion of certain groups of workers. The introduction of technology is not always a clear positive: it can create uncertainty and

resistance among workers, which can inhibit the adoption of new systems (Frey & Osborne, 2017). Of particular importance is the question of how workers in different jobs and with different educational backgrounds perceive and value these changes, and how this affects the competitiveness and operational efficiency of organizations. Our research explored the views of workers with different educational levels and job titles, as well as those with intellectual and physical jobs, on the likely impact of AI in the near future.

2. INTRODUCTION

2.1 Increasing business competitiveness through AI

Companies are constantly looking for ways to innovate to increase their competitiveness (Soltysik et al., 2024). In recent years, Artificial Intelligence (AI) has played an increasingly important role in this process, especially since the Covid-19 pandemic, which has significantly accelerated the process of automating and digitizing work tasks (Cramarenco et al., 2023). AI is not just a new technology, but an engine of transformation that is reshaping work processes, business models and boundaries between industries. It is becoming increasingly popular and pervasive in cross-border e-markets, transforming the global economy (Mirbabaie et al., 2022), embedded in business strategies and decision-making processes (Shrestha et al., 2019), and has become a key factor in business value creation (Dwivedi et al., 2023). Its application not only increases efficiency, but also opens up new opportunities for companies in innovation and customer experience. It is pervasive (Wang and Siau, 2019) and applicable across a broad spectrum of industries, from automated customer service systems to predictive analytics and intelligent supply chains (Mirbabaie et al., 2022). According to research by Ransbotham et al (2017), more than 80% of companies already consider AI to be of strategic importance and almost 85% believe it can provide them with a competitive advantage.

While one of the biggest benefits of AI is cost reduction and efficiency gains (Enholm et al., 2022), its application is multifaceted and still relatively new in the corporate sector, leaving organizations facing a number of challenges (Mirbabaie et al., 2020). Digital transformation, the application of new technologies, is transforming organizational forms, production processes and business models (Nambisan et al., 2019), leading to a number of workplace changes. Many companies have implemented digital transformation to gain a competitive advantage, but success is not guaranteed: the transition involves risks and difficulties, mostly at the organizational and employee level (Cramarenco et al., 2023). Employees are the most important actors in digital transformation, as they operate and apply the technology, and their motivation, openness to change (Don Ton & Berke, 2024) and commitment are key to the success of a company's AI strategy (Ye et al, 2024). Employee mental health is also a key factor: a balanced, mentally healthy workforce can significantly increase an organization's performance and competitiveness (Soulami et al., 2024). Conversely, if employees experience stress and burnout, this has a negative impact on productivity, concentration, and increases absenteeism and turnover rates (Dimoff & Kelloway, 2018).

The successful integration of AI depends not only on technological advances, but also on shaping corporate culture and employee attitudes. Organizations need to design their AI-enabled business strategies with innovation and teamwork at the forefront (Fredström et al., 2022; Perifanis & Kitsios, 2023). It is important that leaders create an environment that supports employee skill development while providing them with stability, inclusion and well-being (Jiang et al., 2022). An innovative organizational culture stimulates continuous improvement in performance implementation (Strugar Jelača, 2018), but the active participation of employees, either directly or indirectly, is essential for success (Enholm et al., 2022; Pap et al., 2022).

2.2 The impact of AI on workers

The continued rise of artificial intelligence (AI) is fundamentally shaping the labor market, affecting almost every profession and influencing the way people work (Frey & Osborne, 2017). The integration of AI into the enterprise not only means new technological solutions, but also impacts on the skills, career paths and well-being of employees. It is predicted that by 2025, 50% of workers will need to learn new skills in order to keep pace with continuous technological advances and innovations (Schwab & Zahidi, 2020). Upskilling and retraining are essential for success: continuous learning and adaptation is what differentiates successful companies from those that lag behind the competition (Randstad, 2020). The spread of AI could also lead to the emergence of new professions and the creation of new jobs (Nübler, 2016; Lane & Saint-Martin, 2021). In parallel, there is a growing demand for highly skilled talent who can effectively apply AI-based technologies (Babashahi et al, 2024).

The digital switchover places heavy demands on workers. The widespread deployment of AI-related technologies requires the need to be prepared for human-machine interaction (Jaiswal et al., 2022) and to retrain employees to adapt to new job requirements (Li, 2022). The development of digital skills is becoming increasingly important: not only technical skills need to be mastered, but also expectations are rising in the areas of information management, communication, creativity and cybersecurity (Cramarenco et al., 2023; Major & Spalek, 2022; Pelau et al., 2021).

The mismatch between skills and job requirements can be a source of stress, which can reduce employee satisfaction (Ruzele et al., 2024; Gasic et al., 2025) and increase job insecurity (Nemțeanu et al., 2022). Gartner (2018) reports that

83% of companies have failed to achieve their digital transformation goals because employees have not actively engaged in technology-driven business processes and changes. Another study found that 61% of employees feel anxiety about technological developments in their workplace, while 49% fear that digital transformation could have negative workplace consequences (Hizam et al., 2023).

The introduction of new technologies can create uncertainty in the workplace and affect employee engagement and performance (Ye et al., 2024; Hizam et al., 2023). The use of AI technologies has many benefits, but employers need to develop appropriate strategies to adequately address these employee needs (Horobet et al., 2024). AI can also increase competition among employees and create polarization, so management should consciously promote collaboration and teamwork, fostering a positive organizational culture and cohesion among employees (Ye et al., 2024).

A motivated and engaged workforce is one of the most important factors in a company's growth and success. Research by Stamate et al. (2021) has shown that employees' attitudes towards AI play a crucial role in how they feel at work, significantly influencing their job satisfaction and psychological well-being. Although AI creates new opportunities, it can also become a source of stress for some employees, especially those who find it harder to adapt to rapid technological change (Nazareno & Schiff, 2021; Soulami et al., 2024). The impact of AI goes beyond employee well-being: it also affects engagement, productivity and overall satisfaction (Soulami et al., 2024).

Therefore, AI should be implemented in a way that takes into account the specific needs, age and skills of each worker (Wei et al., 2022).

The aim of our research is to investigate how different groups of employees perceive the impact of AI on their corporate life. In developing our hypotheses, we have taken into account the most recent literature, which is presented in detail in the following chapters. The perception of AI depends on a number of factors, including the educational level of employees, the nature of their work and their position in the organizational hierarchy. Below we describe the main relationships that form the basis of our research.

2.2.1 The expected impact of AI in the context of corporate scheduling

Organizational hierarchy can also influence opinions on AI. Executives and managers often view AI as a competitive advantage and an efficiency-enhancing tool, while subordinate employees may be more concerned about the uncertainties associated with automation and the transformation of work processes (Acemoglu & Restrepo, 2019). Research suggests that corporate culture also plays a key role in the adoption of AI, as openness to organizational innovation and the willingness of employees to use new technology in the long term (Enholm et al., 2022) determine the success of the adoption of technological innovations (Mikalef & Gupta, 2021). Senior managers play a crucial role in shaping this culture (Alsheibani et al., 2023). In innovative organizations, employees are more willing to engage with AI, especially if management supports the integration of technology and provides the necessary resources (Lee et al., 2024). The role of top management is also key because successful AI implementation requires significant organizational changes, such as increased collaboration between departments and reengineering of data management processes (Mikalef & Gupta, 2021). Positive attitudes and support from managers are essential for successful implementation (Enholm et al., 2022). However, the use of AI in leadership roles is still a divisive issue; the majority of employees support AI in helping them schedule and monitor their work processes (Raveendhran and Fast, 2021), but many reject the idea that AI will fully replace human leaders. AI in managerial roles is considered less reliable and acceptable, especially when it directly impacts their career, they disapprove of the use of AI-based managers, while the use of AI in non-managerial roles is considered more acceptable (Dong et al., 2024). The implementation of AI requires significant changes in the structure of the organization, the level of collaboration between departments, and the management of data within the organization (Mikalef and Gupta, 2021). It is therefore important to determine the benefits of strategic use of AI for employees in different positions and how this aligns with organizational goals (Enholm et al., 2022).

Based on the above, leaders and managers are often focused on the competitive advantages and efficiency gains of AI, and thus, the authors hypothesize, that they have a more positive attitude towards it, while lower-level employees are less confident due to uncertainty about change:

H1: People with different job titles will have different perceptions of the future impact of AI on business.

The aim of this research is to empirically test these hypotheses using statistical methods in order to better understand the impact of AI on corporate life. The results can help companies to develop more effective AI strategies, taking into account employees' opinions and expectations, reducing their resistance to technological change.

3. METHODS

3.1 Data collection and sample

The study focuses on assessing the opinions of employees of Slovak companies about the impact of artificial intelligence on daily life of businesses in the near future.

The questionnaire survey was chosen from quantitative research methods.

The questionnaire consisted of closed questions only, some of which were Liker-scale questions. It made the analysis easier – from a statistical and mathematical point of view. The questionnaire was made on Limesurvey platform. Single-cross-sectional research method was used, since the data was collected from many different individuals at a single point in time. The convenience sampling method was used from the non-probability sampling methods as authors used their own list consisting of more than 5000 companies and individuals, since there is no list about them. The aim was to collect only 1 answer from 1 company. The questionnaire was sent out via email to the companies and individuals. The questionnaire period lasted from March 2024 to June 2024. A total of 331 responses were collected. This research is based on 260 responses (meaning 260 employees of different companies), since some of the responses were omitted due data cleaning and some responses were insignificant for the topic of this research. IBM SPSS software was used for data processing. Table 1. presents the demographic characteristics of the sample.

Table 1: About the sample (n = 260)

Size of the company	n	%
Micro	94	36.2%
Small	55	21.1%
Medium	37	14.3%
Large	59	22.6%
Non-Competitive Market	15	5.7%
Graduation	n	%
High School	192	73.8%
University	68	26.2%
Type of work	n	%
Physical	128	49.2%
Mental	132	50.8%
Position	n	%
Owner	79	30.4%
Manager	57	21.9%
Employee	124	47.7%

Source: own processing

3.2 Statistics

Three hypotheses were formulated, where factor such as different educational backgrounds, work type and job positions were taken into account. The research model is shown in Figure 1.

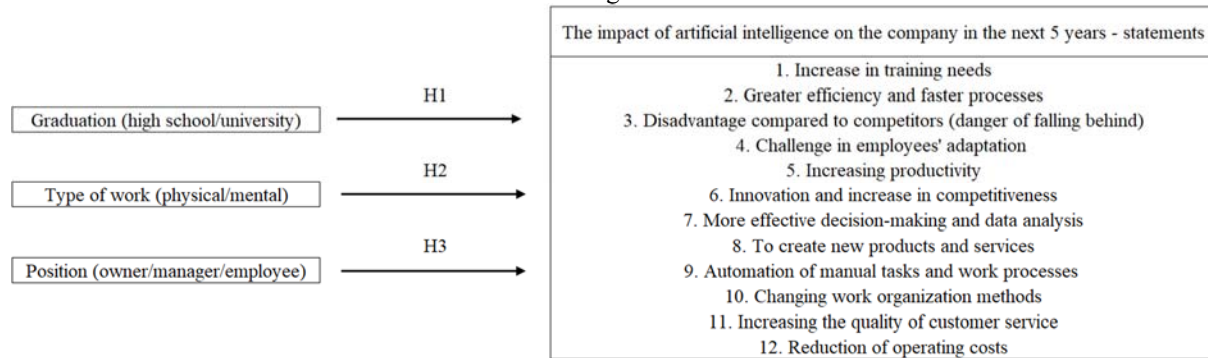


Figure 1: Research model

Source: own processing

A Test of Normality (Kolmogorov-Smirnov and Shapiro-Wilk) was used to decide between parametric or non-parametric method for testing the actual hypothesis:

$$K = |cpo_i - cpe_i|_{max}$$

where

cpo_i and cpe_i = the i^{th} observed and normal cumulative proportions.

$$W = \frac{(\sum_{i=1}^n a_i X_i)}{\sum_{i=1}^n (X_i - \bar{X})^2}$$

where

X_i = ordered sample values

a_i = coefficient based on the sample size

In this research data significantly deviate from a normal distribution. Based on the results, the Kruskal-Wallis test (H statistic) was calculated:

$$H = \left(\frac{n-1}{n} \sum_{i=1}^k \frac{n_i * (\bar{R} - E_R)^2}{\sigma^2} \right)$$

where

n = sample size

n_i = the number of observations in each group

E_R = expected value of the rankings

$\bar{R}$ = mean rank sum in group i

σ^2 = rank variance

4. RESULTS AND DISCUSSION

Based on the hypothesis of the research:

"H1: People with different job titles will have different perceptions of the future impact of AI on business." In testing this hypothesis, we examined questions about the future impact of scheduling (independent, nominal variable) and AI (dependent, ordinal variable). To decide which statistical method to use, a normality test (Table 2) was used:

Table 2: Test of Normality – H1 (n = 260)

Statements	Position	Kolmogorov - Smirnov			Shapiro - Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Increasing training needs	Owner	0.191	79	0.000	0.871	79	0.000
	Manager	0.321	57	0.000	0.830	57	0.000
	Employee	0.259	124	0.000	0.869	124	0.000
Greater efficiency and faster processes	Owner	0.249	79	0.000	0.872	79	0.000
	Manager	0.307	57	0.000	0.800	57	0.000
	Employee	0.262	124	0.000	0.853	124	0.000
Disadvantage compared to competitors	Owner	0.232	79	0.000	0.862	79	0.000
	Manager	0.231	57	0.000	0.868	57	0.000
	Employee	0.237	124	0.000	0.867	124	0.000
A challenge for workers to adapt	Owner	0.218	79	0.000	0.880	79	0.000
	Manager	0.275	57	0.000	0.859	57	0.000
	Employee	0.252	124	0.000	0.868	124	0.000
Increasing productivity	Owner	0.220	79	0.000	0.879	79	0.000
	Manager	0.300	57	0.000	0.840	57	0.000
	Employee	0.253	124	0.000	0.869	124	0.000
Innovation and competitiveness growth	Owner	0.244	79	0.000	0.875	79	0.000
	Manager	0.313	57	0.000	0.809	57	0.000
	Employee	0.280	124	0.000	0.854	124	0.000
More efficient decision-making and data analysis	Owner	0.249	79	0.000	0.870	79	0.000
	Manager	0.275	57	0.000	0.816	57	0.000
	Employee	0.277	124	0.000	0.858	124	0.000
Creation of new products and services	Owner	0.266	79	0.000	0.863	79	0.000
	Manager	0.278	57	0.000	0.852	57	0.000
	Employee	0.221	124	0.000	0.876	124	0.000
Automation of manual tasks and workflows	Owner	0.194	79	0.000	0.878	79	0.000
	Manager	0.262	57	0.000	0.836	57	0.000
	Employee	0.244	124	0.000	0.867	124	0.000
Changing work organization methods	Owner	0.223	79	0.000	0.870	79	0.000
	Manager	0.242	57	0.000	0.861	57	0.000
	Employee	0.220	124	0.000	0.878	124	0.000
Improving the quality of customer service	Owner	0.236	79	0.000	0.875	79	0.000
	Manager	0.253	57	0.000	0.867	57	0.000
	Employee	0.276	124	0.000	0.851	124	0.000

Reducing operating costs	Owner	0.219	79	0.000	0.865	79	0.000
	Manager	0.243	57	0.000	0.858	57	0.000
	Employee	0.260	124	0.000	0.867	124	0.000

Source: own processing

Based on the above (Table 2), the data is not normally distribution for any of the items, so a Kruskal-Wallis test (Table 3) was performed.

Table 3: Kruskal-Wallis Test - Ranks – H1 (n = 260)

Statements	Position	N	Mean Rank
Increasing training needs	Owner	79	117.17
	Manager	57	147.90
	Employee	124	130.99
Greater efficiency and faster processes	Owner	79	110.11
	Manager	57	149.40
	Employee	124	134.80
Disadvantage compared to competitors	Owner	79	127.92
	Manager	57	141.52
	Employee	124	127.08
A challenge for workers to adapt	Owner	79	125.02
	Manager	57	143.65
	Employee	124	127.95
Increasing productivity	Owner	79	119.25
	Manager	57	145.44
	Employee	124	130.80
Innovation and competitiveness growth	Owner	79	121.80
	Manager	57	149.11
	Employee	124	127.49
More efficient decision-making and data analysis	Owner	79	123.22
	Manager	57	151.51
	Employee	124	125.48
Creation of new products and services	Owner	79	127.23
	Manager	57	152.40
	Employee	124	122.52
Automation of manual tasks and workflows	Owner	79	115.97
	Manager	57	153.62
	Employee	124	129.13
Changing work organization methods	Owner	79	113.02
	Manager	57	151.39
	Employee	124	132.04
Improving the quality of customer service	Owner	79	134.03
	Manager	57	143.30
	Employee	124	122.37
Reducing operating costs	Owner	79	124.49
	Manager	57	151.73
	Employee	124	124.57

Source: own processing

Based on the mean rank scores (Table 3), managers were the most likely to agree with our statements that AI will bring big changes to different areas of work in the next 5 years.

Table 4: Kruskal-Wallis – Test Statistics – H1 (n = 260)

Statements	Kruskal-Wallis H	df	Asymp. Sig
Increasing training needs	6.175	2	0.046*
Greater efficiency and faster processes	11.003	2	0.004*
Disadvantage compared to competitors	1.723	2	0.422
A challenge for workers to adapt	2.547	2	0.280
Increasing productivity	4.491	2	0.106
Innovation and competitiveness growth	5.373	2	0.068
More efficient decision-making and data analysis	6.531	2	0.038*

Creation of new products and services	7.068	2	0.029*
Automation of manual tasks and workflows	9.141	2	0.010*
Changing work organization methods	9.648	2	0.008*
Improving the quality of customer service	3.646	2	0.162
Reducing operating costs	6.398	2	0.041*

Source: own processing

Based on the results of the Kruskal-Wallis test (Table 4), "*Increasing training needs*" ($p = 0.046$), "*Greater efficiency and faster processes*" ($p = 0.004$), "*More efficient decision-making and data analysis*" ($p = 0.038$), "*Creation of new products and services*" ($p = 0.029$), "*Automation of manual tasks and workflows*" ($p = 0.010$), "*Changing work organization methods*" ($p = 0.008$), "*Reducing operating costs*" ($p = 0.041$) show significant differences between the different positions.

5. DISCUSSION AND CONCLUSION

This research, we wanted to find out how people with different educational and professional backgrounds perceive the impact of AI in the near future. We looked at the extent to which people with manual and mental jobs feel affected and the differences in their views. Our aim was to use statistical methods to empirically test our hypotheses and to gain deeper insights into how AI affects business operations.

Results related to the hypothesis (*H1: People with different job titles will have different perceptions of the future impact of AI on business*) clearly support that employees in different positions have different perceptions of the impact of AI on the company. Senior management tends to be more favorable to the adoption of AI as a strategic and competitive advantage, while for employees the level of adoption depends largely on the practical application of AI, technological transparency and training opportunities. This finding is consistent with previous research (Lee et al., 2019; Mikalef & Gupta, 2021; Dong et al., 2024) that suggests that adoption of AI is strongly influenced by organizational culture, openness to innovation, and managers' attitudes towards technology. While top management decisions play a crucial role in the successful corporate integration of AI, the attitudes and skills of employees are key to the effective adoption of new technologies.

According to research by Rožman et al (2023), an AI-based corporate culture, leadership approach and targeted training programs can significantly contribute to reducing employee workload and increasing organizational performance. In particular, AI offers benefits in the area of complex decision-making and data analytics, enabling managers to make faster and more informed decisions, while reducing the volume of frequent tasks for employees and increasing workplace engagement. Therefore, it is essential for companies to support AI adoption with transparent communication and detailed training programs to increase employee confidence and reduce resistance.

The integration of artificial intelligence into the enterprise will continue to accelerate in the coming years, creating new opportunities and challenges in the labor market. The evolution of AI is expected to not only transform decision-making and data analysis processes, but also play an increasing role in automation and customer relationship management. To adapt successfully, companies will need to proactively develop their training strategies to ensure that employees have the necessary technological and analytical skills.

The role of managers in promoting the adoption of AI is becoming more important, while corporate culture and employee attitudes are also becoming key factors. In the future, it will be particularly important to develop effective human-machine collaboration that not only increases efficiency but also improves employee satisfaction and engagement. The success of AI implementation will therefore be not only a technological issue, but also a strategic and organizational one.

The rapid development of AI adoption in the enterprise warrants further research on the long-term impact of AI adoption. Future studies may focus on the dynamics of AI adoption, especially in relation to how different industries and corporate cultures adapt to technological changes.

Optimizing the interaction between AI and human work could also be an important research direction, especially among manual workers, where automation is seen as a threat. Further empirical studies are needed to explore the impact of AI on worker satisfaction, engagement and performance, and what training programs can facilitate adaptation.

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MEASURING CUSTOMER EXPERIENCE QUALITY IN BANKING SERVICES IN SERBIA: VALIDATION OF THE EXQ SCALE

Abstract: Customer Experience (CX) has emerged as a key element in business strategies globally. With the increasing focus on the service and experience economy, understanding and managing the customer experience has become essential to achieving business success. As markets become increasingly competitive over time, companies focus on providing exceptional customer experiences as a way to stand out from the competition. CX is formed through direct contacts such as purchasing and using products and services, and interacting with staff; as well as through indirect contacts such as advertisements, user reviews, and social media. There is a growing awareness about critical importance of precise tools for measuring the quality of CX in order to obtain accurate feedback and take appropriate measures for improvement. The most applied scale for measuring CX found in literature is EXQ scale developed by Klaus and Maklan. Original scale was reevaluated, covering three stages in its three dimensions: the brand (pre-purchase), the service provider (during purchase), and post-purchase experience, extending the number of items to 25.

The aim of this paper is to determine the possibility of implementing the reevaluated EXQ scale in financial service sector in Serbia. The validation of the instrument was conducted on a sample that consisted of 702 valid responses to the questionnaire sent to more than 2000 customers of banking services mainly from Vojvodina and Belgrade regions. The evaluation of the psychometric characteristics of the EXQ scale was performed using principal component analysis. The analyses were conducted at the individual level, which means that the sample size on which the analyses were conducted was 702 respondents.

Keywords: Customer Experience, EXQ Scale, Banking Sector, CX Measurement

1. INTRODUCTION

The transition from an industrial economy to a knowledge economy, along with the shift from product and goods marketing to service marketing, are parallel processes that reflect changes in value creation in the modern economy. While the industrial economy focuses on physical goods and production efficiency; knowledge economy (Foray, 2004) and service marketing (Lovelock & Patterson, 2015) emphasize the value of intangible resources and customer relationships.

The size of the service sector is growing in almost all countries worldwide. As economies develop, the relative share of employment between agriculture, industry, and services undergoes dramatic changes. Even in developing countries, the value generated by service provision accounts for at least half of the gross domestic product (GDP) (The Service Economy | OECD, 2000; Wirtz & Lovelock, 2021).

In service marketing, customer relationships are not just one-time transactions but long-term engagements. Customer Relationship Management (CRM) enables companies to track customer interactions and continuously improve the experiences they provide, fostering deeper and more lasting relationships. Key ways in which CRM contributes to this include:

- Tracking all stages of the customer journey, from initial contact to post-service support, allowing for personalized and timely interactions with customers (Woelke, 2023);
- Enabling customer segmentation based on loyalty and behavior, to create targeted offers and reward programs aimed at customer retention (Setiawati et al., 2019);
- Enhancing customer experience (Customer Experience – CX) (Purcărea, 2019), which is a crucial element in service marketing.

By using CRM, companies can better understand their customers and respond quickly to their needs or complaints, thereby increasing customer satisfaction. CRM allows companies to:

- Analyze customer feedback by collecting insights that can be used to improve service quality and tailor offerings to specific needs;
- Provide a consistent customer experience by giving employees access to customer information, ensuring a seamless and personalized service across all interaction points.

2. CUSTOMER EXPERIENCE

Customer experience (CX) has emerged as a key element in business strategies worldwide. With an increasing focus on the service and experience economy, understanding and managing customer experience has become essential for achieving business success. CX encompasses all interactions a customer has with an organization, including products, services, and all touchpoints with the brand (Lemon & Verhoef, 2016). Growing competition and changes in customer expectations have compelled companies to recognize the importance of delivering an exceptional customer experience to differentiate themselves in the market.

In recent years, the importance of customer experience has been extensively studied, exploring its concepts, strategies, and influential factors. Contemporary literature is increasingly examining various instruments used to measure the quality of customer experience. The most applied scale for measuring customer experience found in literature is EXQ scale developed by Klaus and Maklan (“Phil” Klaus & Maklan, 2012).

The definition of CX emphasizes the importance of a holistic approach to understanding customer experience. CX is the result of complex and interconnected emotional, cognitive, sensory, and interactional elements that collectively shape the customer's perception of the brand (Klaus, 2014).

Customer experience (CX) encompasses all interactions a user has with a brand throughout the customer journey, including pre and post-sale stages. Customer experience is not only related to the product or service a company provides, but also to the overall experience a customer has across all touchpoints with the brand. (Lemon & Verhoef, 2016).

Klaus and Maklan (Klaus & Maklan, 2013) explore different aspects of CX and focus on a multidimensional approach to its measurement, identifying the following key factors: the emotional aspect (Klaus, 2014), the cognitive aspect (McColl-Kennedy et al., 2019), the sensory aspect (Tyagi & Tyagi, 2022), interactions with employees (Klaus & Maklan, 2013), environment - both physical and digital (Froehle & Roth, 2004), direct and indirect contacts (Bagdare & Jain, 2013).

In their paper (Wetzels et al., 2023) the authors lay the foundation for linking Customer Experience Management (CXM) practices to company performance, emphasizing which practices are more rewarding than others. Their study lays the groundwork for research to further elaborate on the cause-effect relationship between CX and performance.

3. THE INSTRUMENT FOR ASSESSING CUSTOMER EXPERIENCE

Measuring service quality is essential for understanding and improving the customer experience. For several decades, various reviews of measurement methods have been conducted to assess service quality and related aspects of customer experience. Traditional models like SERVQUAL and SERVPERF have been used often in the literature (Klaus, 2007; Maklan & Klaus, 2011). The authors (Maklan & Klaus, 2011) emphasize the need for the development of new tools that better reflect the complexity of CX, given that service quality is one of the key determinants of customer experience. When consumers receive a service that meets or exceeds their expectations, their overall experience is positive, which can lead to greater loyalty, repeat purchases, and positive word-of-mouth recommendations. Service quality can be seen as a fundamental element of CX, as it establishes the foundation on which consumers' perception of a brand is built.

One of the main challenges in linking service quality with CX is measuring these aspects in a way that accurately reflects consumers' subjective experiences.

In his work (Klaus, 2007) the author points out that traditional methods such as the previously mentioned SERVQUAL and SERVPERF provide useful frameworks for evaluation, but often fail to account for the full complexity of CX. For example, the SERVQUAL model focuses on the gap between consumer expectations and perceived service delivery but does not encompass all touchpoints that constitute CX. The most applied scale for measuring customer experience found in literature is the EXQ scale developed by Klaus and Maklan ("Phil" Klaus & Maklan, 2012). The original scale was re-evaluated, covering three stages in its three dimensions: the brand (pre-purchase), the service provider (during purchase), and the post-purchase experience, extending the number of items to 25.

4. THE RESULTS OF EVALUATING THE VALIDITY AND RELIABILITY OF THE INSTRUMENT FOR ASSESSING THE CUSTOMER EXPERIENCE QUALITY

The re-evaluated original EXQ scale instrument comprises 25 items that assess attitudes towards the quality of the customer experience, resulting in the development of a hypothesis to be tested:

H₀: The re-evaluated original EXQ scale instrument can be used to identify and measure the attitudes of respondents from the Republic of Serbia regarding customer experience (CX).

The empirical study was conducted to test the EXQ scale in the banking sector within the Serbian context. All respondents were users of banking services in Serbia, including both individuals and legal entities. The analysis was performed on a sample of 702 respondents. Within the sample, male respondents constituted 61.3%, and female respondents 38.7%. The predominant age group in the sample was "25-34 years old," representing 44.4% of the total sample. Respondents with a "completed university degree" constituted 49.1% of the sample. The majority of respondents were from the Vojvodina region, making up 83.5% of the sample.

The study adopted new EXQ scale with 7 point Likert scale (1 – strongly disagree, 7 – strongly agree), and the items appeared in random order on the questionnaire. Assessment of the items confirmed face validity, meaning that the scales measured what was supposed to be measured. Revisiting the items' content, we labelled the dimensions in keeping with Klaus's study (Klaus, 2014). Therefore, the first dimension (comprising 7 items) **Brand Experience**, the second dimension (comprising 11 items) **Service Purchase Experience** and the third dimension (comprising seven items) **Post Purchase Experience**.

The psychometric characteristics of the instruments were evaluated by applying Principal Component Analysis (CPA). The analyses were conducted at the individual level.

This research aimed to evaluate the unidimensionality of each subscale of the EXQ scale. To achieve this, a one-component factor analysis was conducted on the items within each subscale. By applying the criterion of having eigenvalues greater than 1 along with the "Scree plot" criterion, a single factor was extracted for every subscale, confirming their unidimensional nature. Additionally, an analysis was carried out on the entire sample to assess the instrument's reliability. The results for the specified dimensions indicated high-reliability values, aligning with findings from prior research in the literature.

4.1. The validity of subscale Brand Experience

The measure of representativeness of the sample was assessed by the *Kaiser–Meyer–Olkin (KMO)* test. Resulting value of 0.907 indicated adequate sampling according to Kaiser's interpretation. Cronbach's alpha, as a measure of internal consistency, was used to assess the reliability of the subscale, and the resulting value of 0.881 (Table 4) indicated sufficient consistency of the items, and reliability of the measure. The significance of correlations between variables was measured by Bartlett's test of sphericity, and the resulting values indicated statistical significance ($\chi^2= 1949.565$; $df=21$; $p=0,000$). Thus, the conditions that would justify the application of factor analysis were fulfilled.

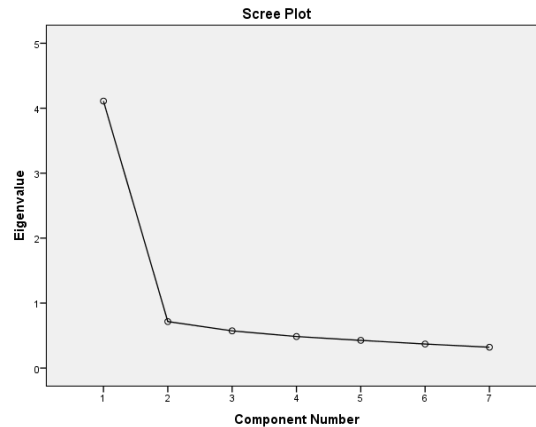
Table 1: Values of component saturations for the first principal component determined by the items of the subscale Brand Experience

Brand Experience	Factor loadings
BRE5 - The people who work at XYZ represent the XYZ brand well	.822
BRE6 - XYZ's offerings have the best quality	.796
BRE7 - XYZ's offerings are superior	.793
BRE2 - I am confident in XYZ's expertise	.793

BRE3 - XYZ gives independent advice (on which product/service will best suit my needs).	.787
BRE4 - I choose XYZ not because of the price alone	.717
BRE1 - XYZ has a good reputation	.639

Source: autors, 2025.

The subscale Brand Experience can be considered one-dimensional, i.e. to have one measurement subject, and to be homogeneous. The conclusion was based on the amount of explained variance of the first principal component of 58.709%, whose characteristic root was $\lambda=4.110$ (Table 4, and Scree Plot in Picture 1). The Brand Experience construct is psychometrically valid and reliable because all variables have statistically significant factor saturation (Table 1).



Picture 1: Scree Plot of the components on the items of the Brand Experience subscale

Source: autors, 2025

4.2. The validity of subscale Service Purchase Experience

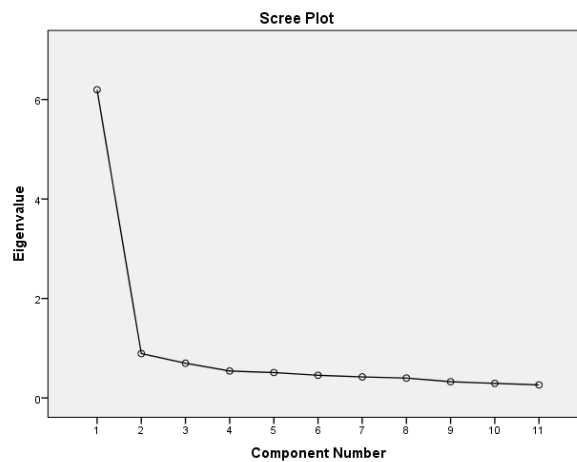
The measure of representativeness of the sample was assessed by the *Kaiser–Meyer–Olkin (KMO)* test. Resulting value of 0.946 indicated adequate sampling according to Kaiser's interpretation. Cronbach's alpha, as a measure of internal consistency, was used to assess the reliability of the subscale, and the resulting value of 0.910 (Table 4) indicated sufficient consistency of the items, and reliability of the measure. The significance of correlations between variables was measured by Bartlett's test of sphericity, and the resulting values indicated statistical significance ($\chi^2= 3772.469$; $df=55$; $p=0,000$). Thus, the conditions that would justify the application of factor analysis were fulfilled.

Table 2: Values of component saturations for the first principal component determined by the items of the subscale Service Purchase Experience

Service Purchase Experience	Factor loadings
SPE8 - XYZ delivers a good customer service	.843
SPE6 - XYZ's personnel relates to my wishes and concerns	.815
SPE4 - XYZ demonstrates flexibility in dealing with me	.812
SPE1 - XYZ advised me throughout the process	.811
SPE7 - The people I am dealing with (at XYZ) have good people skills	.793
SPE2 - Dealing with XYZ is easy	.755
SPE5 - At XYZ I always deal with the same forms and/or same people	.735
SPE11 - XYZ's (online and/or offline) facilities are designed to be as efficient as possible (for me)	.719
SPE10 - XYZ's facilities are better designed to fulfill my needs than their competitors	.656
SPE3 - XYZ keeps me informed	.652
SPE9 - I have built a personal relationship with the people at XYZ	.627

Source: autors, 2025.

The subscale Service Purchase Experience can be considered one-dimensional, i.e. to have one measurement subject and to be homogeneous. The conclusion was based on the amount of explained variance of the first principal component of 56.321%, whose characteristic root was $\lambda=6.195$ (Table 4, and Scree Plot in Picture 2). The Service Purchase Experience construct is psychometrically valid and reliable because all variables have statistically significant factor saturation (Table 2).



Picture 2: Scree Plot of the components on the items of the Service Purchase Experience subscale
Source: authors, 2025

4.3. The validity of subscale Post Purchase Experience

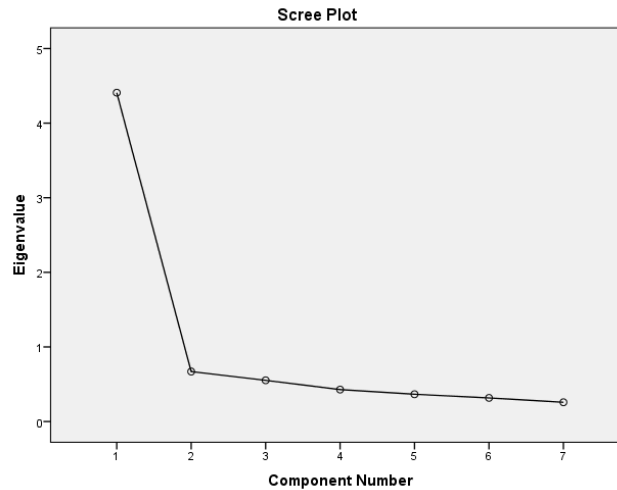
The measure of representativeness of the sample was assessed by the Kaiser–Meyer–Olkin (KMO) test. Resulting value of 0.912 indicates adequate sampling according to Kaiser's interpretation. Cronbach's alpha, as a measure of internal consistency, was used to assess the reliability of the subscale and the resulting value of 0.900 (Table 4) indicated sufficient consistency of the items, and reliability of the measure. The significance of correlations between variables was measured by Bartlett's test of sphericity, and the resulting values indicated statistical significance ($\chi^2= 2366.489$; $df=21$; $p=0,000$). Thus, the conditions that would justify the application of factor analysis were fulfilled.

Table 3: Values of component saturations for the first principal component determined by the items of the subscale Post Purchase Experience

Post Purchase Experience	Factor Loadings
PPE4 - XYZ will look after me for a long time	.867
PPE6 - I am happy with XYZ as my (service firm)	.844
PPE5 - XYZ deal(t) well with me when things go(went) wrong	.838
PPE1 - I stay with XYZ because they know me	.794
PPE3 - XYZ keeps me up-to-date	.784
PPE2 - XYZ knows exactly what I want	.733
PPE7 - Being a client at/customer of XYZ gives me social approval	.679

Source: authors, 2025.

The subscale Post Purchase Experience can be considered one-dimensional, i.e. to have one measurement subject and to be homogeneous. The conclusion was based on the amount of explained variance of the first principal component of 62.981%, whose characteristic root was $\lambda=4.409$ (Table 4, and Scree Plot in Picture 3). The Post Purchase Experience construct is psychometrically valid and reliable because all variables have statistically significant factor saturation (Table 3).



Picture 3: Scree Plot of the components on the items of the Post Purchase Experience subscale
Source: authors, 2024

In this study, Cronbach's alpha coefficient was used to calculate the internal consistency of the items included in the questionnaire for the study with 702 respondents. Results of the overall reliability analysis demonstrated that the items in the three constructs had a satisfactory discriminating power of 0.961 (Table 4 - Instrument EXQ). The results indicated the satisfactory level of construct validity and internal consistency of this questionnaire. Furthermore, it was suitable to measure the respondents' attitude towards customer experience.

Table 4: The reliability and variance extracted for the EXQ instrument's subscales

Subscale	Cronbach's alpha	%	Λ
Brand Experience	.881	58.709	4.110
Service Purchase Experience	.910	56.321	6.195
Post Purchase Experience	.900	62.981	4.409
Instrument EXQ	.961		

* Λ - the characteristic root of the first principal component; % - variance extracted

Source: authors, 2025.

5. CONCLUDING REMARKS

Customer Experience (CX) has become a vital component of business strategies worldwide. As the economy shifts towards prioritizing services and experiences, effectively understanding and managing CX is crucial for achieving business success. With the marketplace becoming increasingly competitive, companies are prioritizing outstanding CX to distinguish themselves from their rivals. CX derives from direct interactions, such as product purchases, service usage, and staff engagement, alongside indirect interactions like advertisements, user reviews, and social media presence. There is an increasing recognition of the need for precise tools to measure user experience quality, enabling accurate feedback and necessary improvements.

A structured questionnaire was employed to assess respondents' attitudes regarding the CX with banking services in Serbia. All constructs and their associated items in the questionnaire were sourced from existing studies. The revised original EXQ scale instrument includes 25 items that evaluate attitudes towards customer experience quality across three dimensions: the first dimension (consisting of 7 items) is Brand Experience; the second (comprising 11 items) is Service Purchase Experience; and the third (also comprised of 7 items) is Post Purchase Experience. This tool was tested with a sample of 702 respondents in Serbia.

Results of the overall reliability analysis demonstrated that the items in the three constructs had a satisfactory discriminating power, indicating the satisfactory level of construct validity and internal consistency of this questionnaire. The hypothesis that *"The re-evaluated original EXQ scale instrument can be used to identify and measure the attitudes of respondents from the Republic of Serbia regarding CX"* was confirmed. Therefore, we concluded that the EXQ scale instrument was appropriate for measuring the respondents' perceptions of assessing CX with banking services in the Republic of Serbia.

In recent years CX has evolved from a mere buzzword into a significant marketing paradigm and an essential aspect of business practices (Arne De Keyser et al., 2020). Consequently, CX has emerged as a priority for both the business sector and the academic community (Becker & Jaakkola, 2020). The validated EXQ instrument should benefit business communities operating in transitional economies (such as Republic of Serbia).

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CAN BUSINESS BENEFIT FROM APPLYING ARTIFICIAL INTELLIGENCE TO PROJECT MANAGEMENT? EVIDENCE FROM GOOGLE SCHOLAR LITERATURE

Abstract: This article aims to identify research related to artificial intelligence (AI) and project management (PM), mainly through an analysis of Google Scholar literature selected by clearly defined search criteria. The paper also makes a systematization of areas in which businesses can benefit from the application of AI on PM activities. The results show that the number of titles containing the words “project management” & “artificial management”, as well as “project management” & “AI” has increased enormously in recent years, which makes the importance of this research issue obvious.

Keywords: project management, artificial intelligence, google scholar

1. INTRODUCTION

We live in a so-called “Data-driven society” where, as a result of digitalization processes, each activity leads to the creation of data that can be used to predict trends related to our behavior, whether in everyday activities or in completing our professional tasks or business activities. These claims are supported by the predictions of Statista, whose report states that the volume of data/information created, captured, copied, and consumed worldwide in 2028 will amount to 394 zettabytes, which is as much as 15 times more compared to 10 years earlier (in 2017 this volume was 26 zettabytes) and as much as over 197 times larger volume of data compared to 2010 when it was “only” 2 zettabytes (Taylor, 2024). Since all businesses produce, collect and use data, their possession is an important source of success in solving everyday complex problems and making decisions based on experiences. Considering the above, artificial intelligence, whose functioning requires data, is gaining more and more importance every day. Such processes do not circumvent the activities related to project management where data is needed from the very identification of the issue, to the analysis and production of different scenarios for solving the defined problem. Using data, artificial intelligence redefines project management by creating opportunities for real-time decision-making, strengthening teamwork and efficiently dealing with the increased complexity and scope of projects (Ibrahim Adedeji Adeniran et al., 2024), but also in the processes of project selection and prioritization, monitoring the progress of project activities, speeding up reporting and facilitating testing (Nieto-Rodriguez & Viana Vargas, 2023). According to the announcement on the official PMI website, the not-yet-published edition of the PMBOK® Guide – Eighth Edition includes a dedicated Appendix on Artificial Intelligence for the first time, and this edition “...is the most data-driven update yet...” (Project Management Institute, 2025), which further confirms the role of AI in project management.

Taking into account these considerations, this article aims to provide a brief review of the scholarly literature related to artificial intelligence and project management and also to systematize the areas in which businesses can benefit from adopting artificial intelligence in project management. Against this backdrop, Google Scholar was used as a Web Search engine to broadly search for the relevant literature using certain search criteria. Initially, the idea was to identify publications that contained the words “project management” & “artificial management” as well as “project management” & “AI” in the title of publication, and an additional criterion was that the literature was written in English.

More specifically, the following criteria were taken into account:

C1 Publications listed on Google Scholar

C2 Publications written in English

C3 All publications published by the date of the search

C4 The words “project management” & “artificial management” should be contained in the title of the publication

C5 The words “project management” & “AI” should be contained in the title of the publication

The paper is organized into four sections including the introduction and conclusion. The section 2 defines the concepts of project, project management and artificial intelligence, while section 3 provides a brief overview of Google Scholar literature related to the impact of artificial intelligence on project management.

2. PROJECT, PROJECT MANAGEMENT AND ARTIFICIAL INTELLIGENCE

The following text will define what a project and project management are, and subsequently a definition of artificial intelligence will also be provided.

2.1. Project and Project management

There are different perspectives and interpretations when defining the term project, but they all have certain common characteristics. According to BS 6079-2:2000 Project Management Vocabulary, a project is “a unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including constraints of time, cost and resources.” (Lester, 2021, p.1). The definition provided by APM (Association for Project Management) states that, “a project is a unique, transient endeavor, undertaken to achieve planned objectives, which could be defined in terms of outputs, outcomes or benefits” (APM, 2019, p.214). In its Project management body of knowledge, PMI (Project Management Institute), defines a project as “a temporary endeavor undertaken to create a unique product, service, or result” (Project Management Institute, 2021, p.4), while according to PRINCE2 “a project is a temporary situation where a team is assembled to address a specific problem, opportunity or change that is sufficiently difficult that it cannot be handled as routine ongoing work” (AXELOS, 2018, p.36). This means that every project in some way follows defined components such as timeframe, budget, activities, requirements, uniqueness, quality, etc. that lead to a specific result.

Project management, as a discipline directly related to projects, is defined as the application of knowledge, skills, tools and techniques to project activities to meet project requirements and achieve planned results (Project Management Institute, 2021). According to APM, project management includes “the application of processes, methods, knowledge, skills and experience to achieve specific objectives for change” (APM, 2019, p.214), while PRINCE2 defines it as “the planning, delegating, monitoring and control of all aspects of the project, and the motivation of those involved, to achieve the project objectives within the expected performance targets for time, cost, quality, scope, benefits and risk” (AXELOS, 2017, p.35). All these definitions indicate that project management is a special concept of management and the application of methods of planning, organizing and controlling with the intention of allocating all resources necessary for the efficient execution of the project and achieving its defined objectives, taking into account various aspects of the project.

Hence, it is necessary to examine the role of AI in project management, or how various aspects of project management can be optimized or automated in order to improve the success of project activities.

2.2. Artificial Intelligence

The term artificial intelligence (AI) refers to a machine or computer-based system that, based on data, has the ability to demonstrate intelligent behavior and, for certain human-defined objectives, to make predictions, provide recommendations, or make certain decisions (Boucher, 2020; Johnson Eddie Bernice, 2021). Although AI includes a large number of subfields that have an impact on almost all segments of human life, efficiency improvement and human capabilities augmentation, there are still six broad categories that are particularly worth mentioning such as: Machine Learning (ML), Neural Networks (NN), Deep Learning (DL), Robotics, Computer Vision (CV), and Natural Language Processing (NLP) (Athanasopoulou et al., 2022; Angeleski & Kostoska, 2022; Angeleski & Kostoska, 2023; Kostoska et al., 2024) some of which can also contribute to project management.

3. GOOGLE SCHOLAR LITERATURE ON THE IMPORTANCE OF AI FOR PM AND THE RELATED BENEFITS FOR BUSINESSES

Although artificial intelligence has been widely discussed in recent years, and its application in project management is even more specific, the first publications on Google Scholar related to these search criteria were published as early as 1987. More specifically, a total of 475 publications were listed that contained the terms “project management” & “artificial management” or “project management” & “AI” in the title of the publication. The frequency of publication of the scholarly literature by year is shown in Figure 1.

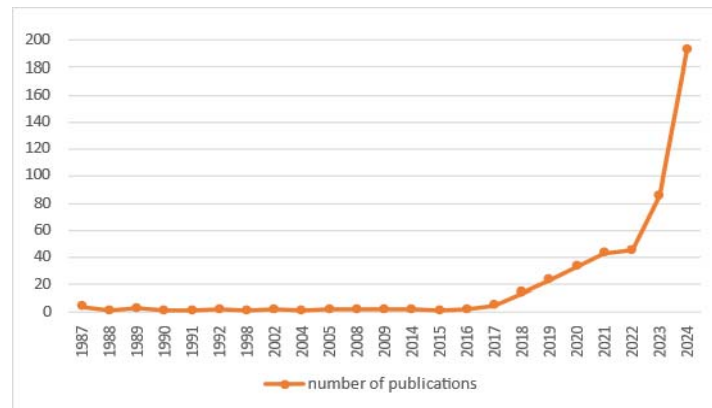


Figure 1: Number of publications with “Artificial intelligence or AI” and “Project management” in the title, by year (Google Scholar 1987 - 2024)

Source: Author’s calculation based on Google Scholar data

The number of scholarly literatures until 2017 is almost imperceptible with a maximum of 5 publications recorded per year, but the increase is evident especially in the last few years, reaching a peak in 2024 when a total of 193 publications were published. Analyses show that in the last five years (from 2020 to 2024) a total of 400 publications or 85.3% of the total number of publications with these terms in the title have appeared in Google Scholar search results (in 2025, as of 11.01.2025, a total of 6 publications have been displayed).

Table 1: Number of publications with “Artificial intelligence or AI” and “Project management” in the title and number of citations (Google Scholar 1987 - 2024)

Number of citations	Number of publications	Citations (%)	Cumulative number of citations	% of total publications
30+	26	50.73%	50.73%	5.47%
10-29	49	28.48%	79.21%	10.32%
1-9*	183	20.79%	100%	38.53%
0**	217	0%	100%	45.68%
	475	100%		100%

Source: Author’s calculation based on Google scholar data

*This number includes a publication published in 2025

**This number includes five publications published in 2025

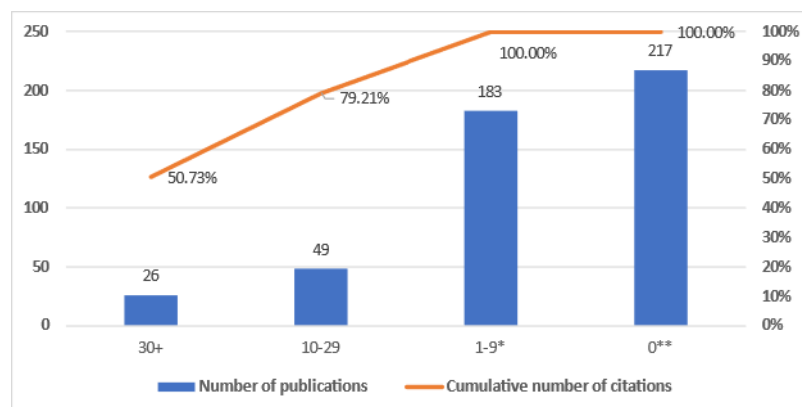


Figure 2: Number of publications with “Artificial intelligence or AI” and “Project management” in the title and cumulative number of citations (Google Scholar 1987 - 2024)

Source: Author’s calculation based on Google scholar data

According to the number of citations, 26 publications or 5.47% of the total number of publications have 30 or more citations and they include more than 50% (50.73%) of the total number of records and 49 publications or 10.32% are in the range from 10 to 29 citations and they include 28.48% of the total number of listed citations, which means that the first 75 publications by citations accumulate a total of about 80% of the citations (79.21%); 183 publications or 38.53% range from 1 to 9 citations and they include 20.79% of the total number of listed citations; the remaining 217 publications have not recorded a single citation (Table 1; Figure2).

Moreover, an analysis of the frequency of appearance of the first 40 most frequently appearing phrases in the titles was made with the help of <https://www.webtools.services/text-analyzer>.

In addition to the first 5 words that were included in the search (project, management, intelligence, artificial, AI), the titles of the publications also include the following words: review, role, application, construction, agile, impact, software, future, driven, based, study, risk. The complete list of the frequency of occurrence of the first 25 most frequent words in the publication's titles is given in the Table 2.

Table 2: List of the frequency of occurrence of the 25 most frequent words in the analyzed publication's titles

No.	Word	Freq.	No.	Word	Freq.
1	Project	509	14	Driven	26
2	Management	493	15	Based	26
3	Intelligence	298	16	Study	25
4	Artificial	296	17	Risk	25
5	AI	208	18	Enhancing	24
6	Review	36	19	Analysis	22
7	Role	36	20	Data	21
8	Application	34	21	Efficiency	20
9	Construction	32	22	Literature	18
10	Agile	31	23	Decision	18
11	Impact	31	24	Challenges	18
12	Software	30	25	Generative	18
13	Future	28			

Source: Author's calculation

Finally, the Table 3 provides a summary of some relevant publications where the areas in which AI can have an influence on PM activities are systematized.

Table 3: Summary of some relevant publications where AI can have an impact on PM activities (by authors, alphabetical order)

Authors	Title of the publication	Application of AI in PM
(Celestin & Vanitha, 2017)	The Surprising Role of AI in Revolutionizing Project Management	improved resource allocation; improved risk management; improved communication and collaboration; improvement in time management; reduction in unforeseen risks; boost in team collaboration
(Duică et al., 2024)	The Use of Artificial Intelligence in Project Management.	facilitate the processes of planning and organizing work; monitoring employees; make informed decisions; anticipate future situations; increases the efficiency of managers by delegating routine tasks to machines
(Fridgeirsson et al., 2021)	An Authoritative Study on the Near Future Effect of Artificial Intelligence on Project Management Knowledge Areas	project cost estimation; project risks estimation; schedule success; estimating project duration; creating WBS; planning procurement management; monitoring and controlling project work

(Fridgeirsson et al., 2023)	A Qualitative Study on Artificial Intelligence and Its Impact on the Project Schedule, Cost and Risk Management Knowledge Areas as Presented in PMBOK	automating tasks; optimizing resource allocation providing data-driven insights; enhance decision making; enhance risk analyses; enhance project forecasting; increasing efficiency; reducing costs; improving project outcomes; predict future project outcomes; resource allocation; risk management
(Hashfi & Raharjo, 2023)	Exploring the Challenges and Impacts of Artificial Intelligence Implementation in Project Management: A Systematic Literature Review	decision-making; problem-solving; data analysis; risk assessment; performance monitoring; optimization; improve project planning; improve resource allocation; improve cost estimation; improve risk mitigation; improve overall project outcomes; enhance efficiency, accuracy, and insights in project management processes; improved project success rates and delivery
(Hossain et al., 2024)	The Impact of Artificial Intelligence on Project Management Efficiency	improve overall project efficiency decision-making, and resource optimization; decrease in project costs; early identification of risks; enhanced resource allocation efficiency; enhanced communication efficiency; facilitating superior utilization of resources; fostering heightened productivity; improved risk management capabilities; facilitating the early detection and alleviation of potential project risks
(Ibrahim et al., 2024)	Enhancing Project Management Efficiency through Artificial Intelligence: A Comprehensive Review	enhance decision-making; optimize resource use; streamline project execution
(Karamthulla et al., 2024)	Navigating the Future: AI-Driven Project Management in the Digital Era	enabling organizations to make informed decisions; mitigate risks effectively; forecast project timelines; forecast resource requirements; streamline project communication; automate repetitive tasks; improve project efficiency and productivity
(Ong & Uddin, 2020)	Data science and artificial intelligence in project management: The past, present and future	reduce risks; daily tracking of projects; identify anomalies; identify outliers or correlations within projects; integration and automation; chatbot assistance; autonomous management of projects
(Prifti, 2022)	Optimizing Project Management using Artificial Intelligence	increasing project manager support; increasing accuracy, strategy and insight; increased the productivity of project managers; increased the emotional intelligence of project managers;

		increased creativity of project managers
(Sahadevan, 2023)	Project Management in the Era of Artificial Intelligence	proactive use of data for early risk detection; faster analysis and resolution of defects; handling scope creep and raise in expectations; predicting and experimenting (reduce risks, enhance results, and boosting total project delivery accuracy and efficiency); team empowerment to replace central management
(Shamim, 2024)	Artificial Intelligence in Project Management: Enhancing Efficiency and Decision-Making	automating tasks; optimizing resource allocation; enhancing decision-making; project planning and scheduling; risk management; stakeholder communication; improve efficiency, effectiveness, and outcomes
(Shoushtari et al., 2024)	Application of Artificial Intelligence in Project Management	improved resource allocation; enhanced risk prediction and mitigation; increased scheduling accuracy; more accurate cost estimation; enhanced project communication
(Taboada et al., 2023)	Artificial Intelligence Enabled Project Management: A Systematic Literature Review	understand, classify, and analyze stakeholders; improve team performance through AI-assisted communication; planning, duration prediction, effort estimation, scheduling, assignment of human resources to project tasks, resource leveling, and project cost estimation; effective procurement management; appropriate communication with stakeholders, continuous learning, and the management of physical resources; the automation of requirements meetings and project quality management; efficient project delivery; measure project performance indexes; assess delays and implement appropriate responses, and monitor activities, gives rise to precise project measurement; risk identification, probability distribution modelling, risk assessment, stability prediction, dispute risk forecasting, and project riskiness classification

Source: Overview provided by authors

4. CONCLUSIONS

This article has used Google Scholar as a Web Search engine to identify the relevant scholarly literature related to artificial intelligence and project management and also to systematize the areas in which firms can benefit from implementing artificial intelligence in project management. The results show that the number of literatures is almost indiscernible until 2017 (maximum of 5 publications per year), but the upsurge is evident especially in the last few years. When it comes to the number of citations, 5.47% of the total number of publications have included more than 50% of the total number of records, while the first 75 publications by citations accumulate a total of about 80% of the citations. Finally, the summary of relevant titles of publications shows that artificial intelligence has an impact on project management activities, mainly in the following areas: reducing risks, daily tracking of projects, identifying anomalies, project cost estimation, project risks estimation, estimating project duration, enabling organizations to make informed decisions, mitigating risks effectively, forecasting project timelines, forecasting resource requirements, facilitating the processes of planning and organizing work, monitoring employees, making informed decisions, anticipating future situations, increasing the efficiency of managers by delegating routine tasks to machines, improving

resource allocation, enhancing risk prediction and mitigation, understanding, classifying, and analyzing stakeholders, improving team performance through AI-assisted communication, problem-solving, data analysis and many others.

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M12, M14, D91, C12

MANAGER'S EMOTIONAL INTELLIGENCE: IMPACT ON BUSINESS PERFORMANCE AND DECISION-MAKING

Abstract: Workplace is characterized by significant diversity, dynamism, varied teams, and rapid decision-making, which requires mindful awareness and calmness in interpersonal relationships. Therefore, the use of emotional intelligence elements (self-awareness, self-regulation, empathy, social skills, and motivation) are essential for both understanding and implementation by managers and employees. Managers play a crucial role in the problem-solving process, where emotional intelligence is essential, as emotions influence every phase - from the first recognition of an issue to the choices, assessments, and measures taken to resolve it.

The subject of this study is the impact of emotional intelligence on managers and their business decision-making. The aim of this paper is to examine the application of emotional intelligence elements in the management practices of Macedonian companies and to analyze their dependence on specific variables. A survey method was employed using closed-ended questions and a Likert scale. The anonymous questionnaire was created using Google Forms and distributed via email to 220 companies, obtaining responses from 62 respondents. Descriptive statistics, including the calculation of the arithmetic mean and standard deviation, as well as the χ^2 -test, were applied in data processing. The collected responses were analyzed using Microsoft Excel and SPSS software.

The majority of managers indicated that elements of emotional intelligence have a significant impact on business operations and play a crucial role in decision-making. Specifically, the findings confirm that the impact of emotional intelligence elements on business performance and decision-making depends on the work experience of the managers.

Keywords: emotional intelligence, managers, business decision-making, Macedonian companies.

1. INTRODUCTION

Today's fast-paced and complex lifestyle affects both personal and professional aspects of life, increasing the need for emotional awareness and intelligent decision-making. Emotions are ever-present in business operations, shaping interactions, influencing decisions, and impacting overall performance. However, these emotions can have varying

effects on the performance of daily tasks, either enhancing or hindering productivity. Emotional intelligence is becoming a necessity that must be practiced in diversity in work environments, filled with challenges. Hence, emotional intelligence plays a crucial role for both managers and employees, as it enhances decision-making, fosters effective communication, and drives workplace success. When employees are in a positive mood, their productivity increases due to enhanced efficacy and flexibility, which, in turn, improves decision-making skills. Conversely, negative emotions such as anger and anxiety can hinder the mind's ability to process information effectively. Additionally, a negative organizational climate can further contribute to unfavorable outcomes (Prins, Niekerk & Weyers, 2018). Managers who spread negativity hinder business success, while those who cultivate and share positive energy foster a more productive and thriving organization. Emotional intelligence acts an important psychological factor, significantly influencing employees' abilities, engagement, and overall performance (Anyim, Ilesanmi, 2019).

A manager is ultimately responsible for the performance of their subordinates or team, using formal authority, rules, policies, and procedures to drive results. However, this responsibility should encourage managers to apply the right emotional intelligence skills to effectively motivate, coordinate, and guide their team towards organizational performance. Emotional intelligence is a dynamic trait in both leaders and organizations, and it can be developed by actively cultivating key emotional competencies. Emotional intelligence encompasses both personal and social competencies, each requiring continuous development. Personal competencies involve self-management and self-awareness, while social competencies focus on effectively managing relationships and social awareness (Goleman, Boyatzis, McKee, 2013). By mastering these skills, managers can enhance their performance, build stronger relationships, and achieve greater success in their professional work (Singh, 2006).

Emotional intelligence plays an essential role in shaping decision-making processes, especially for managers who face choices that can significantly impact their organizations. Developing emotional intelligence enables managers to better understand and regulate their own emotions while recognizing and empathizing with the emotions of others. This, in turn, leads to more balanced, informed, and effective decision-making, ultimately driving business success (Gligorovski, Angeloska-Dichovska., Janeska & Zdraveski, 2024).

The theoretical framework of this research focuses on emotional intelligence and the importance of its awareness and application, particularly among managers, to support effective decision-making and enhance organizational performance by achieving business goals and objectives. Section 2 examines the key elements of emotional intelligence, highlighting it as a set of interrelated competencies and abilities that can be developed and enhanced over time. Section 3 presents the empirical research findings on the application of emotional intelligence among managers in Macedonian companies included in the survey. This section details the research methodology, data collection, and analysis, followed by an overview of the surveyed companies, descriptive statistics, and hypothesis testing results. The final section provides concluding insights, recommendations, and acknowledges the study's limitations.

2. EMOTIONAL INTELLIGENCE FOR EFFECTIVE MANAGEMENT

Emotional intelligence is the "ability to monitor one's own and others' feelings and emotions", enabling informed decision-making and effective actions (Salovey & Mayer, 1990, p. 189). Goleman defines emotional competency as a "learned capability based on emotional intelligence that results in outstanding performance" (Cherniss, Goleman, 2001). This competency can be developed through awareness, practice, and persistence in its application. Its effective use positively impacts workplace activities and overall performance. Namely, Goleman (1995) and Salovey and Mayer (1990) assert that emotional intelligence is not a static or inherent trait but rather a malleable skill that can be cultivated and enhanced through deliberate practice and constructive feedback (Antonopoulou, 2024). As Drigas and Papoutsis (2018) state, "emotional intelligence is the rudder for feeling, thinking, learning, problem-solving, and decision-making".

Suman (2022) elaborates that manager's emotional intelligence in organizational efficiency is gaining increasing attention and an organization's effectiveness can be evaluated based on how it handles issues related to leadership, interpersonal relationships, communication, and relationships with other organisations. Cherniss (2001) highlights the critical role of emotional intelligence in managerial decision-making and its contribution to achieving organizational effectiveness. Therefore, any factor influencing organizational effectiveness is ultimately shaped by emotional intelligence. He provides a detailed overview of the areas where emotional intelligence has a significant impact, such as: employee recruitment and retention; development of talent; teamwork; employee commitment; morale, and health; innovation; productivity; efficiency; sales; revenues; quality of service; customer loyalty; and client or student outcomes.

Managing emotions in the decision-making process requires a focus on the following (Singh, 2006): recognizing and understanding your own emotions, becoming an emotional "winner," practicing empathy towards others, building high self-esteem, managing stress, controlling anger, enhancing the ability to influence others, and more. Caruso and Salovey (2004) outline an intelligent approach to emotions that managers should adopt, offering detailed guidelines that include developing the following skills: identifying emotions, or "reading people"; using emotions to guide the thinking and reasoning of others; understanding emotions to predict future emotional responses; and managing emotions by integrating them thoughtfully into decision-making. In fact, emotional intelligence consists of five components (Goleman, 1998; Rahim, & Psenicka, 2002):

- *Self-awareness* as a component of emotional intelligence means recognizing and understanding one's own emotions, moods, and impulses, including their underlying causes. It also encompasses an awareness of how these feelings impact others.
- *Self-regulation* is ability to keep one's own emotions and impulses in check, to remain calm in potentially volatile situations, and to maintain composure irrespective of one's emotions.
- *Motivation* is ability to stay committed to goals despite setbacks, to be driven by the hope of success rather than the fear of failure, to practice delayed gratification, and to embrace change in pursuit of achieving those goals.
- *Empathy* is the ability to share and understand another's "state of mind" or emotion. i.e. ability to "put oneself into another's shoes", or in some way experience the outlook or emotions of another being within oneself (Ioannidou & Konstantikaki, 2008). This skill enables managers and employees to offer emotional support when needed and to understand the connection between others' emotions and their behavior.
- *Social Skills* are a crucial component of emotional intelligence they enable individuals to interact effectively with others, build relationships, and communicate effectively. These skills are essential for managers in building strong workplace relationships.

The previously discussed components of emotional intelligence are interconnected and mutually reinforcing. For managers (and employees) to effectively contribute to organizational outcomes, they must develop these skills and competencies by comprehending and applying them.

3. RESEARCH AND DISCUSSION

3.1. Methodology

To accomplish the purpose of the research, the survey method was used and closed-ended questions and a 5-point Likert scale of responses (I totally agree, I agree, Neutral, I don't agree, I don't agree at all) were used. Likert scales are the creation of Rensis Likert (1932). Likert scale is applied as one of the most fundamental and frequently used psychometric tools in educational and social sciences research (Joshi, Kale, Chandel & Pal, 2015). The Likert-scale has been used by many researchers and mostly used in survey research. The advantage of using Likert scale is because it is simple and easy to use. The reliability of data conducted with this scale is highly valued (Neuman, 2000).

The anonymous questionnaire was created using Google Forms and distributed via email, receiving responses from 62 companies (managers). The questionnaire consists of three parts. (V. Gligorovski, M.A. Dikovska, D. Zdraveski, M. Janeska, Authors research project 2025, survey available at:

https://docs.google.com/forms/d/e/1FAIpQLSeSOla5xYqixhjVefOFW2bCw502DfCJA7hZ3GSb6Jvx_Ti_JQ/viewform?usp=sf_link). The first part consists of five questions that refer to the general characteristics of the companies (activity, number of employees, years of work experience, and gender). The second set of questions is designed to assess emotional intelligence and its impact on decision making. The third group of questions is designed to obtain data on the application of elements of emotional intelligence in business operations. The emphasis of the research is placed on the second and third part of the survey questionnaire, and on those questions that had to be answered with a Likert scale. In processing the results, descriptive statistics (calculation of arithmetic mean and standard deviation) and χ^2 - test were applied. The answers obtained were analyzed using Microsoft Excel and SPSS software packages.

3.2. Results and discussion of the research

3.2.1. General characteristics of the surveyed companies

The survey included 62 respondents, of whom 40.32% are employed in the manufacturing sector, 40.32% in the trade sector, and 19.35% in the service sector. According to the number of employees in the company they work for, 38.71% are employed in companies with 1-9 employees, 40.32% in companies with 10-49 employees, 14.52% in companies with 50-249 employees, and 6.5% in companies with more than 250 employees. Of the total number of respondents, 48.39% have more than 20 years of work experience, 32.26% have 10-20 years of work experience, 14.52% have 5-10 years of work experience and 4.84% have 1-5 years of work experience. In terms of gender, the respondents have an equal percentage of participation. Of the total number of respondents, 66.13% are familiar, 12.9% are not familiar, and 20.97% are partially familiar with the term emotional intelligence. Of the 62 respondents, 74.19% are aware of their emotions, 4.84% are not aware, and 20.97% are unsure about that aspect.

3.2.2. Results of Descriptive Statistics

The following tables present the results of descriptive statistics. Based on the values of the arithmetic mean and standard deviation for each individual variable (indicator), conclusions have been drawn.

(red color indicates the positive attitudes of respondents whose arithmetic means are higher than the average, blue color indicates the homogeneous attitude of respondents whose standard deviations are lower than the average, and purple color indicates the homogeneous attitude of respondents regarding the indicators for which they have a positive attitude)

Table 1: Descriptive statistics (arithmetic mean (M) and standard deviation (SD)) of the responses on the impact of emotional intelligence on decision-making and the application of elements of emotional intelligence

Factors	M	SD
Impact of emotional intelligence on decision-making and elements of emotional intelligence in business operations		
Q1 I know exactly how to identify my emotions, my strengths and weaknesses	4,0323	3,605551
Q2 My emotions affect my business decisions	3,0645	2,741556
Q3I have a lot of control over my emotions when making business decisions	3,7419	3,33602
Q4I make my decisions impulsively	2,2258	1,967478
Q5Sometimes I make wrong decisions because my emotions prevail	2,5806	2,321012
Q6I understand the emotions of the people I work with	3,9516	3,501152
Q7I have empathy for my colleagues	4,0968	3,672039
Q8I stimulate creativity and innovation in my employees/colleagues	3,9839	3,57861
Q9I have effective communication with my employees/colleagues	4,0323	3,596593
Q10Emotions of my employees/colleagues have a great impact on my business decision-making	2,9032	2,565277
Q11I ignore the emotions of colleagues in the interest of some business decision that brings profit	2,5968	2,236068
Arithmetic mean and standard deviation	3,3827	3,011032

From the table it can be ascertained that the largest number of respondents declared positively, that is, they have a high score for the statements: Q1, Q3, Q6, Q7, Q8, and Q9, because the arithmetic mean for them is higher than the average. Of these, the best evaluated components are: that they know how to identify their emotions, have empathy for colleagues and have effective communication with colleagues. However, it is important that for the same indicators that companies consider to be relevant, they have higher standard deviations than the average, which means that the agreement of the respondents regarding the assessment of their relevance is at a low level. From the values of the standard deviation (deviation from the arithmetic mean) it can be concluded that the lowest value is for the statements: Q2, Q4, Q5, Q10 and Q11, which means that the respondents have a homogeneous attitude towards them. Of these, those statements that refer to impulsive decision-making (Q4) and ignoring the emotions of colleagues in the interest of a business decision that brings profit (Q11) have the lowest value. On the other hand, if the data on the arithmetic mean and standard deviation are analyzed separately, by activity, number of employees, by number of years of service, job position and by gender, it can be concluded that there are significant deviations from the total results among the respondents. According to the number of years of experience and the number of employees in the company they work for, in relation to the standard deviation, i.e. according to the agreement of their views in relation to the statements for which the arithmetic mean is greater than average. Namely, as can be seen from the following two tables, respondents who have up to 5 years of work experience have a homogeneous attitude regarding statements Q1, Q6, Q7 and Q9, respondents with 10-20 years of work experience have a homogeneous attitude towards statements Q7 and Q8 and respondents with more than 20 years of work experience have a homogeneous attitude towards statements Q1, Q3, Q7 and Q8 and have a high score in relation to them. Respondents who work in companies with up to 9 employees have a homogeneous attitude in relation to statements Q1, Q6 and Q7, respondents who work in companies with 10-49 employees have a homogeneous attitude in relation to statements Q1, Q6, Q7 and Q9, respondents working in companies with 50-249 employees have a homogeneous attitude towards statements Q7 and Q8 and respondents working in companies with more than 250 employees have a homogeneous attitude towards statements Q1, Q3, Q7 and Q8 and have a positive assessment for them (which is not the case with the data for the standard deviation from the summary table). Q7 and Q8, the respondents who work in companies with 10-49 employees have a homogeneous attitude regarding statement Q1, respondents who work in companies with 50-249 employees have a homogeneous attitude regarding statements Q1, Q3, Q6, Q7, Q8 and Q9 (which means for all statements for which they have a positive attitude) and respondents who work in companies with more than 250 employees have a homogeneous attitude regarding statements Q3, Q6, Q7 and Q8 (which is not the case with the data for the standard deviation from the previous table). As a general conclusion from the descriptive statistics, a larger number of respondents declared themselves positively and believe that the elements of emotional intelligence significantly affect business operations and emotional intelligence significantly affects decision-making because the average value is $M = 3.38$.

Emotional intelligence has a major impact on both business operations (business operations) and decision-making. In business, it fosters a positive work environment, improves teamwork (better communication, collaboration, and conflict resolution in teams), increases motivation, thereby increasing efficiency and productivity of work, better communication with customers, and improves overall organizational performance.

In decision-making, it enables individuals to make more rational, less impulsive decisions, especially under pressure and stress (emotional intelligence plays a key role in managing stress and pressure, which are inherent in the decision-making process), and generate innovative solutions. Emotional intelligence significantly influences decision-making, distinguishing between intuitive and rational styles. Individuals with a higher degree of emotional intelligence tend to make decisions based on intuition, using their emotional awareness and empathy to understand situations and predict outcomes. In contrast, those with lower levels of emotional intelligence are more likely to rely on rational, data-driven decision-making. Thus, emotional intelligence contributes to more informed decisions, efficiency, and effectiveness of management processes.

Table 2: Descriptive statistics (arithmetic mean (M) and standard deviation (SD)) of the responses on the influence of emotional intelligence on decision-making and the application of elements of emotional intelligence in business operations by respondents' work experience

Factors	M (1-5)	M (5-10)	M (10-20)	M (>20)	SD (1-5)	SD (5-10)	SD (10-20)	SD (>20)
Q1	2,67	4,44	3,95	4,10	2,56	9,94	16,00	10,60
Q2	1,67	2,78	3,25	3,17	6,22	12,42	10,96	14,17
Q3	2,33	4,00	3,75	3,80	11,11	10,33	14,09	10,59
Q4	1,67	2,11	2,30	2,27	6,22	8,79	6,62	8,28
Q5	2,00	2,00	2,50	2,87	8,33	8,11	9,43	11,03
Q6	2,67	4,56	3,80	4,00	2,56	7,06	17,89	14,33
Q7	2,67	4,22	4,15	4,17	2,56	8,36	12,21	10,07
Q8	2,33	4,11	4,15	4,00	1,11	14,79	12,21	10,00
Q9	2,00	4,22	4,25	4,03	9,67	8,14	13,01	13,47
Q10	2,00	2,78	3,10	2,90	8,33	12,20	13,36	13,43
Q11	2,00	2,89	2,70	2,50	8,33	9,54	8,74	10,35
Arithmetic mean and standard deviation	2,18	3,46	3,45	3,44	6,09	9,97	12,23	11,48

Table 3: Table Descriptive statistics (arithmetic mean (M) and standard deviation (SD)) of the responses on the impact of emotional intelligence on decision-making and elements of emotional intelligence in business operations according to the number of employees in the company where the respondents work

Factors	M (1-5)	M (5-10)	M (10-20)	M (>20)	SD (1-5)	SD (5-10)	SD (10-20)	SD (>20)
Q1	3,88	4,12	4,00	4,50	14,83	10,12	10,11	9,13
Q2	3,25	2,80	3,33	3,00	13,05	11,59	12,70	14,75
Q3	3,42	3,88	4,00	4,25	12,56	12,28	10,11	7,06
Q4	2,50	2,16	1,78	2,00	9,52	6,29	6,75	8,00
Q5	2,63	2,72	2,56	1,50	11,94	8,55	10,62	5,38
Q6	3,83	4,00	4,00	4,25	18,49	11,88	10,11	7,06
Q7	4,00	4,04	4,22	4,75	11,42	10,92	8,14	2,69
Q8	3,88	4,04	3,89	4,50	16,16	8,36	9,21	0,63
Q9	3,92	4,08	4,22	4,00	13,66	12,52	8,14	13,50
Q10	3,04	2,84	2,89	2,50	14,63	11,67	12,88	11,63
Q11	2,46	2,44	3,11	3,25	8,94	8,78	14,23	8,81
Arithmetic mean and standard deviation	3,34	3,37	3,45	3,50	13,20	10,27	10,27	8,06

In continuation of the analysis, a check of the internal consistency, that is, the reliability of the applied factors within the framework of the application of the elements of emotional intelligence in business operations and the application of

emotional intelligence in making business decisions was carried out. The assessment of the internal consistency was carried out using the Cronbach alpha test. In order for them to be considered reliable and thus to justify continuing with the analysis, the value of this test, that is, the Cronbach alpha coefficient, must be at least 0.7 (Hulin, Netemeyer & Cudeck, 2001). The results of the analysis showed that the value of this coefficient for the researched factors is 0.714073, which indicates the internal consistency of the factors and the reliability of the findings. Similarly, it is justified to proceed with further analysis.

3.2.3. Hypothesis Testing Results

The paper poses two general hypotheses.

Based on the research, the first general hypothesis is set:

H₀₁ – The application of the elements of emotional intelligence on business performance and the impact of emotional intelligence on decision-making does not depend on the work experience of the managers. This hypothesis will be accepted or rejected based on the testing of the following two sub-hypotheses:

H₀₁₁- The application of the elements of emotional intelligence on business performance does not depend on the work experience of the managers.

H₀₁₂- The impact of emotional intelligence on decision-making does not depend on on the work experience of the managers.. The first sub-hypothesis refers to the questions from the third part of the survey questionnaire, while the second one refers to the questions from the second part of the survey questionnaire.

First sub-hypothesis:

Table 4: The empirical values of the respondents' answers by years of work experience

Years of work experience	I totally agree	I agree	Neutral	I don't agree	I don't agree at all	Sum
< 5 years	3	1	2	4	8	18
From 5 to 10 years	16	19	11	8	0	54
From 10 to 20 years	22	59	24	10	5	120
> 20 years	34	71	53	13	9	180
Sum	75	150	90	35	22	372

Table 5: The theoretical values (by years of work experience)

Years of work experience	I totally agree	I agree	Neutral	I don't agree	I don't agree at all	Sum
< 5 years	3,629032258	7,258064516	4,35483871	1,693548387	1,064516129	18
From 5 to 10 years	10,88709677	21,77419355	13,06451613	5,080645161	3,193548387	54
From 10 to 20 years	24,19354839	48,38709677	29,03225806	11,29032258	7,096774194	120
> 20 years	36,29032258	72,58064516	43,5483871	16,93548387	10,64516129	180
Sum	75	150	90	35	22	372

Results:

Number of Columns: 5
Number of Rows: 4
Alpha Error: .05
Degrees of Freedom: 12
Critical chi-square: 21.026
Computed chi-square: 70.622
p=2.4497E-10

Conclusion: Since the calculated χ^2 test is greater than the critical (table) value ($\chi^2_{cal} = 70.622$) > ($\chi^2_{(0,05;12)} = 21.026$), it can be concluded that the first sub-hypothesis is rejected, which means that the application of the elements of emotional intelligence on business performance depends on the work experience of the managers. The intensity of the mutual relationship is measured by the contingency (Dura, Driga, 2017) coefficient "C", which is calculated by the following formula:

$$C = \sqrt{\frac{\chi^2}{\chi^2 + n}},$$

where n represents the sample size and χ^2 represents the chi-square test value. The contingency coefficient ranges from 0 to 1. If its value is closer to 1, the stronger the relationship between the observed variables will be. For the purposes of this research, it was determined that for values from 0 to 0.3 there is a weak correlation, from 0.3 to 0.5 a moderate correlation, from 0.5 to 0.7 a strong correlation and from 0.7 to 1 a very strong correlation, association between observed variables. From the data for the first sub-hypothesis, the value for the contingency coefficient is $C = 0.730$ and it indicates that there is a very strong connection between the application of elements of emotional intelligence in business and the work experience of the respondents.

The second sub-hypothesis:

Table 6: The empirical values of the respondents' answers by work experience

Years of work experience	I totally agree	I agree	Neutral	I don't agree	I don't agree at all	Sum
< 5 years	1	1	1	7	5	15
From 5 to 10 years	7	13	7	12	6	45
1 ge	12	34	25	15	14	100
> 20 years	22	48	35	34	11	150
Sum	42	96	68	68	36	310

Table 7: The theoretical values (by work experience)

Years of work experience	I totally agree	I agree	Neutral	I don't agree	I don't agree at all	Sum
< 5 years	2,032258065	4,64516129	3,290322581	3,290322581	1,741935484	15
From 5 to 10 years	6,096774194	13,93548387	9,870967742	9,870967742	5,225806452	45
From 10 to 20 years	13,5483871	30,96774194	21,93548387	21,93548387	11,61290323	100
> 20 years	20,32258065	46,4516129	32,90322581	32,90322581	17,41935484	150
Sum	42	96	68	68	36	310

Results:

Number of Columns: 5
Number of Rows: 4
Alpha Error: .05
Degrees of Freedom: 12
Critical chi-square: 21.026
Computed chi-square: 23.172
 $p=0.026299$

Conclusion:

Since the calculated χ^2 test is greater than the critical (table) value ($\chi^2_{cal} = 23.172 > (\chi^2_{(0,05;12)} = 21.026)$), it can be concluded that the second sub-hypothesis is rejected, which means that the influence of emotional intelligence on decision-making depends on the work experience of the managers.

From the data for the second sub-hypothesis, the value for the contingency coefficient is $C = 0.522$ and it indicates There is a strong connection between the influence of emotional intelligence on decision-making and the respondents' work experience.

General conclusion: The first general hypothesis is rejected, which means that the influence of the elements of emotional intelligence on performance and the influence of emotional intelligence on decision-making depend on the work experience of the managers.

Based on the research, the second general hypothesis is established:

H_{02} – The application of the elements of emotional intelligence on business performance and the impact of emotional intelligence on decision-making do not depend on the number of employees in the company. This hypothesis will be accepted or rejected based on the testing of the following two sub-hypotheses:

H_{021} - The application of the elements of emotional intelligence on business performance does not depend on the number of employees in the company.

H_{022} - The impact of emotional intelligence on decision-making does not depend on the number of employees in the company. The first sub-hypothesis refers to the questions from the third part of the survey questionnaire, while the second one refers to the questions from the second part of the survey questionnaire.

First sub-hypothesis:

Table 8: The empirical values of the respondents' answers by the number of employees in the company

Number of employees in the business entity	I totally agree	I agree	Neutral	I don't agree	I don't agree at all	Sum
< 9	17	74	29	15	9	144
From 10 to 49	34	57	31	17	11	150
From 50 to 249	14	13	25	2	0	54
> 249	10	6	5	1	2	24
Sum	75	150	90	35	22	372

Table 9: The theoretical values (by the number of employees)

Number of employees in the business entity	I totally agree	I agree	Neutral	I don't agree	I don't agree at all	Sum
< 9	29,03225806	58,064516	34,83870968	13,5483871	8,516129032	144
From 10 to 49	30,24193548	60,483871	36,29032258	14,11290323	8,870967742	150
From 50 to 249	10,88709677	21,774194	13,06451613	5,080645161	3,193548387	54
> 249	4,838709677	9,6774194	5,806451613	2,258064516	1,419354839	24
Sum	75	150	90	35	22	372

Results:

Number of Columns: 5
Number of Rows: 4
Alpha Error: .05
Degrees of Freedom: 12
Critical chi-square: 21.026
Computed chi-square: 41.407
 $p = 4.18945E-05$

Conclusion: Since the calculated χ^2 test is greater than the critical (table) value ($\chi^2_{cal} = 41.407$) > ($\chi^2_{(0,05;12)} = 21.026$), it can be concluded that the first sub-hypothesis is rejected, which means that the application of the elements of emotional intelligence on business operations depends on the number of employees in the company. From the data for the first sub-hypothesis, the value for the contingency coefficient is $C = 0.633$ and it indicates there is a strong connection between the application of elements of emotional intelligence in business operations and the number of employees in the company.

The second sub-hypothesis:

Table 10: The empirical values of the answers of the respondents by number of employees in the company

Number of employees in the business entity	I totally agree	I agree	Neutral	I don't agree	I don't agree at all	Sum
< 9	10	45	28	25	12	120
From 10 to 49	21	37	22	28	17	125
From 50 to 249	7	9	16	9	4	45
> 249	4	5	2	6	3	20
Sum	42	96	68	68	36	310

Table 11: The theoretical values (by number of employees in the company)

Number of employees in the business entity	I totally agree	I agree	Neutral	I don't agree	I don't agree at all	Sum
< 9	16,25806452	37,16129032	26,32258065	26,32258065	13,93548387	120
From 10 to 49	16,93548387	38,70967742	27,41935484	27,41935484	14,51612903	125
From 50 to 249	6,096774194	13,93548387	9,870967742	9,870967742	5,225806452	45
> 249	2,709677419	6,193548387	4,387096774	4,387096774	2,322580645	20
Sum	42	96	68	68	36	310

Results:
 Number of Columns: 5
 Number of Rows: 4
 Alpha Error: .05
 Degrees of Freedom: 12
 Critical chi-square: 21.026
 Computed chi-square: 16.050
 p=0,188975545

Conclusion: Since the calculated χ^2 test is lower than the critical (table) value ($\chi^2_{cal} = 16.050$) < ($\chi^2_{(0,05;12)} = 21.026$), it can be concluded that the second sub-hypothesis is accepted, which means that the influence of emotional intelligence on decision-making does not depend on the number of employees in the company. From the data for the second sub-hypothesis, the value for the contingency coefficient is $C = 0.453$ and it indicates that there is a moderate connection between the influence of emotional intelligence on decision-making and the number of employees in the company in which the respondents work.
 General conclusion: The second general hypothesis is accepted, which means that the application of the elements of emotional intelligence on business operations and the influence of emotional intelligence on decision-making does not depend on the number of employees in the company.

CONCLUDING OBSERVATION AND RECOMMENDATIONS

The following can be highlighted as general conclusions from the research:

In the elaborated model there is a very high internal consistency of the factors, which indicates a high reliability of the findings;

In terms of the impact of emotional intelligence on decision-making, respondents give the highest marks to the identification of their emotions, strengths and weaknesses, and control over emotions when making decisions;

In terms of applying the elements of emotional intelligence in business, the respondents gave the highest marks to effective communication with employees, empathy towards colleagues, understanding the emotions of colleagues, and stimulating creativity and innovation among colleagues; This was confirmed by the first general hypothesis, i.e. by the values of χ^2 the test, the p values and the values of the contingency coefficient of its two sub-hypotheses. In terms of the consistency of the respondents' attitudes regarding the assessments of the individual indicators, they differ by the number of employees in the companies where they work only in relation to those indicators that relate to the application of the elements of emotional intelligence in business operations. This was confirmed by the first sub-hypothesis of the second general hypothesis, while there is no dependence between the influence of emotional intelligence on decision-making and the number of employees in the companies where the respondents work. This was confirmed by the values of χ^2 the test, p values, and the values of the contingency coefficient of the second sub hypothesis from the second general hypothesis.

Following Limitations Should Also Be Taken Into Account:

The application of the elements of emotional intelligence in business operations is measured through 6 variables and the application of emotional intelligence in making business decisions through 5 variables. The model can and should include a larger number of variables that will be representative of the five basic groups of factors of emotional intelligence. In that way, it would be possible to apply a greater number of statistical methods, in order to draw more conclusions from different aspects;

The following research would cover a proportionate number of micro, small, medium and large companies, as well as a proportionate number of companies from different sectors in relation to the total number of relevant companies, in order to obtain a complete and realistic picture of the application of emotional intelligence in the operation of the companies; The same analysis would be done individually from each aspect: activity, years of service, job position and gender, in order to draw appropriate conclusions, and that in relation to these different aspects, as well as to make cross-analyses. Other aspects could also be covered.

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BLOCKCHAIN FOR SUPPLY CHAIN EFFICIENCY IN THE MALDIVES

Abstract: Blockchain technology presents a potentially transformative opportunity for Small Island Developing States (SIDS), particularly for the Maldives. With inefficiencies in supply chain of primary economic sectors such as tourism, fisheries, and public procurement, blockchain offers solutions for greater transparency, security, and operational efficiency. This study examines the current state of blockchain technology and its adoption in the Maldives, investigating its use in supply chain digitalization, and determining key barriers and facilitators. Findings indicate the Maldives is seeing a growing interest in blockchain, however, there is no legal or regulatory framework in place yet. Although the government has undertaken some initiatives primarily towards enhancing trade facilitation, there is limited evidence of blockchain adoption in the private sector. The study explores the potential benefits of blockchain for supply chain efficiency, focusing on improvements in traceability, transparency, automation, and risk management and the challenges hindering blockchain adoption, including technical, regulatory, financial, and institutional barriers. Finally, it puts forward strategic considerations for blockchain-enabled supply chains in the Maldives and other SIDS, highlighting the importance of investing in complementary technologies, capacity building, regulatory frameworks, and pilot projects.

Keywords: Blockchain Technology, Small Island Developing States (SIDS), Maldives, Sustainable Supply Chains, Supply Chain Digitalization, Smart Contracts

INTRODUCTION

Improving supply chain performance goes beyond organizational boundaries and companies are shifting their focus from individual organizational performance to supply chain performance. The blockchain-driven supply chain has a positive impact on supply chain management, as well as supply chain innovation and sustainable supply chain performance (Estampe *et al.*, 2013).

Global supply chains are undergoing digital transformations driven by the need for enhanced security, transparency, and efficiency. Blockchain technology has emerged as a crucial factor in this transformation, providing decentralized and immutable digital records that significantly improve traceability in supply chains. Developed countries are leveraging this technology for logistics and trade, however, SIDS face various barriers to its adoption. Like many other SIDS, the

Maldives relies heavily on imports, tourism, and fisheries exports (Van Driessche, 2024; Marinakou, 2025). To manage these sectors efficiently, a robust and digital supply chain system is essential (Lee, 2021).

This paper examines the current state of blockchain adoption in the Maldives, identifies the challenges and benefits of the technology, and offers strategic recommendations for facilitating blockchain-driven supply chains.

METHODOLOGY

This study adopted a structured literature review approach, which, unlike a systematic review with strict criteria for inclusion and exclusion, uses narrative synthesis to organize the literature into clear themes. Preliminary searches of peer-reviewed literature did not reveal any studies specifically on the Maldives and blockchain. This highlights the significance of this review as it tries to fill this important gap by synthesizing insights from global practices and identifying their potential for the Maldives and other SIDS.

This literary gap also stands as the primary reason for including news media articles, reports from international organizations, and government publications in this study. These sources served as the basis for assessing the existing state of blockchain adoption in the Maldives, given the lack of peer-reviewed literature. However, the remainder of the discussion is based on peer-reviewed journal articles from 2018 and onwards, sourced from major academic databases. These studies were selected based on their relevance to blockchain's use in supply chains. The analysis focused on several themes including the benefits of adopting blockchain on supply chains, potential challenges, and strategic considerations for effective implementation and management. Structuring the discussion around these themes allowed us to contextualize the literature to provide insights relevant to the Maldives and other SIDS.

FINDINGS AND DISCUSSION

This section examines the current state of blockchain adoption in the Maldives, the potential benefits of the technology, and the challenges hindering its widespread adoption. Finally, it presents strategic considerations for establishing blockchain-enabled supply chains.

The Current State of Blockchain Adoption in the Maldives

The exploration of blockchain technology is in its early stages in the Maldives. There are no existing legislations in place that regulate the technology and its use in the nation. Although this lack of a regulatory framework has created an uncertain environment for investors and entrepreneurs looking to engage with blockchain, it also opens an opportunity for the Maldives to be more proactive about its regulatory approaches by observing and tailoring strategies taken by other nations to best suit Maldivian economic and social needs.

The Maldives Monetary Authority (MMA) has taken a cautious stand regarding cryptocurrencies. They have issued public warnings about the potential risks of using it in trading and explicitly stated that they have granted no entities in the Maldives to use virtual currencies (Abdulla, 2021). Despite this, it has been reported that the MMA is currently drafting regulations to introduce asset-backed digital money in the Maldives (Corporate Maldives, 2024). This shows a potential openness toward exploring blockchain-based solutions in a more regulated and controlled environment. Most recently, the government of Maldives signed several agreements with Estonia to collaborate on using emerging technologies in the public sector (Corporate Maldives, 2025b).

A 2022 national stakeholder survey examined the Maldives' capability to implement Central Bank Digital Currencies (CBDCs) and stablecoins (Hrnjic and Clarke, 2022). Although this survey did not specifically focus on blockchain-based digital solutions, the findings highlighted a need for greater digital literacy and knowledge exchange to support the adoption of advanced digital solutions. Based on recommendations from this survey report published by the Economic and Social Commission for Asia and the Pacific (ESCAP), a commission of the United Nations (UN), MMA has established frameworks and a sandbox environment for testing new fintech solutions under supervision (Hrnjic and Clarke, 2022; Corporate Maldives, 2025a). This could potentially serve as the experimental environment for blockchain-based financial solutions in the Maldives.

Another government-backed blockchain initiative involves the South Asia Subregional Economic Cooperation (SASEC) National Single Window Project, supported by the Asian Development Bank (ADB). This project aims to develop a single electronic platform to enhance the speed and efficiency of cross-border control procedures in international trade. A major component of this project is the blockchain pilot testing for supply chain management and trade facilitation, supported by the ADB's High-Level Technology Fund (Asian Development Bank, 2020).

Despite an initial pilot phase that saw the development of an application integrated with key Maldivian institutions and user training, the project faces major setbacks. The original turnkey contract was terminated and ADB halted a substantial portion of its funding due to concerns regarding potential anti-corruption policy violations and contractor eligibility (Shaahunaz, 2020). While the ADB has required a new tendering process for funding, these events have caused

considerable delays, indicating the complexities of implementing such large-scale technology projects in small island nations. Beyond these projects and initiatives led by the government, limited evidence exists of blockchain adoption among private enterprises in the Maldives.

BENEFITS OF BLOCKCHAIN FOR SUPPLY CHAIN EFFICIENCY

Enhanced Operational Efficiency and Transparency

Global supply chains are being made significantly more transparent, efficient, and reliable through secure, real-time data management solutions provided by blockchain technology. Blockchain consolidates data into a permanent, shared ledger which ensures all records are tamper-proof (Liu and Wang, 2024). This leads to an overwhelming reduction in fraud and a more reliable supply chain. Blockchains real-time tracking ability improves operational efficiency by streamlining different processes and sharing data among stakeholders consistently (Azzi, Chamoun and Sokhn, 2019; Dutta et al., 2020; Dhivya et al., 2024; Espahbod et al., 2024). In pharmaceutical and food industries where traceability is essential to prevent contamination, blockchain provides the chance to carry out prompt product recalls, thereby improving customer safety and trust (Melendez, Bergey, and Smith, 2024).

Blockchain also minimizes risks associated with counterfeit products by ensuring authenticity and secure ownership transfers (Nadime et al., 2025). This further strengthens the credibility of the supply chain. When combined with other technologies like IoT and big data analytics, blockchain not only enhances efficiency but also improves engagement in industries such as tourism, where smart contracts can potentially streamline transactions (Luo and Zhou, 2021). In an increasingly digital economy, blockchain stands as an invaluable tool to foster transparency, security, and efficiency, and reinforce stakeholder confidence in supply chains.

Improved Security and Trust

Blockchain technology plays an increasingly essential role in improving security and trust in trade and supply chain management. Its decentralized and immutable nature ensures data integrity, significantly minimizing the risks of fraud and deception (Lustenberger and Spychiger, 2025). By maintaining an unalterable ledger of transactions, blockchain strengthens the security of supply chains, mitigating threats such as cyberattacks, errors, and fraudulent activities, thereby promoting stakeholder confidence (Dutta et al., 2020).

Beyond security, blockchain enhances credibility by ensuring traceability and authenticity, which is essential for consumer trust and satisfaction (Liu and Wang, 2024). This is particularly beneficial for island nations like the Maldives that depend on the reputation of their exports, such as sustainable fishery products. By preventing counterfeiting and ensuring verifiable traceability, blockchain helps protect the integrity of exports, empowering small economies to enter niche, sustainable markets (Queiroz, Telles and Bonilla, 2019).

Smart Contracts and Automation

With the development of blockchain, smart contracts have also become considerably popular as they offer an innovative technology to be used in a blockchain system to mechanically negotiate, conduct, and enforce the terms and conditions of a legally binding contract (Rouhani and Deters, 2019; Taherdoost, 2023). This technology enables seamless execution of agreements by eliminating the need for intermediaries and manual processing. It also reduces transaction costs and administrative burdens on supply chains (Queiroz, Telles, and Bonilla, 2019; Lustenberger and Spychiger, 2025). Similarly, blockchain helps further reduce administrative overhead by automating several processes including customs declarations, billing, and monitoring warehouses (Nadime et al., 2025). It also facilitates faster decision-making and improves supply chain agility by allowing real-time automation and eliminating paper-based processes (Melendez, Bergey and Smith, 2024).

However, Ioannou and Demirel, (2022) warn that changing paper-based processes to a blockchain-enabled system poses potential legal risks including issues with legal recognition and enforceability of smart contracts. In nations like the Maldives without an existing regulatory or legal framework, smart contracts and other blockchain-based solutions may not fully align with current laws designed around paper-based, physical documentation. This puts the validity of digitally signed contracts and the allocation of liability into question. To minimize these risks, stakeholders need to collaborate with regulators to reform and update legal and regulatory structures. Such reforms would help ensure that blockchain-enabled processes are standardized and that there are effective dispute-resolution mechanisms in place (Ioannou and Demirel, 2022).

Supply Chain Finance

Blockchain offers significant opportunities to enhance supply chain finance including addressing information asymmetry and improving credit access for small and medium-sized enterprises (SMEs). SCF often faces inefficiencies and uncertainties which stand as a barrier for SMEs to secure necessary working capital, especially in small economies. Blockchain eases access to finance by enabling financial institutions to carry out more reliable and cost-effective credit assessments (Chen *et al.*, 2024). This is only possible due to the transparent and decentralized nature inherent to blockchain technology (Queiroz, Telles and Bonilla, 2019). Similarly, Kumar *et al.*, (2023) argue that blockchain helps improve managing working capital in SMEs by reducing transaction costs, streamlining different processes, and extending financing options.

Additionally, blockchain can potentially transform the credit and financing environment for SMEs as it offers a reliable basis of credit for different financial institutions. It helps resolve the information asymmetry issues inherent in traditional supply chains (Xiao, Salleh and Cheng, 2022; Kumar *et al.*, 2023). Recording and verification of transactions in real-time in blockchain platforms further enhances the trust among SMEs and financial institutions. This facilitates better credit risk assessments while improving financing options (Chen *et al.*, 2024). Blockchain platforms also enable small nations to engage with larger firms and international financial institutions, expanding access to diverse funding sources (Du *et al.*, 2020).

Supply Chain Resilience and Sustainability

When met with disruptions such as global crises or natural disasters, blockchain and other integrated technologies including the Internet of Things (IoT) and Radio Frequency Identification (RFID), can together track real-time data to allow rapid response and recovery (Dutta *et al.*, 2020). This is especially significant for the Maldives and other SIDS where supply chain interruptions pose severe economic and social repercussions (Lopes, Gomes and Mané, 2022; Tchonkouang, Onyeaka and Nkoutchou, 2024).

Blockchain further enhances the resiliency of supply chains by improving overall governance as it increases security and visibility within supply networks. Its immutable ledger system ensures transparency and reduces fraud (Queiroz, Telles and Bonilla, 2019; Dutta *et al.*, 2020). This will provide significant value for small nations battling inefficiencies and corruption (Martin *et al.*, 2022), as blockchain verifies and safeguards transactions against tampering (Queiroz, Telles and Bonilla, 2019).

The technology also enables the adoption of lean, agile, resilient, green, and sustainable (LARGS) practices into supply chains. This facilitates organizations to trace sustainability credentials, verify authenticity, and improve overall resource efficiency and environmental management (Espahbod *et al.*, 2024). By establishing such practices, Maldives and other SIDS have an opportunity to use blockchain to meet global regulatory standards as well as address the rise of ethical consumerism (Kutaula *et al.*, 2024).

In food supply chains, blockchain is commonly viewed through two distinct lenses. Some consider it a valuable tool with significant technical attributes, while others have embraced a much broader philosophical take on it. This philosophy entails blockchain's ability to foster democratic participation, decentralization, and equitable distribution of power, positioning the technology as a key driver of organizational change (Friedman and Ormiston, 2022). Considering this view, SIDS can apply blockchain as a tool to improve its supply chain efficiency. However, accepting and advocating for the broader philosophy of blockchain could potentially empower local fishermen, farmers, and entrepreneurs, giving them more direct access to markets, cutting out intermediaries, and ensuring fairer prices. This can increase the economic viability of small-scale sustainable fisheries and agricultural projects to improve the resilience of local supply chains and promote sustainable practices.

CHALLENGES IN BLOCKCHAIN ADOPTION

High Implementation Costs

Blockchain technology and its solutions require substantial upfront investment. At times, these costs and subsequent expensive challenges outweigh the benefits of adopting blockchains into supply chains. Consequently, many blockchain initiatives remain in the pilot stages (Lustenberger and Spychiger, 2025; Nadime *et al.*, 2025). The financial burden posed by blockchain includes continuous investment in security updates, maintenance, and regulatory compliance, acquiring advanced hardware and software integration, and extensive system overhauls to make it compatible with legacy systems (Alimohammadlou and Alinejad, 2023; Sharabati and Jreisat, 2024).

Similarly, Vu, Ghadge and Bourlakis, (2023) argue that having to integrate and master blockchain technology along with the need to invest in complementary hardware and software poses a significant financial risk. While large enterprises may justify these costs in anticipation of long-term benefits, smaller firms with lower profit margins face a critical challenge in accepting blockchain, as a sudden spike in expenses can make the investment unjustifiable (Vu, Ghadge and Bourlakis, 2023). These financial obstacles can overshadow potential benefits unless organizations coordinate closely or receive

regulatory subsidies to offset the heavy upfront investment (Pun, Swaminathan and Hou, 2021; Melendez, Bergey and Smith, 2024; Awasthy, Haldar and Ghosh, 2025).

Organizational Resistance and Awareness Issues

Organizational resistance and a lack of awareness often stand in the way of successful blockchain adoption. A limited understanding of the technology can lead stakeholders to view it as overly complex or as a threat to traditional business practices (Dutta *et al.*, 2020; Çoban *et al.*, 2024). Concerns over information control, data privacy, and uncertainty about blockchain's advantages over existing IT systems further exacerbate this resistance (Lustenberger and Spychiger, 2025). According to Friedman and Ormiston, (2022), resistance to blockchain adoption can take several forms, including resistance from incumbents that benefit from the status quo and actively refuse adoption, difficulties in coordinating stakeholders with different data-sharing norms, and functional resistance from perceptions that the technology is too complex or that it would not provide sufficient added value. Additional forms of resistance, according to Friedman and Ormiston, (2022) include challenges in integrating with legacy systems and the psychological resistance rooted in people's comfort with familiar practices.

However, Walsh *et al.*, (2021) find that managers are less resistant when they see clear benefits of the technology. This could include blockchain's ability to reduce expenses, enhance transparency, and accelerate different processes, which outweighs the effort or risks of switching and leaving the old practices behind. Walsh *et al.*, (2021) also find that even when switching costs such as the resources or effort that were put in are considered, the perceived benefits such as streamlined operations and automation through smart contracts have a stronger influence on minimizing resistance (Walsh *et al.*, 2021).

To overcome fears related to privacy and competition, Cozzio *et al.*, (2023) suggest developing a clear strategy and training plan for information sharing. For successful implementation, there must also be cross-functional collaboration and effective communication of the benefits of blockchain to both internal stakeholders and consumers (Cozzio *et al.*, 2023). Although awareness issues and internal resistance can create hurdles, they are minimized by the strong external incentives that encourage the integration of blockchain into supply chain management (Agi and Jha, 2022).

Data Confidentiality and Privacy Concerns

Data confidentiality and privacy remain critical challenges in blockchain adoption. Blockchain depends on accurate data input by individuals, leaving it vulnerable to intentional misinformation or bribery that can undermine trust at the point of entry (Dutta *et al.*, 2020).

Additionally, the inherent transparency of blockchain means data is openly shared among all participants, which can compromise confidentiality and negatively affect business relationships (Dutta *et al.*, 2020). In regions with high levels of corruption and political instability, such transparency may even threaten powerful vested interests. To address this, Mullet, Sondi and Ramat, (2023) designed a Blockchain-based Product-centred Confidentiality-preserving Architecture for Traceability (BPCAT). BPCAT allows making requests to the data owner to access their confidential data and compare it against the related data. This data is validated by all the blockchain participants which then helps establish authenticity.

Technical Complexity and Standardization Issues

Technical complexity and a lack of standardization obstruct interoperability (a protocol that allows blockchains to interact and share data in a uniform and reliable way (Yin *et al.*, 2023)) and integration among supply chains. These issues arise due to the absence of common standards across different blockchain platforms (Dutta *et al.*, 2020; Kotey *et al.*, 2024).

Additionally, blockchain's inherent design makes it costly to modify default information. This creates disproportionate challenges for SMEs who are already struggling with increased compliance and financing difficulties (Li, Peng and Zhou, 2022). Ambiguities in governance structures and regulatory frameworks further add to the uncertainty and impede the expansion of blockchain solutions (Lustenberger and Spychiger, 2025). The lack of standardized protocols such as in developing smart contracts leads to operational inefficiencies and challenges smooth integration of blockchain across supply chains (Liu and Wang, 2024; Melendez, Bergey and Smith, 2024). Maldives and other SIDS must address these technical and standardization challenges to unlock blockchain's full potential in supply chain management.

Strategic Considerations for Blockchain-Enabled Supply Chains

As blockchain adoption gains momentum in global supply chains, its establishment in the Maldives presents both opportunities and challenges. Given the nation's heavy reliance on tourism, imports, and fisheries exports, blockchain can play a transformative role in improving transparency, efficiency, and credibility in trade and logistics.

However, the successful adoption of blockchain technology requires complementary technologies, better workforce capacity, comprehensive regulatory frameworks, and well-designed pilot projects. This section outlines key strategic considerations to successfully adopt and use the technology in supply chains. It highlights the significance of:

- Investing in Complementary Technologies
- Capacity Building and Skill Development
- Developing Regulatory Frameworks
- Pilot Projects.

Investment in Complementary Technologies

Complementary digital technologies maximize blockchain's impact on supply chains, improve operational efficiency, and strengthen system resilience (Dutta *et al.*, 2020). For instance, Lukacs *et al.*, (2025), proposed a framework that combines blockchain with IoT, RFID, near-infrared spectroscopy (NIRS), and computer vision to create a seamless track-and-trace system. This integrated approach automated data collection and validation across the supply chain and connected all tools to minimize errors and ensure traceable transactions.

Similarly, Zhang *et al.*, (2025), found that integrating blockchain with IoT, AI, and big data analytics enhances transparency, traceability, and trust, while also reducing waste and supporting sustainable practices. Additionally, investments in robust technological infrastructure, including computer resources and reliable internet connectivity are essential for geographically unique nations like the SIDS (Lustenberger and Spychiger, 2025).

Capacity Building and Skill Development

Improving the capabilities and skills of the workforce is fundamental for the Maldives and other SIDS looking to adopt blockchain technology effectively. Building the specialized skill set and technological literacy requires significant investment in training, education, and awareness programs (Dutta *et al.*, 2020; Melendez, Bergey and Smith, 2024). According to Noor, (2022), employee resistance, which frequently stems from depending on traditional systems and practices requires comprehensive training initiatives such as seminars and workshops to help familiarize the workforce with blockchain and its benefits. These programs have been found to build confidence, reshape mindsets, and foster a willingness to engage with new systems. Additionally, building stakeholder awareness and demonstrating the added value of blockchain can drive broader participation at different levels (Lustenberger and Spychiger, 2025). Educational and awareness campaigns targeting the public can also help demystify blockchain, making it more approachable and reliable (Shahzad *et al.*, 2024).

Development of Regulatory Frameworks

The long-term success of blockchain adoption is also dependent on a robust regulatory and governance framework. For instance, clear guidelines addressing data privacy concerns and ownership structures of blockchain are necessary to mitigate operational risks and encourage compliance (Dutta *et al.*, 2020; Lustenberger and Spychiger, 2025). Similarly, Zhuk, (2025) argues that meticulous legal design for conflict prevention and customer protection are necessary to address the jurisdictional ambiguity and cross-border complexities inherent in blockchain technology.

Pilot Projects

Targeted simulations and case-based pilot projects can help examine the real-world impact of embracing blockchain, and customize specific solutions tailored to local needs (Dutta *et al.*, 2020). Given the technological, financial, and political hurdles facing the Maldives and other SIDS, initiating small-scale pilot projects and feasibility studies is a proactive strategy that can help build institutional capacity while minimizing risks. These carefully designed pilot projects facilitate better cost management and reinforce stakeholder confidence, potentially leading to a measured and effective scale-up (Melendez, Bergey and Smith, 2024).

CONCLUSION

Although the government of Maldives has taken the lead in initiating blockchain exploration, its widespread adoption, especially in the Maldivian private sector faces significant challenges. The absence of a comprehensive regulatory or legal framework along with weak technical, institutional, and financial capabilities requires these nations to adopt strategic planning, targeted investments, and collaborative efforts to improve the overall supply chain performance with the help of blockchain.

Future research should include longitudinal studies to examine the economic and social impacts of adopting the technology in the long run. It should also identify strong governance models and frameworks that help minimize potential risks of its use in supply chains. Additionally, future research must investigate the potential of interoperability solutions in connecting various blockchain platforms and legacy systems within supply chains. Future studies should also evaluate the role of blockchain technology in building supply chain resilience, considering the overwhelming risks of climate change and other environmental challenges faced by the Maldives and other SIDS alike.

The authors of this study acknowledge that the challenges, benefits as well as other strategic considerations in this paper may vary across different nations and contexts. It is also important to note that blockchain and its application in supply chains is a rapidly evolving field of research and practice. This could potentially limit the long-term relevance of some of the findings and it is imperative that future research address the unique circumstances in SIDS for blockchain adoption in supply chains.

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EU-SERBIA COOPERATION AND DEVELOPMENT IN THE MIRROR OF ECONOMIC FRAMEWORK

Abstract: The present work carries out an analysis of the European Union's enlargement policy and their economic impacts from the dissolution of Yugoslavia until nowadays. The analysis focuses mainly on institutional sources and takes into account the Serbian perspective, as an element of originality and innovation. In more detail, the study assesses the quality parameters in relation to the standard required by the EU. The study questions the level of economic preparedness. Serbia is an important partner for the EU in relation to imports and exports, the data shows and justify that economic reform and the consolidation of a market economy is essential for the integration. As a result of economic-regional cooperation, the country is receiving significant financial support under the IPA programs. The regional approach has proven to be beneficial for Serbia and it is highly asymmetric in favour of Serbian interests. Despite some moderate progress, Serbia is not fully prepared in economic terms for accession.

Keywords: EU, Serbia, Adhesion, IPA funds, Regional cooperation

1. INTRODUCTION

"Serbia is committed to promoting regional cooperation, which is an important element of its European path, while reaffirming the need to maintain regional security and stability, which is the basis for the economic prosperity of the Western Balkans" (Dačić, 2016). After the political changes in 2000, the conditions were created for intensifying relations with the EU. The main objective of this study is to present the main features of economic cooperation and growth from the reform of the 2000s to last year and to look ahead to the future. The year 2001 can be seen as the beginning of the transition to the Serbian market (Simon, 2003). The region attracted foreign investors mainly through the privatisation of state-owned enterprises, with a large part of the inflow of foreign working capital coming from EU countries (Ganić, 2021). The relationship with the EU should be considered in two dimensions: the rapid acquisition of EU candidate status and the implementation of comprehensive reforms necessary for accession, "the Europeanization of Serbia outside the EU" (Vujošević, Zeković & Maricic, 2012). All countries in the region are going through a long and complicated process. The relationship between the parties is important not only from a historical, political, legal, but also from an economic point of view, and therefore in the second chapter of this study the level of economic preparedness for integration will be analysed in the context of regional cooperation and various programmes such as IPA. IPA is the EU's pre-accession instrument for financing the implementation of reforms needed for accession. At the same time, the "second generation of reforms" were implemented. This has included creating the right environment for domestic and foreign investors to enhance property protection rights and contracts, an efficient judiciary, a modern tax

system, public sector reform, harmonised fiscal and monetary policy, the development of an efficient banking system and financial markets, the promotion of public-private partnerships (Ganić, 2021) and the demonstration that economic reform and the consolidation of a market economy are essential if the EU is to be a member. In the third part, the current normative relations between Serbia and the EU will be analysed from the point of view of economic criteria, how cooperation in the field of economic development and trade is taking place. The title of "good economy, good governance" is used to show the importance of national economic policy for the country's relations with the EU. Serbia is without doubt the EU's most important partner in terms of imports and exports. Trade liberalisation has generally had a positive impact on both the import and export side. In the final section of the paper, we will examine the relationship between the parties from the trade perspective. The data show that Serbia is particularly characterised by some of the key institutional weaknesses typical of the Western Balkan countries. The economy has performed strongly over the last decade and weathered the 2008 recession and pandemic well. Macroeconomic and political stability has boosted growth, while EU accession remains key to further reforms. Although Serbia is outperforming its Western Balkan neighbours, it still lags behind EU countries on a number of indicators (The World Bank Group, 2022).

2. LITERATURE REVIEW

There is a near consensus in the literature that countries that implemented bold, radical and comprehensive reforms at an early stage returned to economic growth more quickly, while partial and non-reformers that postponed the necessary changes experienced longer negative periods. We hypothesize that Serbia falls into the latter category, where the economic transformation took place in several stages and is still ongoing. We collected data on the main economic indicators of Serbia. The data sources are from the databases of the EBRD, the World Bank, the European Commission and the National Statistical Office of Serbia, the Ministry of Finance and the National Bank of Serbia. In addition, alternative data sources were used to prepare the report. By performing principal component analysis, we tracked the changes in regional cooperation and economic development over the past 24 years and identified key factors. A comparative analysis was made of the above databases, and conclusions were drawn regarding the differences in the most important microeconomic indicators, projecting expectations for future years (Mišić & Oravcova, 2020, p.515-541). However, the empirical evidence provides mixed and contradictory results and predictions. In fact, the majority of studies find an adverse effect of high public debt on economic growth, especially for developed countries and above-threshold debt levels (Kyrkilis & Grujic, 2020). In reaching conclusions, focus was placed on looking at the past analysis of social and economic changes, along with their legal and political structures. Finally, we examine the cultural specificities of the Western Balkan region, with particular reference to market economies and their analysis with competition (Begovic & Popovic, 2018). This result shows that the turning point of the debt-to-GDP ratio of the Western Balkan countries is the GDP 50.87%, which is much lower than the value found in the literature for developed countries. Most studies that look into this topic suggest that the highest acceptable level for the ratio of public debt to GDP is between 90 and 100% in advanced economies. This includes research by Reinhart & Rogoff (2010), Checherita & Rother (2010), Baum, Poplawski Ribeiro, & Weber (2012), Mencinger, Aristovnik & Verbič (2014), and Woo & Kumar (2015). Some of them suggest that this might happen because nations that are still developing lack the same level of trust from potential lenders and investors as developed nations, leading to the harmful impacts of excessive public debt becoming evident much earlier. Additionally, developing countries tend to be more exposed and heavily reliant on foreign investments. Considering the other explanatory variables, the coefficient of trade openness is positive and statistically significant in all models, indicating that openness to international trade is an important determinant of economic growth in WB countries (Kyrkilis & Grujic, 2020, p.13-32). Most studies have attempted to examine the relationship between democracy and FDI. Harms & Ursprung (2002) and Jensen (2003) found that multinational corporations are more likely to be attracted to host countries with a democratic structure, while non- or less democratic countries are riskier and attract less foreign direct investment. The study of the relationship between corruption and foreign direct investment has received much attention. From a theoretical perspective, corruption can have both positive and negative effects on foreign investment. Corruption increases uncertainty; therefore, it causes additional costs of doing business, which can be a serious disincentive for foreign investors (Ackerman, 1975) and (Shleifer & Vishny, 1993). Therefore, we propose the following hypotheses: the higher the corruption in a given country, the lower the investment incentive due to uncertainty and political instability.

3. DEVELOPMENT OF ECONOMIC RELATIONS AFTER THE DISSOLUTION OF YUGOSLAVIA

There is no consensus among scholars as to when the Serbian transition really began, whether in 1989, late 2000, or after the end of the Milosevic regime. They also differ in their assessment of what has been achieved in recent decades. But there is a consensus that at the end of 2000 the country was heavily dependent on international aid. In the past, the EU has not been able to implement a coordinated foreign policy, but has been at the forefront of financial assistance to the region and has developed several programmes as part of the stabilisation process. Among the many aid programmes,

OBNOVA for infrastructure, development and reconstruction, ECHO (European Commission Humanitarian Aid Office), SAPARD for agricultural development (Special Action Program for Pre-Accession Aid for Agricultural and Rural Development) and ISPA for environment and transport development stand out (Tota, 2019, p. 64-77). However, the different accession funds were not created at the same time. The first was the PHARE programme. The programme, launched in 1989, was originally intended to promote the transition to a market economy and the establishment of political democracy in the countries of Central and Eastern Europe with unstable market economies and democracies (Hughes, Sasse & Gordon, 2004, p. 60-65). The EU developed a new concept of the Western Balkans as a sub-region of the South-Eastern European region. According to this concept, the Balkans were essentially a process of regionalisation and integration. After the war, this type of partnership ideology was called Stabilisation and Association Agreement (SAA). The official name of the European Union's enlargement to the Western Balkans was the Stabilisation and Association Process (SAP) (European Commission, 1999, p. 235), and its launch in 1999 foreshadowed a political change in the relationship between the parties (Trauner, 2009, p. 65-82). The Stabilisation and Association Process (SAP), the framework for relations between the EU and the Western Balkan countries, is divided into four distinct parts: 1. Unilateral trade preferences granted by the EU, which mean that these countries can export their products free of taxes and restrictions, 2. Stabilisation and Association Agreements (SAAS), which are concluded with each country individually and aim at deepening political relations and adopting the EU *acquis*. To achieve the latter objective, candidate countries can count on the EU's technical and financial assistance (Kőbányai, 2019). These agreements have gradually laid the foundations for unhindered free trade with the EU. In order to help achieve these objectives, the European Commission launched the CARDS programme (Community Assistance for Reconstruction, Development and Stabilisation) in December 2000. The main objectives of the programme for the period 2000-2006 were: institutional and legislative reforms, including legal harmonisation with the EU, improvement of legal certainty, respect for human rights, independence of the media and the establishment of a functioning market economy, and strengthening the fight against organised crime. Ensure sustainable economic and social development, including structural reforms. 4. to develop bilateral and regional cooperation between the participating countries and the European Union and the candidate countries of Central and Eastern Europe (CARDS Programme of the European Union, 2666/2000). After 2001, economic reforms accelerated sharply, as suggested by the European Bank for Reconstruction and Development (EBRD) indicators (Halpern, 2011, p. 365-374). The initial phase of reforms included price liberalisation, foreign exchange and trade liberalisation, and small-scale privatisation. Reforms in the second phase included large-scale privatisation, governance and enterprise restructuring, competition policy, infrastructure reforms, banking and interest rate liberalisation, and reform of non-bank financial institutions. The main features of Serbia's economic development in the period 2001-2011 can be gauged by examining the basic indicators of development such as GDP per capita, economic growth rate, inflows and outflows of foreign investment, level of public finances, inflows and outflows of remittances, etc. According to the Maddison Project Database, GDP per capita was at its highest in 2008 (USD 7421). 2009 and 2010 saw a decline in this indicator. The highest economic growth rate in the base period was in 2004, when it was 9.3 percent. The year 2009 was marked by the onset of the global economic crisis, which contributed to negative economic growth of -3.5 percent. It should be emphasized that the inflow of foreign direct investment into Serbia is very important for achieving economic stabilization and growth. The highest growth was realized in 2011, with a 14 percent increase compared to the previous year (Manning, 2017). According to data from the Ministry of Finance and Economy for the period 2001-2011, Serbia's public finances increased significantly in 2010 and 2011, reaching 44 percent of GDP, or 47.7 percent of GDP. This indicator increased by 18 percent in 2010 and 25 percent in 2011 compared to the previous years. According to the National Bank of Serbia (NBS), the public debt-to-GDP ratio was 29.2 percent, or 34.5 percent. Lukić et al. (2013) stated that the state's direct external commitments were increased on the basis of EU macroeconomic support, as well as indirect external commitments based on guarantees for European Investment Bank loans. On the one hand, the EU used asymmetric trade liberalisation to open its markets more rapidly to the Western Balkan countries, and on the other hand, it expected the countries to fulfil political conditions similar to the Copenhagen criteria (Tálas, 2011, p. 44-50). The Thessaloniki European Council of 19-20 June 2003 endorsed the introduction of the European Partnership (Official Journal of the European Union, 2006). Recent new challenges, such as cross-border terrorism and increased illegal migration pressures, mean that the EU can no longer act effectively 'alone' and needs help, and good neighbourly relations and partnership with neighbouring countries are a key factor in stabilising the region and creating external security (Ágh, 2010, p. 20-23). Although there are still many unresolved challenges in the field of institutional reform, progress is being made in the field of economic cooperation. It is true that the economy is greatly influenced by the foreign policy interests of the great powers and the parties, but the importance of cooperation and development is unquestionable. We can state that regional cooperation and cross-border EU programs greatly facilitate the preparation for accession. According to my hypothesis, the economic, trade and income transfer relationship between the parties is extremely asymmetrical in favour of Serbia. This conditions the relationship and provides the EU with a stronger negotiating position. However, it is not only the financial support provided by the EU in the different funding periods that is decisive in this context. According to my assumption, although the European Commission clearly supports Serbia's accession to the EU, the date of accession is unpredictable due to the war in Ukraine and the global crisis. Serbia became an EU candidate country on 1 March 2012, which meant that the European Commission assessed that the country was capable of starting accession negotiations and further legal harmonisation (European Council, 2012). One key issue is the conflict between Serbia and Kosovo, which is one of the decisive reasons why Serbia's EU accession is still pending (Braun, 2017, p. 81-95).

4. NEW REGIONALISM AND COOPERATION IN THE FRAMEWORK OF IPA PROGRAMS

The Western Balkan states are involved in a number of regional and sub-regional programmes and cooperation processes for the exchange of information and experience, and are also members of several regional processes with a wider geographical and thematic coverage, in particular the Budapest or Prague processes (Zitanova, 2014, p.40-48). From Serbia's perspective, the most important regional initiatives are the Central European Free Trade Agreement (CEFTA 2006), which helps prepare Western Balkan economies for the competitive pressures of the EU single market. The process of reciprocal trade liberalisation enhances competition and encourages national reforms to increase competitiveness. The “Regional School of Public Administration (ReSPA)” is a global entity focused on enhancing public administration throughout the Western Balkans. Its objectives are to promote improved regional administrative cooperation, strengthen administrative capacity and develop human resources in line with the principles of the European Administrative Area. In the field of environment, the Regional Accession Network for the Western Balkans and Turkey (RENA) is working on cooperation in the field of environment and climate change. In the field of infrastructure, the Western Balkans Investment Framework (WBIF), formally launched in 2009, jointly by the Commission, the Council of Europe Development Bank, the EBRD and the EIB, is important. This is an innovative funding initiative that combines grants and loans from the Commission, partner IFIs and the WBIF. In 2011, the WBIF allocated €220 million in project grants. The Energy Community Treaty (2006) aims to promote an integrated energy market, facilitating energy trade in the Western Balkans, integration with the EU market and enhancing security of supply. Regional cooperation should be a factor for integration through the development of infrastructures and networks and the creation of free trade areas between neighbouring countries (European Commission, 2019). In the framework of regional and cross-border cooperation, the EU has offered a number of support instruments to raise the level of development of the region over the last decade. Among these, the most significant are the support to the cross-border neighbourhood programmes in the fields of agriculture and rural development, and the environment and water (Szilágyi, 2012, p. 49-54). The Instrument for Pre-Accession Assistance (IPA) for 2007-2013 helped candidate and potential candidate countries to stabilise and integrate into the EU. IPA provided a total of €11.565 billion over the period 2007-2013. Assistance under IPA can take the form of, inter alia: investments, procurement contracts and grants, administrative cooperation through the secondment of experts from Member States to the countries concerned, participation in Community programmes and agencies. IPA is managed and implemented on the basis of multi-annual strategic planning defined by the Commission. IPA also helps candidate countries to manage EU funds for similar purposes (European Regional Development Fund, Cohesion Fund, European Social Fund and European Agricultural Fund for Rural Development). IPA funds increase the capacity of countries during the accession process, leading to gradual and positive progress in the region. For the period 2014-2020, the main novelty of IPA II is the preparation of Strategy Papers for each beneficiary for a period of 7 years. IPA II allows for a more systematic use of sector budget support. Finally, it gives greater weight to performance measurement (European Commission, 2014-2020). Financial support under IPA II pursues four specific objectives: support for policy reform, economic, social and territorial development. Progressive harmonisation of the EU acquis, strengthening regional integration and territorial cooperation. The European Commission noted that the Western Balkans will be a priority in the EU budget for 2021-2027. The question arises, of course, whether the current global crisis in Ukraine and the harbouring of Ukraine will in any way change the IPA's projections or plans for 2021-2027. The Instrument for Pre-Accession Assistance (IPA III) for 2021-2027 provides €83.4 million in EU assistance in the areas of rule of law, good governance and alignment with the acquis, education and economic development. In addition, financing decisions have been taken on two operational programmes for the period 2024-2027 (a) on environment and energy, with EU support of €240 million, and (b) on employment, skills and social inclusion, with EU support of €100 million. This package is complemented by a substantial multi-country programme package and the rural development programme IPARD III, the latter with EU support of €288 million. This is a major contribution to the launch of the implementation of the Western Balkans Economic and Investment Plan and the Green Agenda (European Commission, 2024).

5. “GOOD ECONOMY, GOOD GOVERNANCE” - THE ECONOMIC CRITERIAS FOR ADHESION

As far as a good economy is concerned, meeting the economic criteria is a key condition for EU accession, according to the Copenhagen criteria. This implies the existence of a functioning market economy capable of withstanding competitive pressure in the EU single market. As part of the accession negotiations, 22 chapters have been opened, two of which have been provisionally closed (chapters 25 and 26). In line with the revised enlargement methodology adopted by Serbia, the negotiating chapters are grouped into six thematic clusters and negotiations should be opened for the clusters as a whole, rather than for individual chapters. All chapters in Cluster 1 (Basics) and Cluster 4 (Green

Agenda and Sustainable Connectivity) have been opened. Cluster 3 (Competitiveness and Inclusive Growth) is the most advanced and is about to be opened next. Serbia presented its negotiating position on chapters 2, 3, 10 and 28. Each year, the European Commission reviews the progress made and publishes a country report for the following year, setting out the necessary actions for legal harmonisation and catching up. According to the report, Serbia's preparedness for a functioning market economy is good and some progress has been made, but there are still structural challenges in the areas of state aid, competition and public procurement, and state-owned enterprises have a significant presence in the economy. The private sector is hampered by weaknesses in the rule of law, in particular in the fight against corruption and inadequate administration of justice. Serbia is moderately prepared for the free movement of capital. It is required to liberalise capital movements in line with its commitments under the Stabilisation and Association Agreement (SAA), in particular by removing remaining restrictions on the acquisition of agricultural land by EU citizens. The level of economic and monetary policy preparedness is moderate. Further alignment of legislation on the National Bank of Serbia (NBS) is needed in the coming year to ensure full independence. Serbia is well prepared in the area of customs union. Some progress has been made in implementing the Protocol on the elimination of illicit trade in tobacco products. Serbia is party to the Single Transit Convention. The country still needs to improve its road and rail infrastructure maintenance system; harmonise and simplify border crossing procedures, including the extension of green corridors/green lanes for crossing with neighbouring EU Member States. Serbia is moderately prepared in the field of energy and has some level of preparedness in agriculture and rural development. Limited progress has been made in strengthening the capacity of the IPARD Agency and improving overall efficiency. The ability to tackle major issues in trade policy must be enhanced, especially to move forward with joining the World Trade Organization (WTO). It is important to quickly eliminate any remaining unfair trade barriers and avoid creating new ones. Keep working on the actions outlined in the Common Regional Market Action Plan for 2021-2024. The strategic framework established by the Ministry of Finance has entered its seventh consecutive cycle of the Economic Reform Programme (ERP, 2022-2024) and remains a key policy document for the development of the Serbian economy, which is also part of the ongoing EU accession process. In the foreign policy area, some of the country's actions and statements are at odds with the EU's foreign policy stance. Serbia has high-level relations with the Russian Federation, which raises questions about Serbia's strategic direction. The country has also deepened its relations with China. This has included the entry into force of the free trade agreement with China on 1 July 2024, which is a cause for concern at this level. Serbia has made limited progress, in particular with the adoption of the Youth Guarantee Implementation Plan for 2023-2026. In terms of macroeconomic stability, after weathering a series of external shocks, the budget deficit narrowed from 8% of GDP to 2.2% in 2020-2023, while public debt fell from 57.8% to 52.6% of GDP over the same period. Investment and private consumption boosted growth, helped by strong foreign direct investment (FDI) and rapid real wage growth due to slowing inflation. The current account deficit narrowed from 6.9% in 2022 to 2.6% in 2023. The current account deficit was fully financed by net working capital inflows and widened slightly to 6.5% of GDP in the first half of 2024, reaching a new record level of 37.8% of GDP in the first half of 2024, covering 7.2 months of imports of goods and services. Serbia has reached economic stability due to a careful combination of policies. Because of ongoing robust foreign direct investment inflows, the euro's foreign exchange reserves have now surpassed €25 billion. Inflation is anticipated to drop within the target limits established by the National Bank of Serbia. In May 2024, the European authorities approved the creation of the Reform and Growth Facility, under which the country could receive up to €1.7 billion by 2027. In addition to financial support, the plan could speed up integration into the single market before Serbia becomes a full EU member. It also aims to achieve a common regional market. In particular, Serbia's 2025 fiscal strategy announced that the enforcement of the deficit component of the fiscal rules, which targeted 1.5% of GDP, has been postponed from 2025 to 2029, with a 2.25% increase in pension expenditure by 2029. In the baseline scenario, Serbia's external debt will be around 50% of GDP at the end of 2025. One of the key factors contributing to the downturn is the increase in the openness of the Serbian economy (measured as a percentage of exports or imports of goods and services as a percentage of GDP) to over 120% of GDP. Serbia needs to increase the transparency of annual budgets and ensure a more credible and stable medium-term budget. The reform of the public sector pay system has been postponed until 2025, which still places a heavy burden on public finances. Investment to address existing infrastructure gaps has surged and is expected to accelerate further under the ambitious "Jump to the future of Serbia 2027" development plan. In the UN 2030 Agenda for Sustainable Development, Serbia is most often described as a "challenging economic environment" for sustainable development. In terms of global competitiveness, Serbia ranked 72nd out of 141 countries in the Global Competitiveness Index in 2019. The score remained unchanged from the previous year (60.9) but the ranking was 7 places lower due to the faster development of other countries than Serbia. The World Bank's involvement is co-financing the Green Transition Programmatic Development Policy Operation Series (FY23 and FY25), with US\$420 million per operation coming to the country. Serbia is working towards full compliance with the EU Single Euro Payments Area (SEPA). If SEPA compliance is achieved, it is estimated that the country could save up to USD 228 million. The World Bank's involvement in digital governance (EDGE) and project financing (USD 50 million) is significant. With this in mind, the Bank's strategic priorities for Serbia in 2023-2028 are: increasing private sector competitiveness, productivity and access to finance; and financing sustainable infrastructure, strengthening regional connectivity, government services. A loan of €72 million has been extended and private financing of around €100 million. Serbia has increased its living standards by a third, turned a significant budget deficit into a surplus and cut the unemployment rate by more than half. Despite this, from 2022, GDP per capita will be less than half that of the EU-27. GDP is dominated by services, while growth is ultimately driven by exports, which have

expanded strongly thanks to continued strong FDI inflows into manufacturing (The World Bank Group, 2022). Despite progress, Serbia is still not converging fast enough with the EU. Serbia would only approach EU average per capita income in 2074 if it continues to grow at an average annual rate of 3%.

6. TRADE REVIVAL - "RISING BALKANS"

As we have seen above, Serbia benefits from its relationship with the EU through various programmes, and a large part of EU funds is spent on reforms in democracy, public administration, environment and energy, agriculture, as well as strengthening the rule of law, education and transport. Serbia's relationship with the European Union is also important in terms of foreign trade, which has an impact on the country's economic development. In order to promote regional integration and development in the Balkans, the EU unilaterally granted asymmetrical trade concessions to Serbia in 2000, known as autonomous trade measures. It allowed the region quota-free access to the EU market for 95% of its products. However, due to the difficulties of implementing a large number of FTAs and the difficulties of administration by customs in the region, the idea was to replace the network of many bilateral trade agreements by the creation of a single FTA. The main objective of CEFTA 2006 is fully liberalised intra-regional trade within the region. Its implementation aims to make the region attractive for trade and investment (Pjeroti'c, 2008). The period 2001-2007 is considered a period of rapid trade "expansion in the emerging Balkans". To increase the attractiveness of the regional market and its potential for further trade expansion and deepening, strengthening economic integration between the Western Balkans and the EU is crucial (Handjiski, Lucas, Martin & Guerin, 2010). The vast majority of Serbia's external trade is conducted through bilateral free trade agreements, which include agreements with the European Union (EU), the Eurasian Economic Union (EAEU), CEFTA and Turkey. The main trading partners are the EU countries, especially Germany and Italy, which account for 65% of total trade, followed by the countries of the CEFTA region with a further 15%. Serbia participates in the Balkans process to create a common regional market, but also supports the Open Balkans, which envisages faster and deeper regional integration with Albania and Northern Macedonia. The mini-Schengen agreement signed in 2020 is fully operational, ensuring the free movement of goods, persons, services and capital in the medium term. The free movement of goods ensures that many products can be traded freely in the EU under common rules and procedures (European Commission, 2024). The EU is Serbia's largest trade and investment partner, accounting for 59.7% of its total trade and 48% of foreign direct investment in 2023. Trade with the neighbouring EU 59 countries is still significant. Germany is also one of the most important trading partners (exports amounted to €952.4 million in 2011, representing 11.3% of total exports). Italy is in second place (€936.6 million, 11.1%), followed by Bosnia and Herzegovina (€852.6 million, 10.1%). Therefore, Serbia's main objective is to continue to increase its export performance and its weight in world trade. However, Serbia's largest partner in terms of imports was Russia, from which Serbian imports amounted to €1.9 billion, representing 13.2% of total imports, followed by Germany with €1.6 billion and a share of 10.8%, and Italy with €1.3 billion and 9%. China was fourth (€1.1 billion and 7.65% of imports). Serbia trades some agricultural products, including live animal exports, and exports of iron and steel products exceed imports. This is a cause for concern, and the country should focus on increasing exports and reducing imports in the future, as well as aiming to produce higher value-added products. A further concern is that, according to the Bank of Serbia and Eurostat, both the current account and the international balance of payments are in deficit, which also shows that Serbia is heavily dependent on foreign states, which makes the country very vulnerable financially. Among industrial products, exports of machinery and transport equipment, as well as steel products, are also prominent. Moreover, even food exports (mainly cereals and cereal products, but also livestock, fruit and vegetables) to the EU are significant. Among the products exported to the EU, the share of agricultural products is increasing, while that of industrial products is decreasing. With its current export share, Serbia ranks 47th overall among EU imports in terms of EU imports. The country imports mainly industrial products, including vehicles and their parts, and chemical products from EU member states. The share of fuel imports has increased significantly in recent years, reflecting the country's growing energy dependence. Imports of agricultural products are also important, with Serbia importing dried fruits and nuts, as well as beverages, tobacco and tobacco products, for example. In terms of EU exports, the country is the 31st largest trading partner in terms of trading partners and, most importantly, EU exports of fuel and clothing. On this basis, the increasing external trade and balance of payments deficits over the years could lead to serious economic growth (Endrodi-Kovacs, 2013, p.119-121). WTO membership is also a condition for entry into European integration processes. The establishment of the Common Regional Market, supported by CEFTA and the renewed Berlin process, could further increase trade volumes. The World Bank's Country Climate and Development Report 2024 estimates that the incremental investment in mitigation needed for Serbia to reach net zero emissions by 2050 is US\$10.4 billion, equivalent to 1.6% of GDP per year. The costs of adaptation are estimated at USD 21.5 billion in 2050, equivalent to 2.3% of GDP per year (The World Bank Group, 2022). However, there are important risk factors that need to be taken into account because of their impact on export and investment prospects, particularly on already ailing domestic private investment. Such risk factors may include ongoing geopolitical tensions, relatively weak growth in the EU's traditional trading partners, given the subdued export demand from the EU's main trading partners. Meanwhile, imports are growing much faster. In Germany or Italy, growth is slowing to stagnation or recession, largely against the backdrop of a decline in investment activity - which negatively affects demand for Serbian goods. However, this is somewhat compensated by the structure of Serbia's trade and investment. Construction has been one of the main drivers of growth recently. At least it has been a major contributor to economic growth, with the Serbian economy maintaining its pace in

2024 and a slight slowdown expected in 2025. Imports are growing at a more dynamic pace of around 5% per year. A near 20% increase in imports of capital goods and machinery, against a background of investment in the automotive, petrol and some other industries. A year-on-year increase of nearly 8% in imports of consumer goods, driven by a recovery in household demand. Overall, the export gap is widening. Exports rose to €19.2bn in 24 8 months, imports to €25.4bn so the gap is over €6.2bn. Services, higher tech manufacturing, but also some extractive industries such as mining are becoming increasingly important for exports. In terms of markets, there has been a recovery in merchandise exports, with an increase mainly in exports to EU countries (30.1%, 19.4 percentage points), followed by exports to CEFTA countries (22.3%, 3.6 percentage points) and Chinese exports (157.3%, 3.1 percentage points). The main drivers and bases of export activity were metals (3.6 percentage points contribution), electrical equipment (3.4 percentage points), metal ores (3.3 percentage points), chemicals and chemical products (2.7 percentage points), motor vehicles and trailers (2.7 percentage points), foodstuffs (2.3 percentage points) and rubber and plastic products (2.2 percentage points). On the other hand, the largest negative contribution to exports during this period came from tobacco products (-0.3 percentage points). Overall, the anaemic economic growth since 2008 can be attributed to adverse externalities, but also to low institutional quality, including weak rule of law and widespread corruption. The country remains divided in its EU accession ambitions. China's growing attractiveness in terms of investment and infrastructure lending beyond mere business interests and its share of inward FDI and exports have been growing rapidly in recent years, contributing to supply-side demand from the mining and construction sectors and commodity exports. On the other hand, the recent mass inflow of mainly Russian nationals has positively influenced ICT on the supply side and Russia's continued influence is growing, especially in the energy sector. Maintaining this balance could be a long-term challenge, leading to a further deterioration of democracy, rule of law and human rights in the country.

7. CONCLUSIONS

Serbia is an EU candidate country since 2012, but its accession negotiations are stalled. As for economic characteristics, our analysis highlights the existence of high and pervasive barriers to entry. This is due to several factors: intrusive and inadequate regulations that limit the scope and dynamism of entrepreneurial initiatives, the large-scale direct involvement of the government in many sectors, and the persistence of several markets where, as a legacy of the previous economic regime, dominant players can act strategically to prevent the entry of new competitors and protect their market power. There is significant heterogeneity in the sectoral composition of the economy in the region (Begović & Popović, 2018). Serbia's long-term sustainable economic development is not possible in the current way due to the increase in domestic demand caused by foreign loans and privatization revenues. The consequence of this growth is a permanent deficit in the foreign trade balance, wage growth exceeding productivity growth, and continuous inflationary pressure. The unreformed Serbian public sector is becoming a huge burden and a stumbling block for the state budget and economic growth. What should be Serbia's main economic policy in the coming period? This is clearly the Lisbon Agenda, which it must follow in order to reduce the development gap between itself and the EU. Regional cooperation can be considered the second level of EU foreign policy. The Union has recognized the fact that the Balkans require a specific approach, which can best be achieved by decentralizing power to local specificities. Within the framework of regional cooperation, more effective and greater progress can be achieved in the areas of democracy, the rule of law, human and minority rights, and economic development. The IPA funds established to support these goals are important for Serbia because they provide it with more and more resources, which will increase the country's capacity during the accession process. At the same time, in addition to unilateral support, it should be noted that the relationship between Serbia and the EU is also of great importance in terms of foreign trade. In terms of exports and imports, it can be seen that the EU is Serbia's largest trading partner and creditor. The emerging Balkan region continues to be a micro-region with a significant increase in trade volumes and openness of domestic markets. Like other European transition countries, the region continues to experience rapid trade growth, with imports and exports with the rest of the world and the EU accounting for more than 85% of total trade. In general, the regional integration between the CEFTA 2006 members is mainly based on historical and cultural ties. In addition, in recent years, research has shown that trade intensity in most countries within the CEFTA 2006 region (except Kosovo, Moldova and Albania) is decreasing, and exports to the EU-28 are increasing. At the same time, a good economy and the transformation of a market economy are essential conditions for accession. The reasons for the delay in accession negotiations are partly due to Serbia's internal processes. At the same time, the success of accession also depends on so-called external factors, such as the integration capacity and political will of the Union. Serbia is primarily interested in the economic benefits of the process. The background to the EU's expansion in the Balkans is primarily Europeanization, which imposes country-specific requirements for transformation and approximation to EU legislation. The Union supports the transformation with its own economic resources, helping the country's development, but at the same time ignores and postpones the date of actual accession.

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REQUIREMENTS FOR A SHIFT TO SUSTAINABLE FOOD PACKAGING - A COMPANY APPROACH

Abstract: The accumulation of huge amounts of plastic waste is causing irreversible damage to nature and human health, and one solution could be to apply the principles of the circular economy. A number of global and European regulations (Sustainable Development Goals, Green Deal) address this issue and aim to apply the circular economy model. However, the practical implementation of the targets in the context of food packaging is also very slow and the decision to influence the process is in the hands of companies. The views of corporate decision-makers in this area are particularly important in the food industry, as these companies either produce the packaging themselves and/or decide which packaging to use. The literature identifies some of the factors influencing business decisions (customer expectations, costs). The aim of this study is to present, analyse and discuss the factors that influence domestic manufacturers in their choice of packaging materials. We conducted semi-structured in-depth interviews with decision-makers from various domestic food and food packaging companies, which were analysed using the Berkana two-loop model. Our results show the current practices and the perceived reasons and options for adopting or not adopting the new system. In conclusion, the study shows that theories and goals for reducing environmental impact are only developed when they are translated into everyday practice. In the case of food packaging, alternatives already exist, but it is easier and simpler for decision makers to maintain the status quo.

Keywords: Food packaging, Packaging materials, Circular Economy, Company approach

1. INTRODUCTION

Plastic pollution is a major problem today, with many negative impacts. The widespread use of plastics, their long degradation time and single-use type, often causes irreversible damage to the environment. In the coming decades, pollution is expected to increase exponentially due to rising consumption, high production rates and slow degradation times. Plastic waste in landfills and in the natural environment also damages soils and waters, with impacts on wildlife and human health. However, it is not only end-of-life treatment or lack thereof, but also the manufacturing stages that contribute significantly to adverse impacts (Jagoda et al., 2023). Overall, the United States has the highest per capita plastic waste generation (approximately 130 kg per capita) among all nations (Chapman et al, 2024). Plastic post-consumer externalities have significant economic costs, energy-intensive plastic incineration and manufacturing processes contribute to climate change, and plastic production consumes 6% of global oil production (Kleine Jäger & Piscicelli, 2021). The packaging industry accounts for about 40% of plastic production. Packaging is increasingly seen as a major issue in today's societies. It represents a significant waste stream, accounting for 30-35% of municipal waste in

industrialised countries and 15-20% in developing countries. The shutdown of the waste management markets in China and India (2018 and 2019) has posed challenges for most countries exporting recyclables. The need to address the challenges posed by packaging waste has prompted companies and governments to examine the environmental impact of packaging (Afif et al, 2022). Japan has a very high per capita plastic packaging waste (32.4 kg), second only to the US, but ahead of China and the European Union (EU). Japan has a high collection and recycling rate for beverage bottles (93%), but most plastics are not managed in a sustainable way (Chapman et al., 2024). The packaging industry is growing at an unprecedented rate. It is forecast to reach USD 320.94 billion in the coming years, while the sector's annual growth rate will remain at 4%. The packaging industry has one of the highest waste rates of many other sectors. In the EU, the amount of waste generated by the packaging industry has increased from 163 kg to 170 kg per capita over the last decade (Ada et al., 2023). Food packaging plays a critical role in the sustainability of the global food distribution system. In a globalising world and changing consumer demands, the application of the Circular Economy (CE) in food packaging processes has become an issue that needs to be addressed (Kazancoglu et al., 2023). In order to reduce waste generation in the packaging sector, the European Commission (EC) is implementing policies and practices that facilitate the transition to the CE model (Ada et al, 2023). The transition from a linear economy to a CE model is essential, with packaging made using appropriate packaging materials as an important step (Kazancoglu et al., 2023). The role of education at all levels of the food packaging value chain, as well as the development of sustainable materials and new technologies, have all been identified as cost-effective and green approaches to minimise plastic waste. However, it is not clear which would be the most effective way to achieve a rapid transition to a circular, sustainable system. Many factors need to be taken into account to significantly reduce the demand for single-use, petroleum-based plastic products. Although the impact of plastics on climate change is a general concern, a small percentage of policy makers, companies and consumers are actually engaged in prevention activities (Trubetskaya et al., 2022). The food packaging industry is under pressure to adopt more sustainable practices, in which CE plays an important role. The food packaging industry is in a special position in the context of CE due to the health and safety concerns related to food, high complexity and high dependence on single-use packaging (Nielsen & Hakala, 2023). The current socio-economic system is based on a one-way linear economic model, where consumers dispose of packaging after use. This results in a loss of resources at several points. Today, the transition to a circular economy is ongoing. In this transition period, a complete transformation cannot be achieved in the short term. In this area, the whole system needs to be considered (Kazancoglu et al., 2023).

2. THEORETICAL FRAMEWORK

2.1. Circular Economy

The circular economy is defined as an economic system based on business models that replace the end-of-life concept with the reduction, alternative reuse and recycling of materials in production, distribution and consumption processes. As a regenerative system, CE aims to slow down, close and narrow material and energy cycles (Kleine Jäger & Piscicelli, 2021). CE incorporates the aspect of maximum utility and value into its design structure. It includes a closed loop of material flows and energy and raw materials through different phases. In the concept, finished products and material inputs circulate for as long as possible (Ada et al, 2023). Circular packaging solutions include the redesign of packaging formats and delivery models, the introduction of reusable packaging, and improvements in the economy and quality of recycled plastics (Kleine Jäger & Piscicelli, 2021). Many current food packaging practices are not in line with circular and sustainable supply chains, as they were developed when safety, convenience, affordability and food security were the primary goals. The transition to new solutions poses systemic challenges such as ineffective communication between stakeholders, misconceptions, broad and confusing definitions, imbalances in plastic supply and demand, legislative influences and top-down policies. There is also a need to review food packaging from environmental, social, technological and economic perspectives (Trubetskaya et al., 2022). From a spatial perspective, CE is a widely held idea and the circular economy model agenda is pushing for change based on stricter regulations at national and global levels. While European countries are perhaps at the forefront of the move towards circularity, with most Member States having developed policy agendas to promote circularity, the CE concept is also widespread outside the EU (Nielsen & Hakala, 2023).

2.2. Regulations and policies

Consumers in developed countries are pressing for increased safety, accountability and ever more sustainability in food production. The EU has established a legislative framework to reduce waste and protect consumers. In addition to formal policy regulations, citizen-centred solutions such as the concept of CE have emerged. In order to encourage companies to adopt such environmental practices, governments in most developed countries have launched upstream incentive-based instruments such as packaging taxes. These provide strong incentives for firms to make optimal packaging decisions in terms of volume, weight and materials. Packaging taxes are price-based policy regulations that provide economic incentives for producers to engage in less environmentally damaging practices. Tax rates vary according to the life-cycle impacts of packaging materials. In other words, the packaging tax reflects the environmental harms associated with the production of packaging materials as well as the social costs of their final disposal. This instrument, in the form of weight-

based charges, encourages manufacturers to choose more environmentally friendly packaging materials (Afif et al., 2022). This has led many stakeholders to take action to reduce the negative environmental impacts of food packaging throughout its life cycle. For example, legislators have introduced legislation to increase the recycling of plastics. In particular, extended producer responsibility (EPR) legislation has led to increased recycling rates in many countries. Bans on single-use plastics have put additional regulatory pressure on producers in several countries and regions (Herbes et al., 2024). EPR is a policy approach in which the physical and/or financial responsibility of the producer for the product is extended to the post-consumer stage. It is based on the 'polluter pays' principle, which means that producers contribute financially to waste management. When applied to packaging, the EPR places the responsibility for the packaging life-cycle on the producer and not on the governments. EPR provides strong incentives for companies to make optimal packaging decisions in terms of volume, weight and materials. The aim of the EPR policy is not only to relieve municipalities of part of the financial burden of waste management, but more importantly to encourage packaging producers to reduce resources, use more secondary materials instead of primary materials and design products to reduce packaging waste. EPR policies mean that both manufacturers and retailers are forced to internalise costs that were previously passed on to society, but also have a way to reduce costs and avoid potential environmental penalties or fines (Afif et al., 2022). EU policy makers aim to reduce the volume and environmental impact of certain plastic products through the Single-Use Plastics Directive (2019/904). Member States have committed to introduce more stringent regulatory measures by 2030. Integrating sustainability into the management of plastic production and use involves the systematic integration of technological, socio-psychological, environmental, political and other dimensions from micro to macro levels. Stakeholder perspectives on mitigation strategies to reduce plastic food packaging material will be crucial to support and promote the development of new strategies and to identify innovative ideas to reduce plastic pollution. However, the Directive defines all synthetic polymers and chemically modified natural polymers as plastics. Thus, all manufactured food packaging containing these polymers is covered by the Directive, without exceptions or minimum threshold values. Currently, a broad definition of plastic packaging can be a barrier to the production of safe and shelf-stable food (Trubetskaya et al., 2022). The need to reduce packaging waste generation is addressed in several EU legislation and strategy documents; moreover, the priority of waste reduction over end-of-life management is emphasised. For example, the European Green Deal (Fetting, 2020), the Circular Economy Action Plan and, in particular, the Packaging and Packaging Waste legislation (94/62/EC) currently under review, which would set direct recycling targets. The EU waste hierarchy prioritises reuse over recycling. Due to changes in the operating environment, including consumer demands, the importance of reusable packaging is increasingly recognised and widely applied at the business-to-business (B2B) level, such as in transport packaging, but to a limited extent in business-to-consumer (B2C), such as in retail environments (Tenhunen-Lunkka et al., 2024, Weinrich et al., 2024). Regardless of whether consumers are indeed willing to pay more for recycling, perceived changes in consumer values have influenced legislative action. In addition, many large companies in the food industry (e.g. Nestlé, PepsiCo, Mars, The Coca-Cola Company and Danone) have committed to making their packaging fully recyclable (Nielsen & Hakala, 2023). From an industry perspective, many companies have published their development goals under the UN Global Principles Agreement in the context of sustainability, and are evaluating their existing product structures and promoting models for developing new packaging solutions, mainly in line with their goals for the next 10-15 years (Kazancoglu et al., 2023). The use of recycled and bio-based materials not only meets sustainability goals, but also increases supply chain flexibility by diversifying material sources and reducing dependence on fossil fuels. Understanding these motivations provides critical insights to guide policy development, industry practices, and research efforts aimed at promoting sustainable and responsible material choices in manufacturing processes (Chapman et al., 2024). However, policies pushing for recyclability and reusability of packaging materials have created an industry response that favors simpler, single-material packaging (Nielsen & Hakala, 2023).

2.3. Barrier factors

Manufacturers face various obstacles in dealing with packaging problems. From an environmental perspective, five challenges emerge in the literature. In some cases, the CE principles cannot be properly applied to multi-layer materials, existing environmental legislation, contamination. Non-recyclable materials, such as black plastic, are another environmental barrier. Land use change, toxicity and other factors can have negative impacts on biodiversity or production activities. An additional challenge is that packaging is a low priority compared to operational considerations such as labour and material costs (Ada et al., 2023). A number of factors have been identified in the literature that influence the choice of packaging material. According to Kazancoglu et al., (2023), the choice of packaging material depends on the type of product to be packaged, its chemical and physical properties, the desired packaging life, customer expectations, cost, and other specific factors. Weinrich et al., (2024) broke it down into external and internal influencing factors and found the following: internal factors described as lack of management and employee commitment, resistance to change in packaging and packaging development processes, cost of materials, equipment and training, internal problems in interdepartmental interaction, complexity of decision making processes, lack of knowledge/training/experience, lack of tools and approaches for sustainable packaging design. External influencing factors identified were loss of competitiveness, customer resistance, unfavourable legislation and problems with packaging suppliers. Afif et al, (2022) consider that the price of packaging materials is an important decision factor in raw material procurement. They mention that decision makers are only willing to accept environmentally friendly packaging alternatives if the costs are reasonable. This is because manufacturers are predominantly driven by a cost-cutting approach. Companies will only accept

environmental packaging alternatives if they offer economic benefits such as increased efficiency and cost reduction. Similarly, it appears that reducing packaging at source is sensitive to changes in packaging material prices. According to Chapman et al, (2024), consumer preferences and demand for sustainable products drive manufacturing strategies. Increasing consumer preference for environmentally friendly products is forcing manufacturers to adapt their practices accordingly. Consumer demand for green products is therefore a powerful motivator for manufacturers. Jagoda et al., (2023) found a change in the influencing factors. The parameters considered in the design of sustainability decision making have evolved over the past decades based on market needs and socio-technical dynamics. Although cost and functional criteria dominated design decisions a few decades ago, environmental sustainability has become an important consideration as awareness of environmental consequences has grown. However, the concern for functional and financial aspects is significant from a stakeholder perspective. However, Keränen et al, (2021) also draw attention to disincentives. The value network for plastic food packaging is affected by the maturity of established and well-established technology and related business processes, which may hinder the shift towards more sustainable packaging. Past investments in machinery, manufacturing know-how, processes and relationships may further reduce the interest of established industry players, in particular plastic material suppliers, in new investments. As some plastics companies are also chemical companies, they are usually large and well known, with a strong position in the network. If these companies do not want to take the economic risk of introducing new materials, especially in the early stages, or if they are linked to the oil industry through ownership, they are strong enough not to make changes without strong technological and economic advantages. Indeed, sustainable innovations are often created in complex cross-sectoral networks and their development requires cooperation between different stakeholders, such as regulators and other companies. However, while recognising the important role of regulatory measures, the success or failure of the transition to sustainable packaging also depends on the behaviour of market actors. If companies do not produce and offer sustainable packaging, or if consumers do not buy it, change will not happen. Decision-making processes on packaging in food companies are often not well structured; companies tend to wait and see on sustainable packaging. In any case, it should be clear that assuming that sustainable packaging is a low priority for consumers who will not pay for it is enough of a barrier in managerial thinking to preclude even thinking about redesigning for sustainable packaging (Herbes et al., 2024). However, awareness of changes in production innovation, technology, information technology and communication can contribute to the creation and implementation of sustainable food packaging (Trojanowski, 2023). Nielsen & Hakala (2023) note that many companies are reluctant to switch to environmentally friendly materials and are often reluctant to go beyond a CE approach based on recycling, especially if it requires more resources.

3. MATERIAL AND METHODS

Semi-structured in-depth interviews were conducted with decision-makers from domestic food manufacturing companies (3) and a food packaging company (1). Interviews were conducted between August and December 2024 and lasted between 40-90 minutes. The companies are food and food packaging manufacturers in the SME sector, producing different types of food. The interviewees include companies producing confectionery, canned food, dairy products and vegetable packaging. Two interviews were conducted face-to-face, one on a Webex meeting platform and one with a written response. To analyse the interviews, the Berkana two-round model was used, which is suitable for identifying problems, exploring solutions, and design thinking. This tool is unique because it provides an opportunity to consider not only technical issues, but to combine all aspects of sustainable food packaging, including socio-economic, technical and public thinking. Berkana's two-loop model has identified a roadmap for change from initial challenge to potential solution. The goal is to create a sustainable packaging system that fully integrates policies and systems, technology, environment, mindsets and behaviours, initiatives and outliers (Berry, 2022). Some of the questions that were asked during the interviews and that were ultimately used for the analysis are illustrated in Table 1.

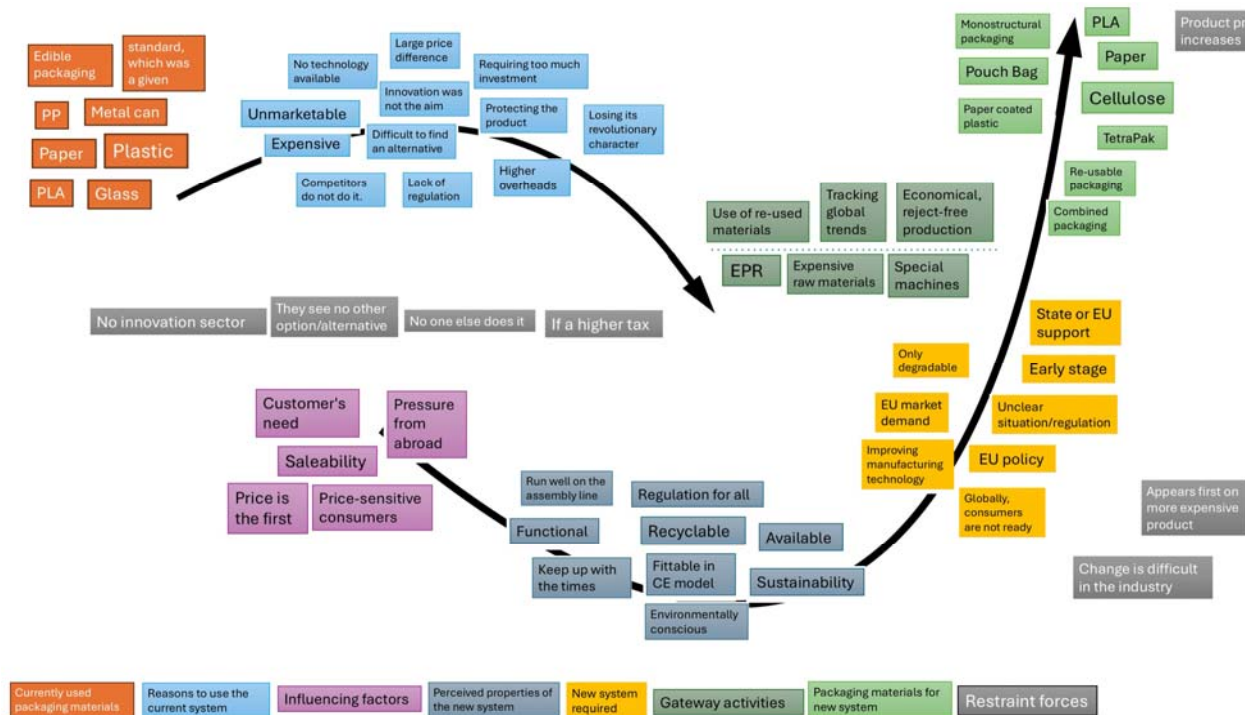
Table 1: The questions used

What packaging material is used?
Have you used alternative packaging materials?
Do you have any long-term plans to switch to alternative packaging materials?
Does the company have producer responsibility in place?
What measures are being taken to improve end-of-life management of packaging?
What criteria are used to select the packaging material used?
What do you think will be the trends in packaging materials in the future?
What changes might come in terms of production and raw materials?
What are the regulations that guide you in choosing the packaging material you use?

Source: Own editing

4. RESULT AND DISCUSSION

After analysing the interviews, we applied the Berkana two-loop model to explore the reasons that led to the current system and how interviewees envision the new system. The current system is the packaging system that companies use, with the usual packaging materials. And the new system is the one we have developed in the second loop based on the opinions of the interviewees. It is the system in which the circular economy can be achieved in a sustainable and environmentally friendly way. Figure 1 illustrates the resulting model.



Picture 1: The model of the old and the new system

Source: Edited by the authors based on their own research

Starting from the top left corner of the figure, you can see the first loop, the current system. The starting point is the packaging materials currently in use (orange text box). Moving further along the loop, we can see the reasons why the companies surveyed use this system (blue text box). The starting point for the second loop starts with the factors that could trigger companies to develop a new system (purple text box). Moving on from this, we can see the perceived characteristics of the new system (grey-blue text box). Turning towards the top, we have illustrated the factors that are necessary to create the new system (yellow text box). At the apex of the new system, we can see the packaging and packaging materials that the interviewees consider to be a new alternative (light green text box). Between the two loops, there is a possibility for a transition to the new system through the use of transition activities by companies using the current system (dark green text box). However, during the interviews, we heard about disincentives that may occur at different stages (grey text box).

The results show that the current use of packaging materials in the food market is still very diverse. Plastic is almost ubiquitous, alongside paper, glass, metal cans and polypropylene (PP). There were some respondents who said they used the standard that was given when they started their business. However, alternatives such as polylactic acid (PLA) or edible packaging are also present. The following barriers to switching to alternatives were identified by respondents: not marketable, expensive, no technology, large price difference, competitors not doing it, difficult to find alternatives, lack of regulation, too high investment, higher overheads. These are identified as reasons for operating under the current system, which are complemented by the fact that they are concerned about product protection, there was no aim to innovate, and biodegradable packaging is losing its revolutionary nature in their view. Afif et al, (2022) find similar results, with the price sensitivity of alternative packaging materials and high investment costs being defined as a deterrent. The following influencing factors were identified during the in-depth interviews: customer needs, price, price-sensitive consumers, saleability and international pressure. In their study, Nielsen & Hakala (2023) conclude that the main drivers for CE adoption are energy savings, environmental protection, financial incentives and tax incentives, but in contrast to our results, consumer demand and regulatory pressure are considered less important. Profitability, market share and economic incentives were also mentioned. A survey by Herbes et al, (2024) reveals that the companies surveyed perceive that consumers are not interested in packaging and the sustainability of packaging. This implies that there is a communication gap where information may be misleadingly flowing, our findings showed that consumer demand is given.

In their research, they conducted a survey representative of the SME sector and concluded that, based on their perception, companies are not able to take the initiative to switch to more sustainable packaging. Weinrich et al., (2024) identified the following criteria: product quality, availability of resources and packaging, shelf life, packaging with appropriate design and deliverability. In addition, they noted that cost is more important in decision making, such as the variable cost of alternative packaging, the fixed cost of investing in new equipment. Based on the interviews, the new system should have the following characteristics: it should be functional, run well on existing lines (so as not to require new investments), be recyclable, sustainable, environmentally friendly and fit into the CE model, and be accessible to all. This requires comprehensive regulation that applies to all. Keränen et al, (2021) are in line with their conclusions, in their research they also found that at the macro level, the policy framework and increasing consumer demand can put pressure on firms to recognise the potential of sustainable innovation at the firm level. In food packaging, large players are strong enough to stick with existing technologies if there are no external drivers to adopt sustainable packaging innovations. In addition to regulations and incentives, education on sustainability can provide an important framework for companies to do business, while raising consumer awareness. Likewise, politicians and consumers can push and encourage firms to make sustainable choices; however, as firms are actors in the value network, macro-level pressures are also transmitted to the network level. Respondents also identified the necessary conditions for the new system to work. They require improvements in production technology, public or EU support. The issues that need to be addressed to make it work: regulation at EU level, global consumers are not yet ready to use and handle alternative packaging, the situation and regulations for these materials need to be clarified, it is still at a very early stage, there is only EU market demand for it. Trubetskaya et al., (2022) and Ada et al., (2023) in their results concur that they see the new system as feasible through consumer education, training of professionals and value chain actors, and government support. They note that the lack of price competitiveness for sustainable materials is too great to be overcome at present and cannot be overcome by government incentives. They believe that the integration and harmonisation of new technologies, materials and processes should be promoted across Europe. We also looked at how manufacturers could envisage alternative materials in this new system. PLA, paper, cellulose, Tetra Pak, as well as Pouch Bag, paper coated plastic, mono, reusable and composite packaging have all been introduced.

It is possible to move from the current system as a bridge/tunnel to the new system by using recycled materials, monitoring global trends, economical and scrap-free production, EPR, special machinery and the introduction of alternative raw materials that are considered expensive. Keränen et al., (2021) also confirm that the transition requires new resources, value-adding activities and cooperation between actors. Jagoda et al., (2023) in their study on EPR systems suggest that national policies could be introduced to organise End-of-Life (EoL) treatment facilities with financial support from the manufacturer, which would encourage the manufacturer to shift towards less environmentally damaging designs. Ada et al., (2023) and Herbes et al., (2024) also draw attention to the legal constraints. Current environmental laws and regulations are complex and contradictory in many areas and are not aligned with CE principles. Waste management and regulatory issues are expected to worsen due to inadequate legislation, despite growing awareness of the long-term impact of global plastic pollution. Legislation alone will not encourage companies to adopt CE practices. CE principles, sustainability and greening should be able to overcome this problem through regulation and be able to adapt to upcoming innovations that may be needed. They mention in their study that in interviews they have conducted, it is repeatedly mentioned that government does not provide sufficient incentives to reduce packaging waste. They argue that appropriate regulations, laws and policies, such as taxes, should be put in place to encourage sustainable activities such as waste management, including taxes on the use of non-renewable resources, landfills and incineration. Weinrich et al, (2024) highlight that current legislation calls for the use of more sustainable packaging, but leaves it up to companies to actually use it.

The interviewees described the lack of an innovation sector, the lack of opportunities and alternatives, the fact that no other competing company is doing it and that it would only be worth it to have a bigger tax drag on the current system as a disincentive to move from the current system to the new one. A disincentive to the new system is thought to be the difficulty of achieving change in the industry, and it is thought that the packaging of products that are more expensive in the first place will be replaced first. The problem at the top of the new system is that this change will make the product itself more expensive. These problems are also noted by Nielsen & Hakala (2023), who note that despite the many technological advances in the industry, manufacturing costs, availability of raw materials and supply problems have often delayed market uptake.

5. CONCLUSION

From the above, it can be concluded that sustainability policies should be designed taking into account systems thinking to encompass the complex dynamics and characteristics of interrelated variables (Chakori et al., 2022). At the firm level, it is important to make changes related to the opportunities that arise from innovation. Firms that recognize these opportunities can enable the spread of sustainable innovation in the plastic food packaging value chain. Sustainable innovation can create new business opportunities for end-of-life service providers. The systemic nature of the diffusion of sustainable innovation requires a strategic and network-based approach by the managers of companies operating in existing value networks. It is important to determine the potential impact of sustainable innovation on a firm's existing and future business activities, and to link it to the impact of innovation on other actors in the network (Keränen et al.,

2021). As the packaging tax mentioned above is an upstream incentive instrument levied on the basis of weight, a tax increase would be more effective if combined with other green design policies or recycling subsidies. A combined approach would encourage companies to use less packaging material at source and to adopt more environmentally friendly packaging alternatives than if they only paid the tax (Afif et al., 2022). Our results show that although companies see the positive benefits of circular economy and alternative packaging, they do not take advantage of these practices. Of particular note is the observation that companies perceive these investments as very costly, but would be willing to open up to them with regulation and support. It can be concluded that in our country, too, the influence of competitors and the difficulty of market situations are strongly present in the case of companies operating in the SME sector. Among the companies interviewed, there were some that are already representatives of the new system and are applying these good practices. However, it is not easy for them because of the immature regulation and the lack of professionals.

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PORTFOLIO SELECTION IN THE YIELD AND SEMI-ABSOLUTE DEVIATION SPACE WITH THE INCORPORATION OF AN ENVIRONMENTAL INDICATOR

Abstract:

Different portfolio models can be used to determine an investor's optimal strategy, diversifying assets to reduce the overall risk of the investment under consideration. In general, the main objectives of portfolio models can be identified as minimised risk and maximised return. In minimizing risk, an investor can use different risk measures, and in the paper presented, investment risk is considered to be the semi-absolute deviation from the expected return. Since the focus is now on sustainable investing, the model considered is extended to include environmental burden conditions on the investment based on the E indicator from the ESG indicators concept. It is generally assumed that implementing environmental criteria may be associated with increased risk. However, for various reasons, sustainable investing may be attractive to the investor, and the risk difference between conventional and sustainable investing may not be significant. The authors make a possible application of the above approach to the assets of the Dow Jones Industrial Average (DJIA) stock index. The paper aims to address the question of to what extent the incorporation of an environmental indicator in portfolio selection models affects the investor's risk, specifically for models based on semi-absolute deviation. The results of the calculations on DJIA index assets confirm that the calculated risk is higher, but the difference is not dramatic.

Keywords: portfolio, environmental, optimization

1. INTRODUCTION

The requirement for environmental sustainability of investments is increasingly encountered when making investment portfolio selection decisions (e.g. Fabozzi et al., 2002). It is generally assumed that implementing environmental criteria may be associated with increased risk. Nevertheless, for various reasons (environmental protection, reduction of greenhouse gases in the air, use of various ecological subsidies, etc.), investors are increasingly interested in investing in companies that meet environmental standards.

Green investing (e.g. Renneboog et al., 2008; Statman, 2000) generally refers to the search for investment opportunities that contribute to protecting and improving the environment. Such investing aims to support companies with a positive impact on environmental indicators, which are part of the ecological factor within the concept of ESG criteria (Environmental, Social, Governance).

In the first part of the paper, a model of portfolio selection based on a measure of risk measured by the semi-absolute deviation is presented, and this model is extended to include an environmental condition on the investment. Subsequently, an analysis is carried out by applying the presented model to the assets of the DJIA stock index (Dow Jones Industrial

Average) to investigate the impact of considering environmental criteria on the riskiness of the calculated portfolio. The results show an increase in risk when the environmental condition is considered, i.e. whether the additional environmental criterion significantly affects the risk-return ratio.

The contribution of the paper is oriented towards the extension of the portfolio selection model to the environmental indicator (E), which is currently a significant indicator of sustainable development based on the ESG concept (e.g. Varmaz et al.2024; Siqi, 2024). Younger investors, especially, are willing to take higher risks when investing in order to take into account the environmental aspect of the investment (of course, the set of efficient solutions is shrinking in the process). Based on portfolio selection models, it can be concluded that at the minimum return set by the investor (E_p), the difference between the risk with and without considering the environmental indicator E under consideration decreases as its value increases (Table 1).

2. PORTFOLIO SELECTION MODEL AUGMENTED WITH AN ENVIRONMENTAL INDICATOR

In 1999, Ogryczak and Ruszczyński (Ogryczak and Ruszczyński, 1999) introduced a model based on a model using absolute deviation (Konno and Yamazaki, 1991). This model uses the mean semi-absolute deviation to measure risk. The semi-absolute deviation is a way of measuring risk when the actual rate of return in the portfolio is less than the absolute value of the average rate of return in the portfolio, the objective being to minimize the same risk measure function as in the absolute deviation model.

The main benefits of their work include:

Use of semi-absolute variance—This method is more robust to outliers than classical variance (Markowitz, 1952), thus better capturing the risk of asymmetric return distributions.

Portfolio optimization - The approach presented by Ogryczak and Ruszczyński (Ogryczak & Ruszczyński, 1999; Belabbes & Guennoun, 2025) allows for an efficient solution to portfolio selection problems, considering investors' risk preferences.

Link with linear programming - Models based on semi-absolute deviation are formulated to be computationally efficient and well tractable using linear optimization methods (e.g., Fang and Wang, 2006).

Let r_{jt} be the t -th ($t=1,2,...,T$, where T is the number of periods used in the construction of the model) component of the discrete random variable X_j represented by the vector $\mathbf{r}_j$ for $j = 1, 2,...,n$, whose values are assumed to be available, whether they are historical returns or simulated return values. It is also assumed that the expected value of the random variable X_j can be expressed as a geometric mean derived from the data used, assuming an equal probability of occurrence of each state. Then the expected return values of the random variable X_j , $j = 1, 2,...,n$, can be expressed:

$$E_j = E(\mathbf{r}_j) = \left(\prod_{t=1}^T (1 + r_{jt}) \right)^{\frac{1}{T}} - 1 \quad (1)$$

If w_j represents the share of the j -th asset, $j = 1, 2,...,n$, in the total investment, the expected return function of the portfolio can be written:

$$E(\mathbf{w}) = \sum_{j=1}^n E_j w_j \quad (2)$$

The goal of every investor is, of course, to maximize the value of the expected return on the investment $E(\mathbf{w})$ and, at the same time, to keep the risk of the investment as low as possible. In the above model, the risk is the semi-absolute deviation, which can be expressed as a risk function $\delta_-(\mathbf{w})$, where δ_- respects that the current rate of return in the portfolio is less than the absolute value of the average rate of return in the portfolio:

$$\delta_-(\mathbf{w}) = E \left[\left| \sum_{j=1}^n \mathbf{r}_j w_j - E \left[\sum_{j=1}^n \mathbf{r}_j w_j \right] \right|_- \right] \quad (3)$$

Then, given a minimum investor required return E_p based on the above risk measure, where the variables y_t represent the absolute deviation in each period t , $t=1,2,...,T$ (T is the total number of states) from the expected value of the return, a portfolio selection model can be formulated based on the risk measure measured by the semi-absolute deviation (SAD):

Input parameters:

T - number of periods used in the construction of the model,

n - number of assets,

$\delta_-(\mathbf{w})$ - A risk function in which δ_- respects that the current rate of return in the portfolio is less than the absolute value of the average rate of return in the portfolio,

r_{jt} - the t -th component of the discrete random variable X_j , $j = 1, 2,...,n$, $t=1,2,...,T$,

E_j - values of the expected return of the random variable X_j , $j = 1, 2,...,n$,

w_j - the share of the j -th asset in the total investment, $j = 1, 2,...,n$

E_p - the minimum return required by the investor.

Variables:

w_j - the share of the j -th asset, $j = 1, 2, \dots, n$, in the total investment,

y_t - absolute deviation from the expected return value in each period t , $t=1,2,\dots,T$ (T is the total number of states).

$$\begin{aligned}
\min \delta_-(\mathbf{w}, \mathbf{y}) &= \frac{1}{T} \sum_{t=1}^T \frac{y_t - \sum_{j=1}^n (r_{jt} - E_j) w_j}{2} \\
y_t + \sum_{j=1}^n (r_{jt} - E_j) w_j &\geq 0, \quad t = 1, 2, \dots, T \\
y_t - \sum_{j=1}^n (r_{jt} - E_j) w_j &\geq 0, \quad t = 1, 2, \dots \\
\sum_{j=1}^n E_j w_j &\geq E_p \\
\sum_{j=1}^n w_j &= 1 \\
w_1, w_2, \dots, w_n &\geq 0
\end{aligned} \tag{4}$$

In sustainable investing, it is desirable to include the values of the environmental indicator under consideration in the model, which will meet the investor's requirement to consider only those assets that do not exceed its specific desired value (Shushi, 2023). In the analysis carried out, model (4) was extended to include indicator E from the ESG concept (e.g. Friede et al., 2015). The parameter used to build the model was: the desired value of E (EN_E). The input parameters were the values of E for each asset EN_j (indicator for the j -th asset, $j=1,2,\dots,n$). Then, the model can be extended with the following condition:

$$\sum_{j=1}^n EN_j w_j \leq EN_E \tag{5}$$

In bound (5), the investor can individually determine the maximum value of the environmental indicator EN_E according to the demandingness he places on the values of E (e.g., on finance.yahoo.com the values of the rating agency Sustainalytics) for the assets under consideration (e.g., the values of the assets of the financial indices DJIA, S&P 500, DAX, and so on, but also the values of any assets under consideration). In further analysis, the value of the EN_E indicator was considered to be the boundary between the 1st and 2nd quartile of DJIA assets (i.e., 25% of the smallest E values of all assets considered).

Clearly, introducing an additional condition (5) into model (4) reduces the set of efficient solutions. In practice, this means that only those efficient portfolios that satisfy condition (5) are computed in addition to the original bounds. However, since the parameter EN_E has been taken into account for all asset values EN_j ($j=1,2,\dots,n$), stocks with a higher value of E but also with a higher return can be accepted into the portfolio. In the case of a strict requirement to meet the condition of the desired value of E , the calculations could only be performed on the relevant set of assets (in the considered case of 29 DJIA assets only for the seven assets with the lowest value of E) without condition (5).

3. ANALYSIS OF THE INTRODUCTION OF ENVIRONMENTAL CONDITIONS

For a good application of the presented model, it is important to correctly determine the time period for the analysis of historical stock prices. This time span is crucial to obtain relevant data on which the average return is then calculated. In the case under consideration, the evolution of the weekly prices of 29 stocks of the DJIA index over a specific period, namely from January 1, 2020 to December 31, 2024, was monitored.

In addition to stock price performance, ESG metrics for selected DJIA index stocks should be obtained. The relevant values are available from the rating agency Sustainalytics at finance.yahoo.com (Sustainalytics, 2024). The agency typically publishes ESG ratings on an annual basis, and the environmental indicator data for 2023 was used in the analysis. In the solution, the maximum weighted value of the environmental indicator for the portfolio was set as the value of the boundary between the first and second quartile, which takes the value of 0.9 for the above stocks.

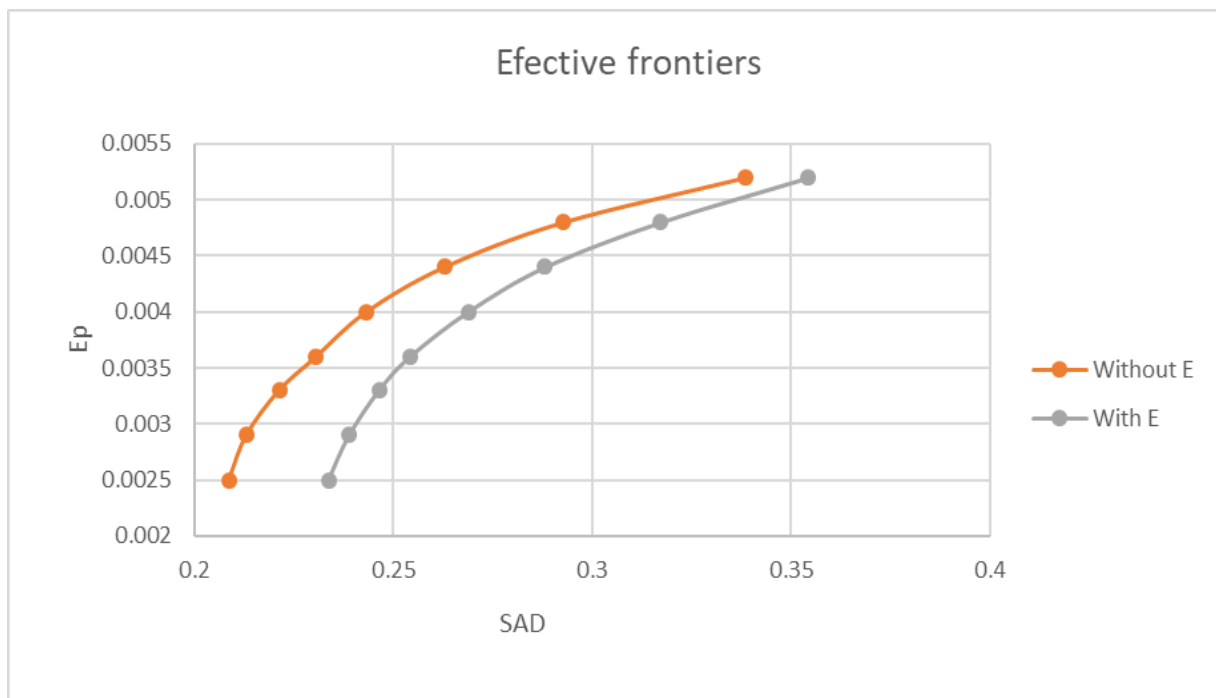
Portfolio optimization based on a portfolio selection model based on a risk measure measured by the semi-absolute deviation (SAD) accepting the investment sustainability condition was performed using Python. The results (efficient portfolios) are shown in Table 1 in the E section. Calculations were also performed without considering the E condition to compare the impact of the sustainability conditions (Table 1 part without E).

Table 1 Calculated efficient portfolios with and without environmental condition

Portfolio	E_p	SAD with E	SAD without E	Increase in SAD
P1	0.25%	23.38%	20.87%	12.0%
P2	0.29%	23.90%	21.31%	12.2%
P3	0.33%	24.65%	22.13%	11.4%
P4	0.36%	25.43%	23.06%	10.3%
P5	0.40%	26.89%	24.32%	10.6%
P6	0.44%	28.82%	26.28%	9.7%
P7	0.48%	31.72%	29.26%	8.4%
P8	0.52%	35.44%	33.84%	4.7%

Source: Author's calculations

A graphical interpretation of the results is shown in Figure 1.

**Picture 1** Effective boundary in case of E boundary and without E boundary

Source: Author's calculations

Table 1 and Figure 1 show that as the value of the minimum investor required rate of return E_p increases, the difference between the calculated values without and with the environmental requirement (5) decreases. Thus, it is clear that as the environmental aspect decreases, the risk/expected return ratio for portfolios also decreases. Such an approach with the application of the environmental aspect can provide the investor with a basis on which to determine his portfolio construction strategy.

It is also interesting to compare the composition of the individual portfolios. Table 2 shows the individual returns of assets that occurred at least once in the efficient portfolio. Columns P1 to P8 report the individual stock weights for the respective efficient portfolio. Similarly, Table 3 provides information on stock returns and weights for the efficient portfolios without considering the environmental benchmark.

Table 2 Efficient portfolios taking environmental conditions into account.

	Retrieved from	P1	P2	P3	P4	P5	P6	P7	P8
AAPL	0.56%	12.5%	16.8%	21.6%	25.7%	29.3%	34.5%	44.9%	61.8%
AMGN	0.15%	3.9%	0.8%	3.9%	5.7%	1.8%	0.0%	0.0%	0.0%
AXP	0.50%	1.4%	2.1%	3.4%	5.0%	6.1%	10.8%	9.6%	6.2%
CSCO	0.20%	8.9%	6.3%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%
DIS	-0.01%	4.2%	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
GS	0.50%	0.0%	0.0%	0.0%	0.0%	2.9%	2.7%	8.5%	16.7%
IBM	0.36%	5.7%	7.1%	9.1%	12.4%	15.6%	12.9%	6.1%	0.0%
JNJ	0.08%	24.6%	23.4%	15.2%	6.1%	0.0%	0.0%	0.0%	0.0%
JPM	0.35%	4.1%	4.6%	3.3%	2.9%	0.0%	0.0%	0.0%	0.0%
MRC	0.15%	12.8%	12.4%	12.6%	14.0%	13.6%	5.5%	0.0%	0.0%
MSFT	0.46%	2.9%	7.9%	6.3%	4.9%	6.1%	7.3%	6.5%	2.4%
TRV	0.33%	4.9%	4.1%	8.4%	7.8%	7.9%	7.1%	2.7%	0.0%
UNH	0.33%	10.3%	12.4%	14.7%	15.6%	16.7%	16.2%	15.7%	6.1%
V	0.27%	3.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
WMT	0.39%	0.0%	0.0%	0.0%	0.0%	0.0%	3.0%	6.0%	6.8%

Source: Author's own calculations

Table 3 Efficient portfolios without considering the environmental condition

	Wine	P1	P2	P3	P4	P5	P6	P7	P8
AAPL	0.56%	0.0%	1.1%	3.6%	7.4%	13.5%	21.0%	35.5%	59.1%
AXP	0.50%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	7.4%	3.7%
CAT	0.48%	1.3%	2.5%	3.5%	4.2%	6.8%	8.1%	18.1%	24.8%
CRM	0.42%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CVX	0.26%	2.8%	2.6%	2.4%	1.6%	0.0%	0.0%	0.0%	0.0%
DIS	-0.01%	2.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
GS	0.50%	0.0%	0.0%	0.0%	0.0%	2.3%	5.0%	0.0%	2.7%
IBM	0.36%	5.6%	9.4%	11.7%	13.2%	13.5%	12.6%	0.0%	0.0%
JNJ	0.08%	10.8%	5.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
JPM	0.35%	0.0%	2.6%	3.5%	4.3%	4.1%	0.0%	0.0%	0.0%
KO	0.16%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MCD	0.23%	15.4%	10.9%	10.1%	7.1%	0.3%	0.0%	0.0%	0.0%
MMM	0.10%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MRC	0.15%	10.5%	8.1%	12.1%	11.5%	8.6%	0.0%	0.0%	0.0%
MSFT	0.46%	12.4%	12.0%	10.7%	13.4%	10.0%	8.3%	7.7%	0.0%
PG	0.20%	14.8%	15.1%	10.2%	3.1%	0.0%	0.0%	0.0%	0.0%
UNH	0.33%	2.1%	3.3%	4.5%	3.0%	1.7%	1.8%	0.0%	0.0%
VZ	-0.01%	6.9%	6.7%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%
WMT	0.39%	15.2%	20.2%	25.4%	31.3%	39.2%	42.6%	31.4%	9.7%

Source: Author's calculations

In both cases, the following actions occurred: AAPL, AXP, DIS, GS, IBM, JNJ, JPM, MRK, MSFT, UNH, and WMT. In contrast to the portfolio without considering the environmental criterion, where the main weight is on AAPL and WMT, when the criterion is considered, the main weight is shifted to AAPL due to its low environmental indicator value (0.5). The calculated weight values of the considered stocks $w_j (j=1,2,...,n)$, with (or without) the application of the environmental aspect, can again provide the investor with the basis on which to determine his own strategy for creating the portfolio.

4. CONCLUSION

The paper focuses on the analysis of the impact of incorporating environmental criteria into the portfolio selection model. The environmental constraint was implemented through a structural constraint that sets a maximum value of the weighted average of the portfolio's environmental score at the boundary between the first and second quartile.

An analysis of the Dow Jones Industrial Average (DJIA) stock index compared the differences between portfolios constructed with and without the environmental constraint to assess the impact of environmental criteria on portfolio performance.

The results of the analysis on the Dow Jones Industrial Average (DJIA) stock index showed that the consideration of environmental criteria influences the selection of assets in the portfolio and its resulting performance. Key findings include:

Higher portfolio riskiness—The inclusion of the environmental factor led to an increase in the semi-absolute deviation, indicating a higher portfolio risk compared to portfolios without this constraint.

Changing asset weights: Companies with lower environmental scores received a higher representation in the optimised portfolio, while the overall investment structure also changed.

Based on these findings, it can be concluded that environmental factors play a significant role in portfolio selection. Their inclusion may lead to a change in an investment's risk-return profile, but at the same time, it provides investors with the opportunity to allocate capital to more sustainable assets.

The analyzed problem of extending the portfolio selection model using absolute deviation with an environmental indicator (E) and its impact on the increase in risk at the minimum return set by the investor determined the structure of the paper. After formulating the problem, the first part of the paper presents the essence of the portfolio selection model, which is based on a measure of risk measured by the semi-absolute deviation. In contrast, this model is extended to include the environmental condition of the investment. In the third part of the paper, an analysis is carried out by applying the presented model to the assets of the DJIA stock index (Dow Jones Industrial Average) in order to investigate the impact of considering the environmental criteria on the riskiness of the computed portfolio. The performed calculations show an increase in risk when the environmental condition is considered, i.e. whether the additional environmental criterion significantly affects the risk-return ratio. They show that, at the minimum return set by the investor (E_p), the difference between the risk when considering the considered environmental indicator E and without considering it decreases as its value increases (Table 1).

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THE ROLE OF DIGITAL TECHNOLOGIES IN THE DEVELOPMENT OF CORPORATE WELL-BEING SYSTEMS IN SMALL AND MEDIUM-SIZED ENTERPRISES OPERATING IN THE SOUTHERN TRANS-DANUBIAN REGION OF HUNGARY

Abstract

The application of digital technologies within corporate frameworks is becoming increasingly indispensable in the modern business environment, serving as a competitive factor in enhancing organizational operational efficiency. Digital technologies, which permeate various aspects of organizational operations, now play a central role in the development of HR and related corporate well-being systems. This study aims to highlight the role and significance of artificial intelligence and digitalization in the evolution of corporate well-being systems integrated with HR systems, as well as in improving their effectiveness.

The exploratory, cross-sectional pilot study conducted in the Southern Transdanubian Region of Hungary examines 100 organizations classified as small and medium-sized enterprises (SMEs) based on employee headcount. Our research hypothesis posits that a strong correlation can be demonstrated between the successful implementation of digitally supported corporate well-being systems and increased operational efficiency in SMEs.

Corporate well-being systems aim to preserve employees' physical and mental health, improve their quality of life, and thereby enhance their adaptability, job satisfaction, and productivity. HR-integrated, digitally supported corporate well-being systems contribute to reduced labor costs and increased work efficiency, which manifests in higher productivity. Both artificial intelligence and modern cloud-based solutions facilitate the optimization of human resource strategies in practice and the integration of corporate processes.

The ideal relationship between digitalization and corporate well-being systems enables the automation of workflows and the reduction of workload. The continuous expansion of artificial intelligence and digitalization is expected to further strengthen this relationship. By adopting integrated and digitalized corporate well-being systems, SMEs can gain a competitive advantage through the optimal utilization of human resources, improved workforce efficiency and adaptability, and the long-term retention of valuable employees.

In Hungary, 65.5% of the working-age population is employed in the SME sector (KSH, 2023). In the Southern Transdanubian Region (comprising Baranya, Somogy, and Tolna counties), 7.69% of Hungarian SMEs operate.

Keywords: digitalization, corporate well-being, HR strategy, SME sector

1. INTRODUCTION

The significance of SMEs in Hungary's economy is underscored by the fact that they accounted for 99% of all enterprises, employed 65.5% of the working-age population, and represented 55% of net revenue and gross value added in 2023 (KSH, 2023). However, the productivity of Hungarian SMEs remains below the EU average, partly due to the limited adoption of innovations (such as digitalization, new technologies, and green solutions) in this sector. Among

Hungarian SMEs, the fewest operate in Southern Transdanubia (Baranya, Somogy, and Tolna counties, 7.69%) and Northern Hungary (Borsod-Abaúj-Zemplén, Heves, and Nógrád counties, 7.58%). Micro-enterprises employ 26% of Hungary's workforce, small enterprises 22%, and medium-sized enterprises 17% (KSH, 2024). The COVID-19 pandemic, the necessity of transitioning to digital technologies, and the emergence of artificial intelligence (AI) have significantly impacted the labor market, presenting new challenges for social and economic actors. These external challenges have raised critical issues in corporate management, particularly in SMEs and their human resource (HR) practices. The changing demands affecting both the labor market and internal organizational environments have manifested in:

- The need for flexible workplaces,
- The shift toward 21st-century work models,
- The adoption of AI and digital transformation,
- and the growing necessity of well-being initiatives.

A corporate well-being system (or workplace well-being program) refers to a set of measures and initiatives implemented by an organization to improve employees' physical, mental, and emotional well-being. These initiatives aim to enhance job satisfaction and employee commitment while reducing workplace stress and related health issues (Diener et al., 1999). By improving employees' quality of life, workplace well-being systems can boost work efficiency, productivity, and long-term retention of valuable talent. Such systems may include:

- Preventive health screenings,
- Medical check-ups,
- Health insurance, and
- Wellness programs promoting a healthy lifestyle.

Our study aims to highlight the role and significance of AI and digitalization in the development of corporate well-being systems, based on an exploratory pilot study conducted in Hungary's Southern Transdanubian Region. Available data suggest that HR-integrated corporate well-being systems are crucial in addressing contemporary challenges. Integrated platforms and real-time data enable companies to respond swiftly and flexibly to changes, reduce stress, and improve communication between employees and employers—contributing to a better work environment (Eurofound, 2024). AI-driven personalized programs use machine learning and real-time data to tailor interventions to individual needs. Virtual support provides mental health and well-being services for remote workers, which is essential in the era of telework. In summary, integrating corporate well-being systems with digitalization and AI presents significant business opportunities. Technological advancements and integrated interfaces can enhance efficiency, productivity, and employee well-being simultaneously.

2. HOW CAN WE MEASURE CORPORATE WELL-BEING?

Employee well-being is a prominent area of organizational assessment, yet the definition of the concept remains debated among researchers (Diener et al., 1999; Forgeard et al., 2011; Keyes et al., 2002). While there is no precise and comprehensive definition, it is generally agreed that employee well-being is determined by a combination of physical and psychological factors. According to Warr (1999), the foundation of employee well-being lies in positive emotional engagement related to work, encompassing all work-related factors (Gelencsér et al., 2022).

Several methods and tools are available for measuring corporate well-being, including:

- **Employee Surveys and Feedback:** Regular surveys and questionnaires help assess employees' mental well-being, stress levels, work-life balance, and access to support mechanisms. Anonymous surveys can encourage honest feedback.
- **Absenteeism and Turnover Rates:** Changes in absenteeism and turnover rates indicate mental and other well-being issues within the workforce. These metrics may reflect workplace stress or inadequate operational conditions (Komáromi, 2023).
- **Performance Metrics:** Employee performance also reflects mental well-being. Regular performance evaluations and open communication help identify challenges (Parsakia et al., 2024).
- **Sickness Rates and Absence Reasons:** The frequency of illnesses and reasons for employee absences are important indicators of well-being (Parsakia et al., 2024).
- **Psychometric Tools:** Reports from validated psychometric tools serve as an ideal starting point for measuring corporate well-being.
- **Gallup Surveys:** Gallup research emphasizes five elements of life satisfaction: career, community, relationships, financial stability, and physical health. The Cantril Self-Anchoring Striving Scale* is particularly useful for measuring employees' current and projected future well-being (Gelencsér et al., 2022).

- Workplace Well-Being Indices and Applications: According to Deloitte research, an increasing number of companies are adopting new technological solutions to measure and enhance workplace well-being. (Komáromi, 2023):

The measurement approaches used in this field so far can be summarized based on the systematic literature review conducted by the author trio Gelencsér, Végvári, & Szabó-Szentgróti (Gelencsér et al., 2022), as presented in the table below:

Table 1. - measurement approaches

Measurement Methods by Reference and Factor		
Reference	Factor	Measurement Methods
Ko (2021)	Organizational social capital	Organizational Social Capital Scale based on Moon (2011)
	Workplace quality of life	16-item measurement tool based on Sirgy et al. (2001)
	Subjective well-being	3 global single-item measures for life satisfaction, happiness, and workplace QoL
	Organizational commitment	5-item scale based on Allen & Meyer (1990) and Mowday et al. (1979)
	Turnover intention	2-item scale based on Huang et al. (2007) and Campbell & Im (2016)
Koon & Ho (2021)	Authentic leadership	16-item scale based on Neider & Schriesheim (2011)
	Employee well-being	3 dimensions: life/job satisfaction, psychological well-being
	Employee commitment	6-item scale based on Schaufeli et al. (2002)
	Empowering leadership	12-item scale by Zhang & Bartol (2010), adapted from Ahearne et al. (2005)
Kim & Beehr (2018)	Job crafting	15-item scale based on Tims et al. (2012)
	Physical complaints	12-item Physical Symptoms Inventory (Spector & Jex, 1998)
	Depression	3-item short version of Mohr's (1986) scale (Dormann & Zapf, 2002)
	Career satisfaction	5-item scale based on Greenhaus et al. (1990)
	Career commitment	5-item scale based on Ellemers et al. (1998)
Wahab et al. (2021)	High-commitment work systems	Scale by Sing (2004)
	Corporate performance	Based on Gates & Langevin (2010)
	Burnout	Maslach Burnout Inventory (Maslach et al., 1996)
	Well-being	General Health Questionnaire (Cheung, 2002)
	Organizational support	Based on Hayman (2009)
	Employee effort	Based on Brown & Leigh (1996) and McClean & Collins (2011)
	Social desirability	Based on Crowne & Marlowe (1960)
Bosle et al. (2021)	Mental well-being	WHO Well-Being Questionnaire (1998)
	Workplace commitment	9-item Utrecht Work Engagement Scale (Schaufeli & Bakker, 2004)
Kundi et al. (2021)	Hedonic well-being	5-item scale based on Diener et al. (1985)
	Eudaimonic well-being	21-item scale based on Waterman et al. (2010)
	Affective commitment	6-item scale based on Allen & Meyer (1990)
	Job insecurity	5-item scale based on Chirumbolo et al. (2015)
	Employee performance	7-item scale based on Williams & Anderson (1991)
Lee et al. (2020)	Employee well-being HR attribution	5-item scale based on Nishii et al. (2008)
	External turnover intention	Scale by Wayne et al. (1997)
	Internal turnover	Job change intention scale (Cammann et al., 1983; Van

	intention	Veldhoven & Meijman, 1994)
	Task-related factors	Based on Rosen, Slater, Chang

Source: Gelencsér et al., 2022

3. THE IMPACT OF DIGITALIZATION ON CORPORATE WELL-BEING

The rapid expansion of digital technologies is fundamentally transforming workplace dynamics while creating new challenges and opportunities in the field of corporate well-being. Recent research clearly demonstrates that digitalization initiates a complex system of effects, where the interplay between technological advancements and human factors determines organizational performance and employee satisfaction (Zhan & Xie, 2025; Trennery et al., 2021).

3.1 Digitalization as a Double-Edged Sword for the Labor Market

According to the latest research findings (Zhan & Xie, 2025), workplace digitalization exhibits both positive and negative effects on corporate well-being.

3.1.1 Positive Effects:

- Increased productivity (35% more likely to be perceived positively).
- Greater autonomy (digital tools increase decision-making freedom by 27%).
- Flexible work arrangements (64% reduction in the feeling of being location-bound).
- Enhanced collaboration (cloud-based platforms improve teamwork by 41%).

3.1.2 Negative Effects:

- Increased time pressure (22% higher perceived stress).
- Disrupted work-life balance (17% deterioration).
- Digital skills gap (low digital literacy increases frustration by 39%..

Research led by Zhan and colleagues in China identifies key factors influencing the success of digital transition (Table 2), revealing fundamental correlations (Zhan & Xie, 2025).

Table 2: Three key factors determine the success of digital transformation

Factors Influencing Well-Being and Digital Transformation Success		
Factor	Effect on Well-Being	Moderator Variable
Perceived threat	+0.41 (positive correlation)	Digital literacy
Technology acceptance	-0.29 (correlation)	Leadership support
Technology acceptance	+0.37	Training opportunities

Source: Zhan & Xie, 2025

Relevant studies clearly show that employees with higher digital literacy are 2.3 times more likely to perceive digitalization as an opportunity rather than a threat (Trennery et al., 2021).

3.4 Addressing Challenges: Developing Resilience Strategies

Post-pandemic research proposes various approaches to managing these challenges. One of the most critical intervention areas is digital skills development. Differentiated training interventions yield varying effectiveness:

- Adaptive training programs show a 70% increase in effectiveness.
- Peer-learning and community-based platforms reduce the learning curve by 56% (Trennery et al., 2021).

Additionally, digitalization has significantly altered workplace design requirements. Future-oriented solutions such as intelligent ergonomic systems (e.g., AI-driven posture optimization) will play a key role (Hammed et al., 2022). A timely transformation of leadership culture can enable the implementation of real-time feedback systems, which, according to a 2021 study, ensure 57% faster problem-solving (Trennery et al., 2021).

4. METHODS

4.1 Literature Review

In conducting this research, we employed an accelerated literature review and analysis using relevant keywords. We examined topic-specific academic sources available in major international databases, including **Scopus**, Web of Science, Google Scholar, PubMed, Embase, and ResearchGate. The search focused on key terms related to workplace well-being, such as:

- Workplace health promotion and maintenance
- Health awareness
- Quality of work life
- Digitalization and artificial intelligence
- Change, crisis, and resilience

The collected publications were categorized by keywords to create a **relevant database** encompassing Hungarian and English-language literature from the past 15 years, including related research findings. The systematic literature review conducted by **Gelencsér, Végvári, & Szabó-Szentgróti** provided significant support in processing the academic material.

4.2 Applied Research Methodology

4.2.1. Sampling

The study sample consisted of small and medium-sized enterprises (SMEs) operating in Hungary's Southern Transdanubian Region (Baranya, Somogy, and Tolna counties). To determine the appropriate sample size, we used GPower 3.1 software, which calculated a required sample of 100 enterprises for 95% accuracy with a 5% margin of error. GPower is a free, widely used tool for statistical power analysis, supporting t-tests, F-tests, χ^2 -tests, z-tests, and exact tests, while also enabling effect size calculations and graphical representation of results.

Sample Demographics:

- SMEs with 10–249 employees were included.
- Micro-enterprises (<10 employees) were excluded due to limited applicability of well-being systems.
- Large enterprises (>250 employees) were excluded due to fundamentally different operational and financial structures compared to SMEs.

Regional Justification: Southern Transdanubia is classified as a NUTS-2 region under the EU statistical system (Eurostat). Comprising Baranya, Somogy, and Tolna counties, it is considered a less-developed region, with per capita GDP below 75% of the EU average. This designation makes the area eligible for EU cohesion funds, supporting practical implementation of research findings. Since most Hungarian regions (except Central Hungary) fall under NUTS-2, the methodology can be standardized for national and EU-wide comparisons.

4.2.2. Data Collection and Processing

Research on corporate well-being systems typically employs a mixed-methods approach to understand their significance, practical application, and impacts (Forgeard et al., 2011).

Quantitative Research:

- Online surveys collected data from employees to assess workplace conditions and well-being factors.
- Financial and operational data were analyzed to evaluate the return on well-being investments.

Qualitative Research:

- Semi-structured interviews with managers and employees explored factors influencing corporate well-being and underlying relationships.

Data Analysis:

- 100 questionnaires and 100 managerial interviews were selected for statistical processing (SPSS 28.0, Microsoft Excel 2018, JASP).
- Descriptive statistics (mean, median, mode, SD) were complemented by:
- Correlation matrices (to examine variable relationships)
- T-tests and chi-square tests (for group comparisons)

The cross-sectional study integrated survey data, interview insights, case studies, and document analysis to provide a comprehensive understanding of corporate well-being practices in Southern Transdanubian SMEs.

4.2.3. Research questions

The research strongly focuses on the current challenges and opportunities affecting HR strategy and well-being measures in the internal environment of SMEs due to digitalization, which are becoming increasingly available and applicable year by year at lower costs. The research questions are as follows:

Q1: What well-being systems and measures can be identified in SMEs operating in the South Transdanubian Region?

Q2: To what extent are the well-being systems operating in SMEs in the South Transdanubian Region integrated into the HR strategy and system?

Q3: What factors influence the development and operation of well-being systems applied among the examined SMEs?

Q4: Along what goals, functions, and activities, and for which employee target groups do the well-being systems applied among the examined SMEs operate? Do the examined corporate well-being systems include measures implemented using various methods and tools, including digital ones, that support disease prevention, health maintenance, and health promotion?

Q5: Which of the applied well-being tools, solutions, and measures are operating or capable of operating on digital foundations?

5. CURENT RESEARCH RESULTS

Preliminary interviews with business leaders have clearly demonstrated that one fundamental tool for responding to the challenges posed by external environmental pressures, which permeate the internal environment of businesses and create a need for adaptation, could be the development and practical application of an integrated HR strategy that includes workplace well-being. Research conducted in similar fields (Trennery et al., 2021) unequivocally highlights that, in the future, the symbiosis of digital tools and human factors can be defined as the key to corporate competitiveness. According to the findings of a 2025 Chinese study (Zhan, X. & Xie, S., 2025), organizations that achieve lasting results are those that simultaneously apply technological advancements alongside programs aimed at enhancing employee resilience. The integrated management of digitalization and corporate well-being not only provides a competitive advantage but will also become a fundamental prerequisite for sustainable business growth in the next decade (Trennery et al., 2021). Following accelerated literature processing, measurement tools (including interview questionnaires and online surveys) were developed and tested. After defining the sample, contact was established with employers. The investigation is strategically supported by the National Association of Entrepreneurs, which facilitates communication with the businesses involved in the study. The ethical approval process required for the research is currently underway.

6. CONCLUSIONS

The expanding digitalization across various work areas has become a fundamental driving force and competitiveness factor in modern business life. The 21st-century work forms clearly rely on the use of modern digitalization technologies, which are well reflected in hybrid and remote work arrangements (Sztrakay, 2022). For this reason, it is crucial to select the most suitable hardware and software for work purposes. This involves considering what employees need to perform their jobs effectively. It is also important that the introduction of technology be preceded by careful consideration and strategy. This allows for achieving the right balance between technology use and human relationships with colleagues. The examination of this topic in Hungary can provide novel scientific results. Continuous development of technology, including ongoing training for employees and leaders, is essential for meeting current challenges and future expectations (Gelencsér et al., 2022, p. 49).

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Estimation of Risk Spillovers Between Russian Financial Markets in the 2022-2023 Sanctions Period by Wavelet Coherence Analysis

Abstract: This paper investigates the impact of European Union sanctions on Russian economy during 2022–2023, with a focus on the oil and gas sector. Given the limited availability of Russian macroeconomic data, financial markets serve as key indicators of economic responses to sanctions. Utilizing wavelet coherence analysis (WCA), this study examines contagion effects between the Russian stock market, government bond market, and foreign exchange market to identify vulnerability and transmission of uncertainty. Unlike traditional econometric models such as GARCH, WCA captures the time-varying nature and statistical significance of co-movements between markets across different time horizons, offering a nuanced perspective on short- and medium-term dynamics. The findings reveal that the sixth EU sanctions package in mid-2022 triggered short-term volatility spillovers from the bond market to both equities and the exchange rate. A more complex pattern emerged in autumn 2022, where coherence between equity and debt markets intensified, though it remains difficult to disentangle the effects of the eighth sanctions package from concurrent political developments. In early 2023, the oil price cap introduced renewed volatility, primarily transmitted from the foreign exchange market to the bond and equity markets within days. However, by the end of 2023, markets showed signs of stabilization, suggesting a degree of adaptation by the Russian economy. This study highlights the evolving nature of sanctions' impact and the effectiveness of WCA in tracing financial contagion in turbulent geopolitical contexts.

Keywords: financial markets, wavelet coherence, economic sanctions, Russia

1. INTRODUCTION

The Russian economy has faced international sanctions since 2014, with the most stringent measures imposed by the United States and the European Union since 2022. These measures vary in effectiveness, causing different levels of economic disruption.

While the overall economy has remained stable, key export sectors, particularly oil and gas, have faced short-term adverse effects. Due to restricted access to trade and macroeconomic data, movements in the Russian stock market serve as an indicator of these effects, reflecting traders' reactions. As more data becomes available, medium-term market responses can be analyzed.

As negotiations may progress, the question of lifting or tightening sanctions will arise. Both sides of the sanctions conflict need to understand which sanctions have caused the most damage. Assessing the impact of economic events requires identifying the financial markets most affected, as these markets propagate risk and uncertainty to others.

To estimate risk transfer during negative shocks, researchers typically use the generalized autoregressive conditional heteroskedasticity (GARCH) family of models (Syriopoulos et al., 2015; Afanasyev et al., 2021; Fedorova et al., 2024). However, GARCH models either fail to show the direction of shock transmission in univariate models or require estimation of multiple parameters with unclear interpretations (Aganin & Peresetsky, 2018). Wavelet Coherence Analysis (WCA), introduced by Torrence and Compo (1998), addresses these issues. Initially applied in physics, WCA detects significant shocks in the relationship between two time series and assesses the persistence of their correlation. Applied to sanctions, WCA allows for the analysis of contagion effects across markets over various time horizons, including the medium term. Unlike regression analysis, WCA reveals insights into the relationships between different components of time series, differentiating short- and medium-term responses.

Unlike GARCH models, WCA captures the time-varying dynamics of correlation and its statistical significance at any point in time. This method is widely used to evaluate the economic consequences of prolonged adverse events on financial markets, such as the impact of COVID-19 (Szczzygielski et al., 2023), economic sanctions on Iran (Samadi et al., 2021; Omid et al., 2021), and sanctions on Russia (Panazan & Gheorghe, 2024).

This study uses WCA to examine Russian financial markets from 2022 to 2023 and identify the most vulnerable sectors. After determining the leading market, contagion effects will be analyzed through uncertainty spillovers, with the strongest shifts in variable coherence indicating the most severe effects of sanctions. The strongest shifts in variable coherence are expected to indicate the most severe effects of sanctions imposed by the European Union, Russia's former main trading partner.

2. METHODOLOGY

Financial market contagion refers to the abnormal transfer of uncertainty between markets. Volatility is commonly used as a measure of risk or uncertainty in financial market literature. There are several methods to estimate the volatility of returns, with the non-parametric realized volatility method being one of the simplest to compute. Despite its simplicity, the realized volatility method provides reliable results for the Russian market, yielding values comparable to those from other parametric methods (Aganin & Peresetsky, 2018). Realized volatility is defined as the squared return for each index's return:

$$V_{i,t} = R_{i,t}^2 \quad (1)$$

where:

$R_{i,t}$ is the logarithmic return of the i index.

The Continuous Wavelet Transform (CWT) decomposes a time series into time-frequency space using a "mother wavelet." CWT projects the series onto wavelets of different scales and positions, revealing how volatility behaves across various time horizons. The main equation of the CWT is given by equation (1):

$$W_x(s, \tau) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \psi^* \left(\frac{t-\tau}{s} \right) dt \quad (2)$$

where:

$W_x(s, \tau)$ is the wavelet coefficient at scale s and time τ ;

$x(t)$ is the time series (volatility of an index);

$\frac{1}{\sqrt{s}}$ is the normalizing agent;

$\psi(t)$ is the mother wavelet. For financial analysis, the Morlet wavelet is commonly used (Szczzygielski et al., 2022) because it balances time and frequency resolution;

s is the time scale, related to frequency or time horizon, e.g., 2, 4, 8... days;

τ is the time position, or the shift of the wavelet along the series.

The Morlet wavelet, a wave-like function modulated by a Gaussian, is defined as:

$$\psi(t) = \pi^{-1/4} e^{i\omega_0 t} e^{-t^2/2} \quad (3)$$

where:

ω_0 is the central non-dimensional frequency, set to 6 for optimal time-frequency localization (Farge, 1992).

The CWT can be computed efficiently using the Fast Fourier Transform (FFT), which is computationally faster than direct integration. The FFT accelerates the process by converting the convolution into a multiplication in the frequency domain:

$$W_x(s, \tau) = \mathcal{F}^{-1} [\mathcal{F}(x(t)) \mathcal{F}(\psi(s, t))] \quad (4)$$

where:

$\mathcal{F}$ and $\mathcal{F}^{-1}$ are the Fourier Transform and Inverse Fourier Transform, respectively.

By implementing equation (2) and applying the FFT through equation (4) to both volatility series for each pair of indices, we can obtain the Cross-Wavelet Spectrum to examine the relationship between each pair of indices:

$$W_{xy}(s, \tau) = W_x(s, \tau) W_y^*(s, \tau) \quad (5)$$

where:

$W_{xy}(s, \tau)$ is the cross-wavelet transform;

W_x, W_y are the CWTs of the two time series (volatilities of the indices);

W_y^* is the complex conjugate of W_y .

The Cross-Wavelet Spectrum measures the joint power (magnitude) and phase (direction) of the two volatilities at each scale and time.

Wavelet Coherence (WTC) normalizes the cross-wavelet power to quantify the strength of the relationship between the two time series. It is calculated as follows:

$$R^2(s, \tau) = \frac{|S(s^{-1}W_{xy}(s, \tau))|^2}{S(s^{-1}|W_x(s, \tau)|^2)S(s^{-1}|W_y(s, \tau)|^2)} \quad (6)$$

where:

$R^2(s, \tau)$ is the wavelet coherence, ranging from 0 (no coherence) to 1 (perfect coherence);

S is the smoothing operator (which averages over time and scale to reduce noise), ensuring that the result is not overly noisy;

$|W_x|^2, |W_y|^2$ are the wavelet power spectra of each series;

$|S(W_{xy})|^2$ is the smoothed cross-wavelet power.

WTC measures the co-movement of two time series in the time-frequency domain. WTC can be viewed as a correlation coefficient in linear regressions, but it operates at different frequencies. If $R^2(s, \tau)$ is high at a particular scale s , the two indices exhibit strong co-movement at that time horizon. Therefore, WTC illustrates how closely the volatilities of two indices align at a given time and scale.

In Wavelet Coherence Analysis (WCA), the phase difference helps determine whether one financial variable leads or lags another at a given time scale. The phase angle from $W_{xy}(s, \tau)$ reveals the lead-lag relationship. It is computed as:

$$\phi(s, \tau) = \tan^{-1} \left(\frac{\Im(S(W_{xy}(s, \tau)))}{\Re(S(W_{xy}(s, \tau)))} \right) \quad (7)$$

where:

$\phi(s, \tau)$ is the phase difference at scale and time;

$\Im, \Re$ are the real and imaginary parts, respectively.

The phase difference can be interpreted by the following angles:

- $\phi = 0$, In-phase: both indices volatilities move together at a time scale;
- $\phi = \pi$, Anti-phase: the volatilities move in opposite directions;
- $\phi = -\pi/2$, Lagging indicator: the first index lags behind the second;
- $\phi = \pi/2$, Leading indicator: the first index leads the second;

The hypothesis of the research is that high coherence with a phase lag might indicate the spillover of risk from one market to another. Changes in coherence over time could reflect the impact of sanctions on the risk level of the Russian financial markets.

The computation code is written in the Python programming language with the help of the Krieger & Freij (2023) package.

3. DATA

The study examines contagion effects in three markets: the equity market, the government bond market, and the foreign exchange market. The returns of the Moscow Exchange Oil & Gas Sectoral Index (MOEXOG) are used to represent the equity market. This is motivated by the fact that companies in the oil and gas industry account for approximately half of the total weight of the main Russian stock exchange index, the RTSI¹. Furthermore, the oil and gas industry, along with the financial sector, was the primary sector affected by sanctions. The yield of the Moscow Exchange Government Bond Index (RGBITR), which reflects the Russian government bond market (Moscow Stock Exchange, 2025), is used to represent the government bond market. The yield of the USD/RUB currency pair is used to represent the currency market. Given the multitude of sanctions imposed on Russia, it is appropriate to limit the sample of sanction events. This study considers only those sanctions from the EU that were targeted at the oil and gas industry (Bown, 2023) and that have demonstrated significance through event-driven analysis (Chernykh, 2024). The list of sanctions is presented in Table 1.

Table 1: List of sanction events imposed by the EU on Russia's oil and gas industry

	Announcement date	Event description
(1)	03 June, 2022	6 th package: imposition of sanctions
(2)	02 September, 2022	8 th package: announcement of the oil price ceiling
(3)	06 October, 2022	8 th package: imposition of sanctions

¹ Moscow Exchange Indices: RTS Index. <https://www.moex.com/en/index/RTSI/constituents>

(4)	05 December, 2022	8 th package: setting of the price ceiling for Russian crude oil of \$60
(5)	04 February, 2023	8 th package: setting of the price ceiling for Russian oil products
(6)	23 June, 2023	11 th package: ban on servicing Russian oil tankers in third countries
(7)	18 December, 2023	12 th package: enforcement of the oil price cap

Source: Bown, 2023.

The sample of sanction events excludes those imposed before March 28, 2022, due to the suspension of trading on the Moscow Exchange.

Table 2 presents the descriptive statistics for the returns of the three financial variables.

Table 2: Descriptive statistics of financial variable returns

	MOEXOG			RGBITR			USD/RUB		
Year	2021	2022	2023	2021	2022	2023	2021	2022	2023
Count	242	190	246	242	190	246	242	190	246
Mean, %	0.04	-0.06	0.18	-0.02	0.13	0.00	0.00	-0.06	0.08
Std, %	1.20	2.01	0.93	0.25	0.65	0.24	0.54	1.91	0.78
Minimum, %	-3.69	-8.72	-2.70	-0.86	-2.18	-1.00	-2.05	-8.26	-3.65
Maximum, %	3.32	7.13	3.68	1.01	4.24	1.07	1.86	9.73	2.84

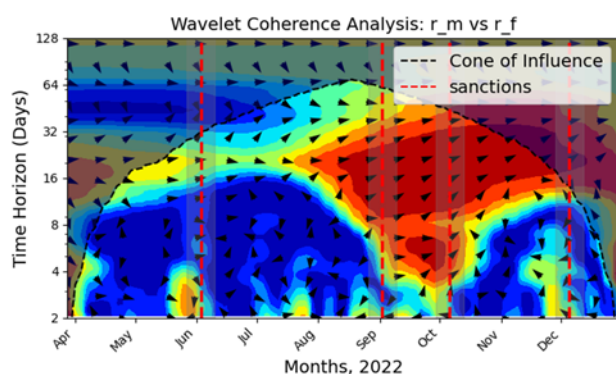
Source: Calculated by the author.

The sampling for 2022 begins on March 28, resulting in only 190 observations for that year. The average value of stock market returns becomes negative at the onset of the sanctions period but returns to a positive value in 2023. The foreign exchange market exhibits a similar pattern in its mean. For the bond market, the rebound occurs as early as 2022. Regarding the standard deviation, which serves as a proxy for risk, the peak values also occur in 2022. Risk decreases in 2023: for both the stock and bond markets, the standard deviation values in 2023 are even lower than those observed in the relatively calm year of 2021. These average returns and standard deviation values may indirectly suggest that Russian financial markets are adapting to the sanctions regime. However, more reliable conclusions require further analysis through the WCA calculations.

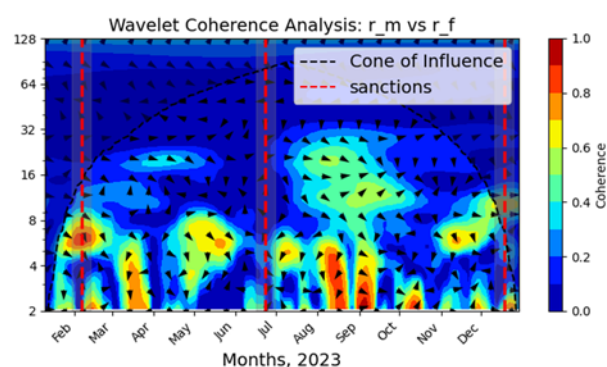
4. RESULTS

In the last relatively calm year, 2021, just before the imposition of large-scale sanctions, the main contagion effects occurred between the government bond market and the ruble exchange rate. The estimation results are presented in the Appendix (Picture A.3). Coherence reaches its peak at the end of March and continues throughout April. During this period, the Key Rate of the Bank of Russia was increased by a total of 75 basis points.

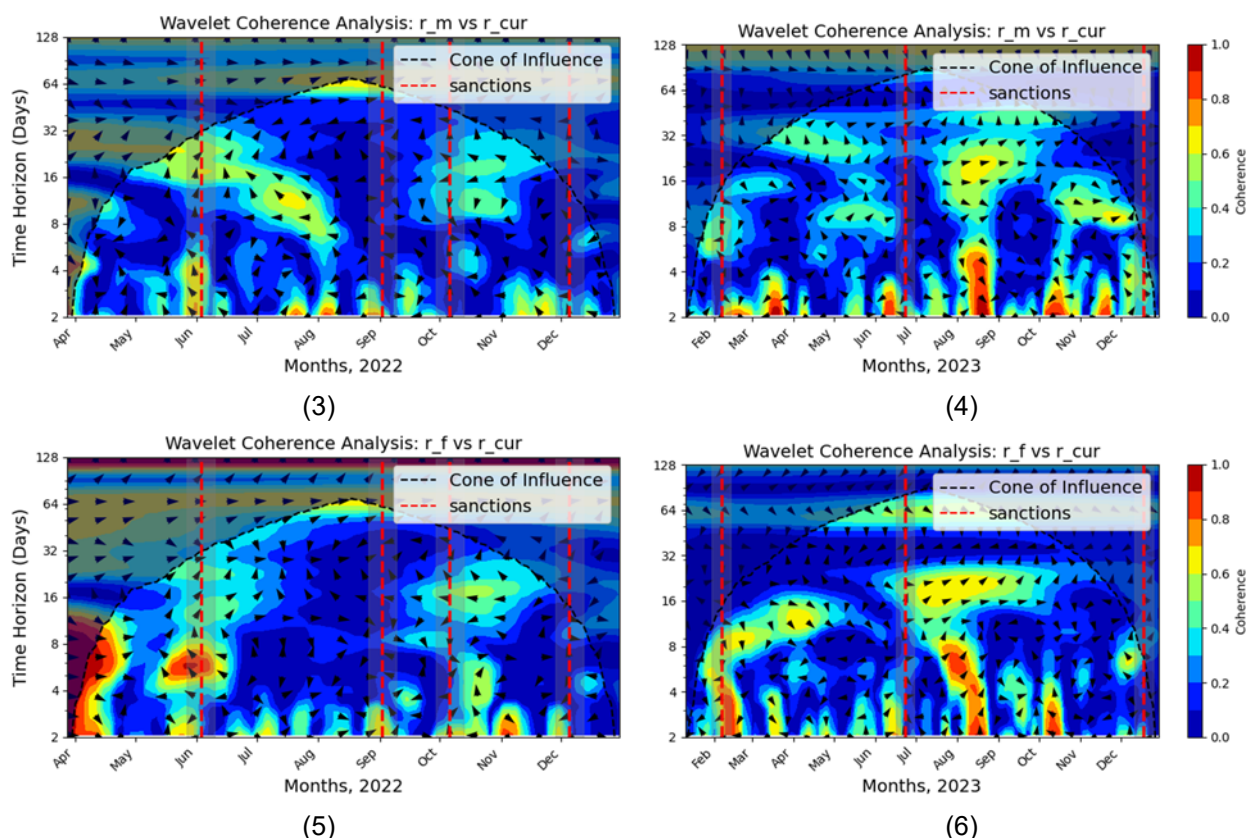
The WCA estimation results for each index pair across the two sanction years are presented in Picture 1. In contrast to 2021, as shown in the Appendix, the main contagion effects are observed between the stock market and the bond market (Picture 1.1).



(1)



(2)



Picture 1: Wavelet Coherence Analysis for each pair of index volatilities in 2022–2023 year
Source: Calculated by the author.

The coherence between the MOEXOG and RGBITR indices in 2022 reaches its maximum in late August to early September, across time horizons ranging from 8 days to 1 month (Picture 1.1). This corresponds to the boundary between short- and medium-term effects. Sanction 2 (Table 1), the announcement of sanctions within the eighth package, coincides with this time period. The arrows in this area of the spectrogram indicate a phase difference in the range $0 < \phi = \pi/4$, suggesting that contagion spreads from the stock index to the bond index with a positive relationship. Between sanctions 2 and 3 (Table 1), another reciprocal reaction of the indices is observed at the 4–6-day horizon. However, this reaction might not be economically driven. The September–October 2022 period corresponds to Ukraine's counter-offensive, which has a long-term impact that cannot be captured by the WCA method, as the area of increased dependence extends beyond the cone of influence.

In 2023, the coherence between stock and bond market volatilities decreases significantly (Picture 1.2). For the most part, the spectrogram shows no contagion effects, except for the fifth sanction event (Table 2)—the imposition of a price ceiling on petroleum products. During the fifth event window, contagion reaches 0.9 on a six-day time horizon, with contagion spreading from government bonds to oil and gas stocks.

Regarding volatility co-movements between the stock market and the exchange rate, only the window of the first sanction event shows an increase in coherence to 0.6. The directions of the phase difference arrows point upward-left, indicating that contagion spreads from the stock market to the ruble exchange rate, with the volatilities moving in opposite directions. For the subsequent sanction events, the spectrogram shows no significant contagion effects between the two financial variables.

Finally, for the pair of the bond market and the foreign exchange market in 2022, there is an increase in volatility on a 5–6-day time horizon during the first sanction event window (Picture 1.5). The angle of the arrows, $\phi \approx 3\pi/4$, suggests that bond index volatility leads currency market volatility with a negative correlation. The beginning of the observations also corresponds to a significant area of the spectrogram with increased coherence. The contagion effects between the markets arise from the onset of the military and sanctions conflicts. The arrows are horizontal and point to the right, indicating a simultaneous reaction of shocks in the two financial markets with positive coherence. However, the boundaries of the cone of influence prevent drawing medium-term conclusions from this observation period.

In the 2023 spectrogram (Picture 1.6), there is also a reaction from the bond market to the increase in ruble exchange rate volatility during the fifth sanction event. The contagion effect extends no further than a four-day time horizon.

A spike is observed in all three WCA spectrograms for mid-August 2023. This period corresponds to an increase in the Key Rate from 8.5% to 12%. The stock market is the first to react, triggering contagion that spreads to the bond market and the currency market. The ruble exchange rate reacts last of the three markets. However, this reaction is not as

pronounced as the market responses observed in pre-sanctions 2021, which may indicate that the markets are becoming accustomed to macroeconomic shocks.

5. CONCLUSION

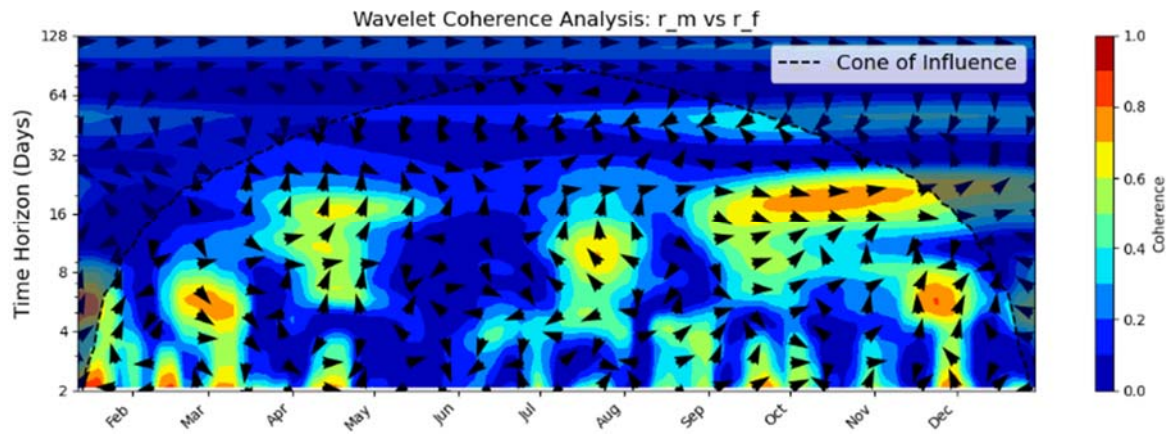
This paper examined Russian financial markets, represented by the respective indices: the stock market, the government bond market, and the foreign exchange market. Using wavelet coherence analysis, a method that has proven effective in assessing sanctions, the contagion effects between markets during the period of announcement and implementation of European Union sanctions against the Russian oil and gas sector in 2022–2023 were analyzed.

Among the sanction events analyzed, the introduction of the sixth sanctions package had a short-term impact. Over the course of a week, there were volatility spillovers from the debt market to the equity market and the exchange rate. In the fall of 2022, significant contagion effects were observed between the equity and debt markets. However, the WCA method was unable to distinguish between the effects of the announcement and implementation of sanctions under the eighth package and those of military and political events. The imposition of a price ceiling on Russian oil products in February 2023 also resulted in a transfer of volatility from the ruble exchange rate to the bond market and then to the equity market, with a duration of less than a week. Additionally, 2023 appears to be characterized by a gradual stabilization of all three Russian financial markets, suggesting that the Russian economy may be adapting to the sanctions regime.

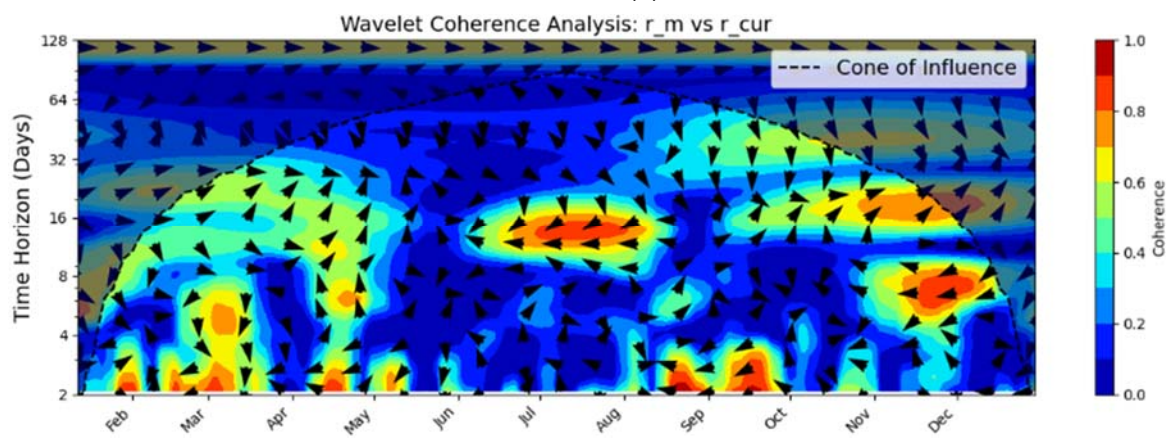
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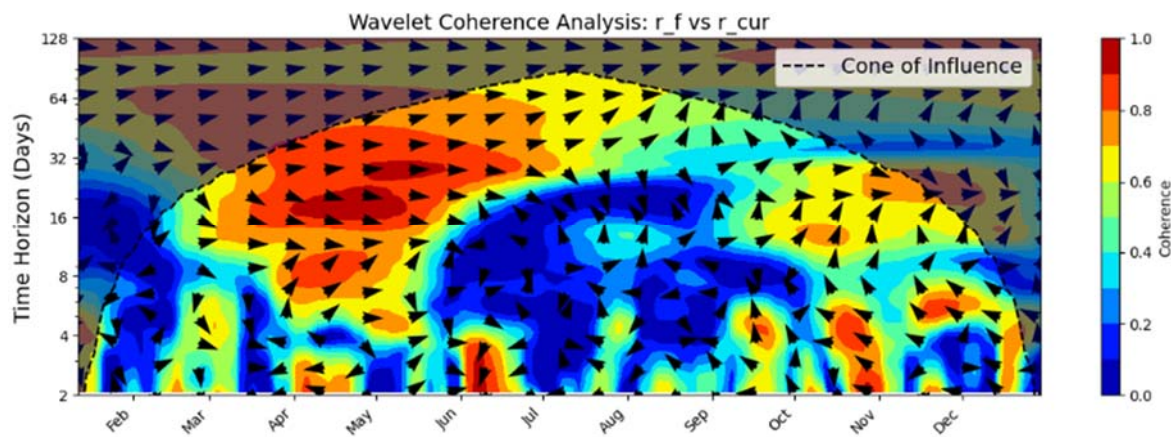
APPENDIX



(1)



(2)



(3)

Picture A: Wavelet Coherence Analysis for each pair of index volatilities in 2021
Source: Calculated by the author

Session

2



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M41, M48

NEW CATEGORIZATION OF INCOME AND EXPENSES IN THE STATEMENT OF PROFIT OR LOSS

Abstract: Investors and other users of information from financial statements demand relevance, credibility and transparency in the presentation of entity's financial statements. They are also interested in greater comparability between financial statements, both between different entities, and between financial statements of an entity from several different periods. Their requirements are recognized in the new International Financial Reporting Standard 18 - Presentation and disclosure in financial statements. The aim of the paper is to familiarize with the new approach in the presentation of the statement of profit or loss that will result after the application of the newly adopted standard starting in 2027. With the entry into force of IFRS 18, there should be an improvement in the structure of the statement of profit or loss, and improvement of the comparability of information on the entity's financial performance. The standard will also introduce new specific requirements for disclosure of management-defined performance measures, and criteria with detailed instructions for (dis)aggregation of financial statements' items. The application of the new provisions from IFRS 18 will enable entities to make their financial statements a truer picture of their operations and financial performance. In this way it will be responded to investors' demand for better information about entities' financial performance. The paper is primarily intended for theoreticians and practitioners in the field of accounting and auditing, regulatory bodies, investors, as well as for all interested parties who use information from financial statements when making business decisions.

Keywords: IFRS 18, IAS 1, financial performance, operating, financing, investing

1. INTRODUCTION

The International Accounting Standards Board (hereinafter: IASB) completed its work on improving the usefulness of information presented and published in financial statements on April 9, 2024. The result is the new standard IFRS 18 - Presentation and Disclosure in Financial Statements (hereinafter: IFRS 18) announced as the most significant change in the presentation of financial performance in the last 20 years and requires all entities applying IFRS to review the overall structure of the statement of profit or loss. The objective of IFRS 18 is to set requirements for the presentation and disclosure of information in general purpose financial statements to ensure that they provide relevant information that fairly represents the entity's assets, liabilities, equity, income and expenses (IFRS, 2024a, 1).

IFRS 18 will be effective for annual reporting periods beginning on or after 1 January 2027. Earlier application is permitted and must be disclosed in the notes to the financial statements. When it enters into force, it will replace the

currently valid IAS 1 - Presentation of financial statements (hereinafter: IAS 1). Some of the requirements from IAS 1 will be moved to IAS 8 - Accounting Policies, Changes in Accounting Estimates and Errors and to IFRS 7 - Financial Instruments: Disclosures. In order for IAS 8 to reflect the expanded content, the IASB will change its name to Basis of Preparation of Financial Statements when IFRS 18 becomes effective. Therefore, with the entry into force of the completely new IFRS 18, the amended IAS 8 with a new name will also enter into force. IFRS 18 will be applied retrospectively to comparative periods by applying the amended IAS 8. Entities will be required to restate comparative period information and disclosure reconciliations for each item shown in the statement of profit or loss for comparative periods immediately preceding the current and cumulative current periods.

The aim of the paper is to introduce the new categorization of income and expenses in the statement of profit or loss that will be introduced upon the start of the application of the newly adopted standard. The paper explains the improvements in the reporting of entities on financial performance and the improvements in the structure of the statement of profit or loss that are expected by all entities in IFRS jurisdictions all over the world starting from 2027.

2. IMPROVEMENTS IN ENTITY'S REPORTING ON FINANCIAL PERFORMANCE UNDER IFRS 18

At first glance, the new standard may seem simple, setting a new requirement for the presentation of the statement of profit or loss and providing new definitions and disclosures regarding management-defined performance measures that have so far been outside the IFRS realm. However, the details of these new requirements may lead to potential challenges that entities will need to address to properly implement the new standard and ensure a smooth transition. Entities should start preparing for the introduction of IFRS 18 well before 2027. Entities should start preparing for the introduction of IFRS 18 well before 2027. Potentially sweeping changes compared to the current IAS 1 can have a significant impact on an entity's financial statements, so preparation for the application of IFRS 18 is already considered a priority in over 100 IFRS jurisdictions worldwide. The newly adopted IFRS 18 includes very detailed technical content with almost 600 pages of text, taking into account the official materials of the IASB (Meirelles Salotii, 2024, 429).

The successful introduction of IFRS 18, as with any other new IFRS, will entail significant challenges and will lead to an increase in the entity's costs in terms of software adaptation, development of new tools, changes in key performance indicators, updating of internal procedures and information systems, as well as expenditure on training and education of employees (Milutinović, 2025, 310). However, the improvement in the quality of financial statements and other long-term benefits of applying IFRS 18 should outweigh the initial implementation costs, according to the cost constraint (IASB, 2018, 2.39-2.43) for useful financial reporting (in the other words, the benefit of providing financial information should outweigh the cost of gathering and reporting that information).

The auditing company KPMG (KPMG, 2024, 3) categorizes the changes in the new standard as a form of reshaping of the presentation of financial statements, highlighting three key requirements:

1. Changes in the structure of the statement of profit or loss: a more detailed statement (without changes in the result) that includes new categories and subtotals.
2. Management-defined performance measures are part of the audited financial statements. This will increase the credibility of some key performance indicators.
3. Improvement of requirements for information aggregation, i.e. greater disaggregation of information.

IFRS 18 by introducing three new requirements to improve entity's reporting on financial performance provides investors, primary and other users of general purpose financial statements a better basis for analyzing and comparing entities. IFRS 18 will not impact the recognition or measurement of items in the financial statements; or which items are presented in other comprehensive income or how (PWC, 2024).

Before going into the details of each of the aforementioned requirements introduced by IFRS 18, a summary of the key differences between IAS 1 and IFRS 18 will be presented in Table 1. For a comprehensive understanding of the new IFRS 18 and its implications for financial reporting, the best starting point is a comparison with the standard that will be valid until the entry into force of IFRS 18.

Table 1: Key differences between the old and new standard

Differences	IAS 1	IFRS 18
Content of the statement of profit or loss	Flexible, entities (or the legislator) can define the statement of profit or loss form themselves.	A more detailed statement of profit or loss, without changes in the result, which includes new categories (operating, financing, and investing) and mandatory subtotals.

Subtotals in the statement of profit or loss	There are no mandatory subtotals.	Two new mandatory subtotals: "operating profit or loss" and "profit or loss before financing and income taxes".
Cost overview	A function (e.g. cost of goods sold, overhead) or the nature of the cost (e.g. depreciation, earnings) could be used.	Encourages clearer classification using mandatory categories. Introduce guidance and disclosures relating to presentation of operating expenses by nature, by function or both.
Management-defined performance measures	N/A	They should be disclosed in the notes separately and with explanations. This will increase the credibility of some key performance indicators and their transparency. As they are part of the mandatory disclosures, they will be subject to audit.
Classification of interest and dividends	They can be variously classified into operating, financing or investing.	Standardized: interest expense is financing, interest income is investing.
Aggregation and disaggregation	Flexible, leads to inconsistent financial reporting.	Enhanced requirements on aggregation and disaggregation to avoid over-generalization or unnecessary detail. Primary financial statements - greater aggregation, notes - greater disaggregation of information.
Flexibility	Different formats/forms are allowed which reduces comparability.	A strict format/form ensures better comparability between entities.

Source: By author and partially modified from BD Chatterjee (2025)

Currently, there is no exact structure of the statement of profit or loss. Entities choose their own subtotals to include in this statement. They often report operating profit or loss, but the way they calculate operating profit or loss varies from entity to entity, thus reducing comparability. One IASB study of 100 entities found that over 60 reported the amount of operating profit, using at least nine different ways to calculate it (IFRS, 2024b). IFRS 18 introduces three new defined categories for income and expenses - operating, financing, and investing - to improve the structure of the statement of profit or loss and requires all entities to provide new defined subtotals, including operating profit. The improved structure and new subtotals will give investors, primary and other users of general purpose financial statements a consistent baseline for analyzing entity's financial performance and facilitate comparisons across entities (Milutinović, 2025, 312).

All items of income and expenses in the reporting period must be included in the statement of profit or loss. They should then be classified into one of five categories in the statement of profit or loss (IASB, 2024, 47):

1. Operating category,
2. Investing category,
3. Financing category,
4. Income tax category, and
5. Discontinued operations category.

The classification of items into these categories can differ depending on the main business activity of the entity (PWC, 2024).

3. IMPROVEMENTS IN THE STRUCTURE OF THE STATEMENT OF PROFIT OR LOSS

An illustration of the new statement of profit or loss structure is shown in Table 2. The first three categories are completely new. In order to eliminate potential misconceptions at the outset, it is important to point out that these new categories are not aligned with the categories from a statement of cash flows. The above categories are complemented by the requirement to present subtotals and totals for the following three categories: "operating profit or loss," "profit or loss before financing and income taxes" and "profit or loss" (Chan, 2024). All entities are required to follow the same classification requirements for the new classification of income and expenses, with some modifications for entities that invest in assets as a main business activity (such as investment entities, investment property entities and insurers) and entities that provide financing for customers as a main business activity (such as banks) (Deloitte, 2024).

Table 2: Categories in the new statement of profit or loss structure

	Categories	Statement of profit or loss structure of entities whose main business activity is not property investment or customers financing
New categories	Operating	Income X
		Operating expenses (analyzed by nature, function or both as appropriate) (X)
	New required subtotal	Operating profit or loss X
	Investing	Share of profit or loss of equity-accounted investees X
		Income from other investments X
		Interest income from cash and cash equivalents X
	New required subtotal	Profit or loss before financing and income tax X
	Financing	Interest expense on borrowings and lease liabilities (X)
		Interest expense on pension liabilities (X)
		Profit or loss before income taxes X
	Income taxes	Income taxes expense (X)
		Profit or loss from continuing operations X
	Discontinued operations	Profit or loss from discontinued operations X
		Profit or loss X

Source: Adapted from KPMG
(2024, 8)

The operating category includes all income and expenses included in the statement of profit or loss that are not classified in the investing, financing, income taxes or discontinued operations categories. In other words, the operating category is the default category that includes, but is not limited to, income and expenses from the main business activities of the entity. Income and expenses from other business activities, such as income and expenses from additional activities, are also classified in the operating category if those incomes and expenses do not meet the requirements for classification in one of the other categories. Some entities might decide that classifying some expenses by nature and other expenses by function provides the most useful structured summary of their expenses. IFRS 18 requires companies that present expenses classified by function to disclose the amount of depreciation, amortization, employee benefits, impairment losses and write-downs of inventories included in each line item in the operating category of the statement of profit or loss. This information is disclosed in the notes and provides investors with additional information about operating expenses to help them forecast future cash flows in changing economic conditions (IFRS, 2024c, 13).

The investing category includes income and expenses from:

- Investments in associated entities, unconsolidated subsidiaries and joint ventures;
- Cash and cash equivalents;
- Other assets that individually generate a return and mostly independent of other (other) resources of the entity.

Income and expenses classified in the investing category include income and expenses arising from the initial and subsequent measurement of assets, including assets derecognition, as well as additional costs that can be directly attributed to the acquisition and disposal of assets (such as transaction costs and cost of goods sold). Examples of income and expenses that are required to be classified in the investing category are:

- The share of profit of associates and joint ventures accounted for using equity method;
- Interest income from debt investments;
- Dividends from equity investments;
- Rental income and fair value gains or losses from investments properties.

The financing category includes income and expenses from liabilities arising from transactions involving the raising of finance, whether or not those transactions involve only the raising of finance. Liabilities arising from transactions involving only raising of finance include debt instruments settled in cash and bonds that will be settled through the transfer of the entity's own shares (so-called convertible bonds). Liabilities arising from transactions that do not involve only the raising of finance include obligations for goods or services and liabilities under leases (Milutinović, 2025, 314). Examples of income and expenses that are required to be classified in the financing category are:

- Income and expenses resulting from the initial and subsequent measurement of liabilities, including liabilities derecognition;
- Additional costs directly attributable to the occurrence and settlement of obligations, such as transaction costs.

The income taxes category comprises tax expense or tax income included in profit or loss applying IAS 12 - Income Taxes and any related foreign exchange differences. *The discontinued operations category* comprises income and expenses from discontinued operations as defined in IFRS 5 - Non-current Assets Held for Sale and Discontinued Operations (Deloitte, 2024). Data on this category allow users insight into income and expenses that will not be present in future business activities (Stojanović, 2024, 44).

In the changed structure of the statement of profit or loss, apart from the three new categories into which it is necessary to classify income and expenses, there are also two new required subtotals also shown in Table 2. These subtotals are "operating profit or loss" and "profit or loss before financing and income taxes". *Operating profit or loss* is the subtotal calculated as the difference between all income and expenses classified in the operating category. It is important to note that this subtotal includes, but is not limited to, income and expenses from the entity's main business activities. Operating profit or loss is a defined term under IFRS 18 that applies to all entities and enables users to better understand financial performance and compare operating profit or loss between entities. Unlike IAS 1, which did not explicitly require that all entities show operating profit or loss in their statement of profit or loss structure, IFRS 18 not only requires the presentation of this subtotal, but defines which income and expenses make up this subtotal.

Profit or loss before financing and income taxes represents a subtotal consisting of the total operating profit or loss and all income and expenses classified in the investing category. Given the new definitions of the financing and investing categories, this subtotal may differ from the commonly used earnings before interest and tax (EBIT) measure (Grant Thornton, 2024, 3). IFRS 18 allows entities to present additional subtotals, but includes specific requirements for the presentation of additional items and subtotals. This is permitted only when necessary to provide a most useful structured summary of the entity's income and expenses. An useful structured summary will provide an understandable overview of the entity's recognized assets, liabilities, income, expenses, equity and cash flows and allow users to make comparisons between entities and between reporting periods for the same entity and identify key areas where they might want to get more information from the notes (Grant Thornton, 2024, 15).

Table 3: New categorization of income and expenses depending on the main business activity of the entity

Entity	Manufacturer A	Manufacturer B	Retail bank	Retail and investment bank	Insurer	Investment property company	Investment entity
Main business activities	Manufacturing and sales of goods	Manufacturing and sales of goods and providing financing to customers	Providing financing to customers	Providing financing to customers and investing in financial assets	Investing in financial assets	Investing in non-financial assets	Investing in subsidiaries, associates and joint ventures
Interest income on cash and cash equivalents	Investing	Operating	Operating	Operating	Operating	Investing	Investing
Interest income on loans to customers	Investing	Operating	Operating	Operating	Investing	Investing	Investing
Fair value gains/losses on investments in debt or equity instruments	Investing	Investing	Investing	Operating	Operating	Investing	Investing
Gains/losses on investment property	Investing	Investing	Investing	Investing	Investing	Operating	Investing
Share of profit or loss of equity-accounted investees	Investing	Investing	Investing	Investing	Investing	Investing	N/A
Gains/losses on investments in subsidiaries/associates/joint ventures measured at fair value	Investing	Investing	Investing	Investing	Investing	Investing	Operating
Interest expense on borrowings	Financing	Operating	Operating	Operating	Financing	Financing	Financing
Interest expense on defined benefit liability	Financing	Financing	Financing	Financing	Financing	Financing	Financing

Source: Adapted from KPMG (2024, 24)

Entities with specified main business activities are a new category. IFRS 18 identifies two types of these business activities:

- Investing in assets as a main business activity, and
- Providing financing to customers as a main business activity.

An entity may have one or more main business activities. To classify income and expenses into operating, investing and financing categories, an entity needs to assess whether its main business activity involves investing in assets or financing customers. If this is the case, they are entities with specified main business activities, such as banks, insurers or investment property companies. If this is not the case, then the operating category includes income and expenses arising from the performance of entities' main business activity that is not specified main business activity according to

IFRS 18. Table 3 shows examples of income and expenses categorization depending on the main business activity of the entity.

There is no doubt that there is a need for future amendments to IFRS 18, as it has not introduced significant changes to the other individual primary financial statements. For example, the new categorization of income and expenses presented in the statement of profit or loss is not implemented in the statement of financial position. Also, as previously mentioned, these new categories are not aligned with the categories from the statement of cash flows. Therefore, one can hope that the newly adopted IFRS 18 is not the end of changes in the structure and content of financial statements (Czajor, 2024, 273).

4. CONCLUSIONS

The aim from which the IASB started when adopting the new IFRS 18 was to provide investors and other users of general purpose financial statements with a clearer insight into the entity's financial performance and to improve the transparency of these statements. The newly adopted standard contains numerous novelties in relation to IAS 1, the standard that will be replaced upon entry into force, but the most notable are the novelties in the statement of profit or loss: three new income and expenses categories (operating, investing, financing), two new mandatory subtotals (operating profit or loss, profit or loss before financing and income taxes) and entities with specified main business activities.

Expectations from the application of the new IFRS 18 go in the direction of greater standardization of financial reporting, improvement of comparability between financial statements of entities, provision of more useful structured summaries to investors and other users of financial statements. The synergistic effect of the aforementioned expectations would be manifested in increasing confidence in financial statements. Bearing in mind that IFRS 18 contains clear guidelines related to the form and content of financial statements, which in the Republic of Serbia is prescribed by legal accounting regulations and by-laws, the very content of the new standard is primarily important for competent authorities whose scope is the adoption of the mentioned regulation. The first steps should be taken by the legislators and to incorporate the provisions from the new standard into the new law and regulations in the field of accounting. Only after that, those liable to prepare financial statements in the Republic of Serbia, i.e. entities, will be able to indirectly (through legal accounting regulations and by-laws) apply the newly adopted guidelines from IFRS 18.

Today, when there is less than a year and a half left until the start of IFRS 18 application, it is crucial to understand the following: firstly, awareness of the existence of far-reaching consequences for the quality of financial reporting if timely preparations for the introduction of the provisions of the new standard are not started; secondly, the importance of the existence of a proactive approach of competent authorities (legislators) and entity's management in joint work with accountants, auditors and IT experts during the period of harmonization and adaptation of all resources to the provisions of the new standard.

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THE IMPORTANCE OF MANAGEMENT ACCOUNTING IN SUPPLY CHAIN MANAGEMENT – THEORETICAL FRAMEWORK AND IMPLEMENTATION OPPORTUNITIES

Abstract: Environmental, social and corporate responsibility are concepts that have received significant attention over the past three decades by researchers and practitioners. The globalized, digitized and changing business environment encourages both the private and public sector to focus on supply chains (SC) and supply chain management (SCM) in the context of sustainable and responsible business. The role of accounting, especially management accounting (MA), in considering this problem is unavoidable. Costing, planning, control techniques and tools have mostly paid attention to supply chain management but have proven to be incomplete. The need to extend cost accounting through the value chain beyond the observed organization and connect it with the organization's suppliers and customers indicates that traditional management accounting must evolve. The subject of the paper are new techniques of modern management accounting in the service of SCM, their theoretical postulates as well as possibilities for practical application. Special attention is paid to the possibility to develop MA techniques and tools that will be useful to non-accountants who most often, in practice, deal with SCM issues. The aim of the paper is to point out the connection between MA and SC through consideration of internal and external supply chain activities, but also research on the connection of SC with costs, performance, lean production and global effectiveness and flexibility of the organization. The intention of the work is to point out the possibilities of practical implementation with a special emphasis on good practices of improving SC and SCM through MA techniques.

Keywords: supply chain (SC), supply chain management (SCM), management accounting (MA), costing, sustainable business

1. INTRODUCTION

Management accounting (MA) functions as a critical component of supply chain management (SCM) in today's data-driven global business environment (Almatarneh et al., 2022). The requirement for businesses to optimize operations while cutting costs and adopting sustainable strategies makes the use of innovative management accounting techniques essential for competitive advantage. Management accounting delivers critical tools to improve decision-making

processes while boosting supply chain performance and providing cost control measures to enhance efficiency throughout supply networks (Bhimani et al., 2021; Weygandt et al., 2020).

Globalization combined with technological advancements and shifts in consumer behavior have made supply chains more complex and exposed traditional SCM practices' limitations. Traditional supply chain methods prove inadequate when it comes to cost optimization and real-time decision making as well as sustainability according to Chopra (2019). Advanced MA techniques must be adopted to provide deeper insights into cost structures and ensure supply chain operations support business goals while promoting sustainability (Hugos, 2018; Voss et al., 2002).

In addition, a greater focus on environmental, social responsibility and corporate governance (ESG) criteria complicates supply chain operations. Effective SSCM demands advanced cost accounting methods that make use of MA tools to achieve both sustainability and profitability goals (Sarkis, 2019; Marota et al., 2017). Organizations need activity-based accounting (ABC), Lean accounting and total cost of ownership (TCO) methods to achieve transparent and accountable cost views of their supply chain activities (Garrison et al., 2020; Kaplan & Cooper, 1998).

The work seeks to explore the foundational theories of managerial accounting within SCM while assessing how current managerial accounting methods can optimize supply chain operations to enhance performance (Chandak et al., 2019) maintain cost control and reach sustainability targets in a constantly changing international market. The paper will also indicate good practices and case studies that illustrate the successful implementation of MA tools in SCM, providing guidelines for improving business processes and achieving competitive advantage. The method delivers an all-inclusive view of how managerial accounting functions in supply chain management while offering theoretical and practical advice to enhance business performance amid global market changes (Bhimani et al., 2021).

2. THEORETICAL FRAMEWORK

MA is a primary function inside organizations visited by data including their gathering, preparing, and examination, which is made to business choices. MA is used by managers for decision-making and strategic and operational planning, including, for example, budgeting, cost control, profitability assessment, and financial reporting. MA has unique features that allow managers to develop a comprehensive understanding of the economic situation in the organization, optimize business processes, and allocate resources most efficiently. In a rapidly changing global business landscape, when companies must be able to respond quickly and efficiently to fluctuations in market conditions, competitors, and developments in technology: MA is, therefore, critical (NovaBay Pharmaceuticals, Inc., 2015).

Production and logistics operations management and the acquisition of raw materials to end-users involves all activities required in the production and distribution of goods or services (Supply Chain Management-SCM). SCM is a core function for modern companies that harmoniously combines resources with market demand. Reducing operational costs, speeding up deliveries, and ensuring greater flexibility to market changes is possible based on supply chain optimization (Pérez-Pérez et al., 2019). Procurement, production, storage, distribution and logistics management are the basic elements of SCM (Chopra, 2019). At the same time, the alignment of social, economic and environmental goals of the company must be accompanied by sustainability (Chopra, 2019). In fact, the set of activities that provide effective coordination and management of the flow of materials, information and resources during all stages of the chain, while ensuring maximum value for customers and minimum total costs, is SCM (Mentzer et al., 2001). In order to keep pace with globalization, technological advances and meet the changing demands of consumers, organizations must constantly modify their supply chains.

Business practices based on sustainability and the application of ethical principles are one of the focuses of today's supply chains. Scarcity of resources, climate change and the protection of workers' rights, as global challenges that the organization constantly faces, have focused attention on the implementation of environmental, social and corporate responsibility (ESCR) (Pultrone, 2020). Consequently, organizations must integrate sustainability into their SCM strategies by applying the triple bottom line (TBL) concept. This means demonstrating success through social and environmental contribution, not just through financial performance.

Although traditional MA was primarily concerned with cost control, budgeting, and variance analysis within internal business processes, it proved insufficient to address the complex challenges of modern SCM. Standard MA practices do not consider external factors such as relationships with suppliers and customers, limiting their application in the modern business environment (Kaplan & Cooper, 1998). In order to increase efficiency in supply chain management, the application of accounting methods must apply, not only to the internal operations of the organization, but also to the entire value chain. This, at the same time, implies a focus on the costs and performance of the entire supply chain, because efficiency depends on the cooperation of all participants in the supply chain, and not only on the organization itself.

Traditional costing practices become insufficiently efficient for companies whose supply chains are often spread across different countries and involve multiple stakeholders. New techniques such as Total Cost of Ownership (TCO) (Ellram, 1995) and Life-Cycle Costing (LCC) (Horngren et al., 2018) are methods that take into account both internal and external factors, i.e., they appear as methods for estimating costs within the entire value chain. By applying these techniques, a more comprehensive view of costs is gained, which affects better decisions regarding the selection of suppliers, inventory management, and overall logistics.

Modern MA systems instill into the firms not only cost information but also generate facts about supply chain efficiency and efficacy. Key performance indicators and the Balanced Scorecard (Kaplan & Norton, 2000) are examples of tools that allow companies to monitor performance at various stages of the supply chain. Closely tied to SCM goals are the principles of lean production waste minimization or efficiency maximization (SuperfastCPA, n.d.) (identifying inefficiencies, optimizing inventory levels, and improving operations). ABC is yet another recent management accounting tool that helps in the more precise identification of costs by causally linking them with activities that induce inefficiency to pinpoint where improvements are needed (Kaplan & Cooper, 1998). The long-run success of any market depends on the prompt ability of the supply chain to respond and adjust to changes in the market, supply chain disruptions, and the dynamics of changing customer demands; therefore, flexibility is a key enabler for SCM (Kleosakul & Smutkupt, 2018). Balancing costs versus flexibility is the task of MA. Flexibility in budgeting, scenario planning, and forecasting empowers organizations to take agile decisions and prepare for potential changes in demand and supply (Pérez-Pérez et al., 2019). So modern MA refers to the integration of financial and non-financial information for better understanding of supply chain performance. Many benefits arise with integration of MA into SCM despite the integration being a difficult science. It allows companies, in the minutest detail, to identify pertinent cost points, focusing on activities yielding high returns on investments (Qube Buildings, n.d.). MA application within SCM decision-making is also important regarding sustainability since it provides companies with the information they need to weigh up financial and environmental objectives, thus allowing for a more coherent integration of economic goals with broader sustainability and social responsibility goals, which are now critical to long-term market competitiveness (Qube Buildings, n.d.).

All of these have become some of the most useful modern management accounting tools; indeed their control has become or is becoming mandatory in any organization dealing with SCM so that they can outline their sustainable operations.

3. IMPLEMENTATION OF MA TECHNIQUES IN SCM: OPPORTUNITIES AND CHALLENGES

Integrating MA into SCM, helps managers had better understand the supply chain's economic dynamics, reducing inefficiencies and increasing cost transparency (Ahi & Searcy, 2013). However, implementing MA in SCM is not without its challenges. One of the main problems is the resistance of organizations to change, especially when it comes to traditional accounting methods that have been the standard for a long time. Moving to more advanced techniques, can cause resistance from employees who are used to older systems (Oyewo et al., 2022). In addition, appropriate training and development of managers' ability to use new tools and techniques in daily decision-making is needed. These obstacles can slow the implementation process and make it more expensive in the initial phase. However, research shows that organizations that successfully integrate MA into SCM significantly progress in cost optimization and performance improvement (Jeschonowsk et al., 2009).

In addition to the technical challenges, there is also a significant challenge in how organizations approach the application of MA in the context of sustainability (Ahi & Searcy, 2013). Companies face increasing pressures to integrate environmental, social, and governance factors into their business operations in today's business environment. MA is crucial in this transition, allowing organizations to precisely monitor the costs linked to sustainable practices, such as reducing carbon emissions, sourcing sustainably, and managing waste responsibly (Marota et al., 2017; Cadez & Guilding, 2017). Using techniques such as TCO, organizations can make better decisions about balancing economic and environmental goals, ensuring sustainability throughout the product life cycle (Garrison et al., 2020).

From a competitive perspective, organizations that have implemented MA in their SCM processes have seen improved flexibility and speed of response to changing market conditions (Fedoryshyn, 2024). For instance, by enhancing cost tracking and optimizing inventory, businesses can adapt faster to shifts in demand, lower their stock levels, cut storage expenses, and boost working capital (Voss et al., 2002).

After successfully implementing MA in SCM, organizations can achieve better synergy between their functions, as cost and performance information is more accessible to all sectors within the enterprise. Organizations can better align their business strategies with supply chain optimization strategies through better coordination between finance and operations teams. Although the integration of MA into SCM comes with specific challenges, the potential benefits of this process can be significant (Jeschonowsk et al., 2009). In addition to better cost management, companies can improve their performance, increase operational efficiency, and achieve long-term business sustainability, essential in the highly competitive and globalized business environment (Ahi & Searcy, 2013).

Applying best practices, relying on successful case studies and understanding their practical effects are necessary for the successful application of MA techniques in SCM. Companies that successfully integrate MA into their SCM processes can improve operational performance, reduce costs, and achieve sustainable business. However, to apply these techniques in practice, thorough planning, coordination with all participants in the supply chain, and continuous improvement are necessary. Recognizing the most effective practices for implementing MA techniques can enable the financial sustainability of the supply chain flexibility about market demands and compliance with the principles of sustainable development.

One of the best practices for successfully implementing MA in SCM is integrating collaboration between the accounting department and the supply chain, thereby achieving a better understanding of cost drivers, performance metrics, and operational challenges. By synchronizing financial goals with operational processes, companies achieve more efficient management of resources, reduce losses, and make better decisions. In addition, good communication supported by standard tools and platforms contributes to the transparency, availability, and usability of financial data for managers outside the financial sector, especially in procurement, production, and logistics. Such coordination contributes to better cost control, more stable operations, and better strategic decision-making (Flynn et al., 2010; Cao & Zhang, 2011).

The use of real-time data and advanced analytics are key implementation practices. In order to extract valuable insights customer demand, it is necessary to use advanced data analysis tools. They enable monitoring of key results, such as: inventory turnover, order fulfilment and transportation costs, in real time. Organizations that integrate advanced analytics into their MA frameworks can make faster, data-driven decisions that optimize supply chain operations and reduce costs. Implementing these practices helps identify inefficiencies and reduce waste, thus leading to more sustainable practices (Unsustainable Magazine, n.d.) in the supply chain (Marota et al., 2017; Bag et al., 2020).

One of the very effective tools for applying MA in SCM is Lean accounting, which focuses on simplifying financial reporting by the principles of lean production. The basis of this approach is the idea of eliminating waste in production and financial processes. For example, Lean accounting pinpoints inefficiencies occurring during the movement of goods and services within a supply chain, thus illuminating certain financial insight areas for resource maximization and cost reduction. Organizations can save on costs and optimize the entire supply chain by reducing non-value-adding activities. In essence, Lean aims at reducing costs associated with goods and services and enhancing supply chain performance. Lean accounting aims at identifying non-value-adding activities related to core processes in a supply chain and therefore unlocking financial insight opportunities for enhanced resource utilization and cost reduction. By the elimination of non-value-adding activities, companies reduce costs and embrace the greater efficiency of the entire supply chain. The particular utility of this approach is in industries where cost control and operational efficiency are critical, such as manufacturing and logistics (Figueira Alves et al., 2021; Hines et al., 2002).

Case studies provide valuable insights into the success of applying MA techniques to improve SCM. This represents an example of a multinational company in the electronics industry employing the activity-based costing (ABC) approach. ABC allowed this multinational company to assign costs accurately across its complicated global supply chain while coming to identify places where indirect service costs were excessively incurred. Concentrating on activities that account for a large part of total costs (Powell, n. d.), the optimization of processes ensured negotiation of better prices with suppliers and elimination of operational inefficiencies. It thus improved the pattern of cost management and created alignment with operational goals such that financial and operation objectives are more closely aligned, thereby resulting in better supply chain performance when combined with profitability (Duh et al., 2009; Cyplik & Uberman, 2016).

Another popular application case is TCO that was applied into another global retail company. The company applied this analysis into understanding supplier relationships and costs of sourcing goods from a certain region (Roda et al., 2019). In so doing, the company was able to know how to select suppliers by including direct and indirect procurement costs like transportation, storage, and possible customs costs. This actually yielded enormous savings and the advantage of building resilience within the supply chain. TCO will thus be having a long-term relationship with suppliers, as the company definitely did better when negotiating the terms with suppliers, based on the deeper understanding of costs and value creation throughout the supply chain (Alfonso, 2013; Degraeve et al., 2005).

Use of COQ in supply chain management brings the real-world effect of improvement of sustainability within the supply chain. A major study case of COQ implementation was that of a leading automobile manufacturer, which partially integrated COQ to assess the costs associated with quality management through its supply chain. The company discovered significant inefficiency in the quality assurance program used by several suppliers within the supply chain, which led to inconceivably high costs incurred on fixes and mistakes. The company wholly embraced COQ and worked closely with its suppliers to boost quality control, which resulted in decreased error rates and costs, while allowing for a more sustainable supply chain. The enhanced focus on quality also helped the company improve its reputation for delivering high-quality products, increasing customer satisfaction and loyalty (Alglawe et al., 2019).

There are multiple practical benefits of applying MA tools to improve SCM. Thus, Lean Accounting and ABC reveal the opportunities for cost reduction via accurate and detailed cost allocation, enabling better supplier selection, production scheduling, and inventory management decisions (Hofmann & Bosshard, 2017). In addition, companies can use tools such as TCO and COQ to improve long-term relationships with suppliers and promote sustainable business practices. MA tools enable the organization to balance cost reduction, quality improvement, and sustainability, thereby achieving cost efficiency and environmental responsibility for supply chains. In addition, integrating sustainability into MA practices helps align strategy with broader corporate social responsibility (CSR) goals, which is a priority in today's increasingly environmentally conscious marketplace (Nartey, 2024; Alfonso, 2013). The continued use of these tools is crucial for organizations that want to remain competitive and be ready to respond to the demands of modern supply chains.

4. DISCUSSION AND FUTURE RESEARCH

The main findings of this study emphasize the essential function of MA in improving cost efficiency, operational performance, and organizational flexibility within SCM (Taschner & Charifzadeh, 2023). Analysis of relevant literature and case studies shows that the application of advanced MA techniques, such as ABC and TCO, contributes to greater transparency and better resource management in the supply chain (Taschner & Charifzadeh, 2023). Also, research has confirmed that digitization and the use of big data analytics in MA enable more accurate cost forecasting and more effective real-time decision-making (Lee & Mangalaraj, 2022).

While the integration of MA and SCM offers substantial advantages, specific constraints of this study must be acknowledged (Hald & Thrane, 2015). One key limitation relates to data availability, as companies often face challenges in collecting and analyzing accounting information in complex supply chains (Wang et al., 2016). Another limitation may be reflected in the different levels of application of MA tools among industries, which makes it difficult to generalize the findings (Taschner & Charifzadeh, 2020).

Considering the mentioned limitations, future research in the field of MA and SCM should concentrate on several key directions. First, it is necessary to explore further the role of artificial intelligence and machine learning (MENA Report, 2022) in cost analysis and supply chain optimization (Sharma et al., 2022; Kokina & Davenport, 2017). Second, future studies could address the impact of sustainable business and environmental, social, governance (ESG) factors on accounting methods in SCM, with particular emphasis on long-term profitability and social responsibility (Dasinapa, 2024). Finally, further research is needed on how non-accountant managers can more effectively use MA tools in supply chain operational decision-making (Khan et al., 2018).

Further research on these aspects can contribute to the development of new theoretical frameworks and practical solutions that will facilitate the integration of MA in SCM and improve organizations' business strategies in an increasingly complex global environment.

5. CONCLUSION

This paper explores the key role of MA in improving SCM, with a particular emphasis on applying innovative MA techniques that optimize business performance. The research results show that the integration of MA in SCM can significantly contribute to reducing costs, increasing the flexibility of organizations, and improving overall business efficiency. Additionally, the importance of introducing sustainable business practices in SCM is emphasized, as well as the use of MA tools to monitor costs related to ESG factors, which are becoming crucial in the modern business environment (Eccles et al., 2014; Jamal et al., 2019).

The practical implications of this research highlight the necessity for further development of management accounting tools that empower managers—regardless of their accounting background—to effectively utilize accounting information for optimization and strategic decision-making within the supply chain. Expanding digital tools, such as artificial intelligence and machine learning, can further improve organizations' ability to analyze costs, identify key efficiencies, and make better real-time decisions (Sharma et al., 2022; Kokina & Davenport, 2017; Toorajipour et al., 2021).

The research underscores the need to better understand the link between MA and SCM, particularly in enhancing long-term profitability and sustainability (Rezaee, 2018; Negri et al., 2024). Given that ESG factors are increasingly recognized as key to strategic decision-making, this research suggests that attention should be paid to developing new MA tools that would enable more accurate measurement and reporting of the costs and performance associated with sustainable practices (Dasinapa, 2024; Krstić et al., 2024).

Future research should focus on further developing techniques that enable the integration of ESG factors into MA models and on analyzing the challenges of implementing these new methods in organizations facing dynamic global markets. Additionally, research should expand to study how new technological trends, such as blockchain and the Internet of Things (IoT), can be implemented in SCM and linked to accounting practices, allowing for better transparency and tracking of costs throughout the supply chain (Khan et al., 2018).

Implementing MA in SCM improves operational processes and is a key factor in achieving competitive advantages (Synytsia & Puzyrova, 2024) in today's globalized and technologically advanced business environment. Future research should explore the practical aspects of implementing MA tools in SMEs, which often have limited resources to implement complex accounting techniques.

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CAPITAL STRUCTURE AND COMPANY PERFORMANCE: EVIDENCE FROM SERBIAN MANUFACTURING LISTED COMPANIES

Abstract: The study includes an examination of the effects of capital structure indicators, mainly indebtedness, on the company's financial performance. Companies from the manufacturing sector are listed on the Belgrade Stock Exchange as part of the BelexLine stock market index and covering the period from 2006. to 2022. were used as a sample. Indicators of return on assets (Roa) and return on capital (Roe) were selected as dependent variables. In the case of independent variables that present the capital structure, indicators of short-term, long-term, and total debt were used. Size and age variables were also used in the study. The results indicated a negative effect of total and short-term debt on the performance of manufacturing companies, while the indicator of long-term debt indicated a positive effect. The findings serve as a complement to the existing literature on the topic of capital structure, as well as to support financial management in better understanding the effects of indebtedness on the profitability of companies.

Keywords: Profitability, capital structure, panel data

1. INTRODUCTION

Financial specialists, researchers, the general public, and company management have all expressed a great deal of interest in, and attention to, the financial performance of businesses. The financial decisions made by management are critical in defining the ideal capital structure. Profits show how well management is performing with finance and investment choices more than any other accounting metric. According to Batchimeg (2017), profitability ratios assess how well a company's management is making money off of sales, total assets, and—above all—stockholder investment. Company management is responsible for determining the optimal capital structure to maximize value. By raising the market price of shares and lowering the total cost of capital, businesses maximize shareholder value, which is one of the most important goals of management (Hassan, et. al., 2022). Companies vary in their amount of leverage, and managers aim to reach the optimal capital structure. Capital structure is a crucial aspect affecting a company's success. Several empirical studies have shown varied results regarding the relationship between company performance and capital structure. Profitability, dividend growth, sales turnover, asset base, and capital utilization are a few ways to evaluate a company's financial success. Nonetheless, there is ongoing discussion across a number of fields about how best to gauge a company's performance and the main indicators influencing it (Omondi & Muturi, 2013). From the standpoint of an investor, profitability is a valuable metric for assessing a company's prospects for the future, and it is crucial to observe in order to determine the amount of profit investors receive from their investment. According to signal theory, a

high degree of profitability combined with the potential for a sizable company encourages investors to invest in the business. Financial backers view the growing interest from stock investors as an indication of improved business execution, which in turn contributes to the construction of expanded profitability over time (Sihombing, et. al., 2023). Given that a company's profitability is one of its primary goals, it is clear why factors influencing a company's profitability have drawn the attention of academic researchers. The main focus of this study is to investigate the nature of the relationship between capital structure indicators and company performance and confirm the majority of previous findings in this field indicating a negative connection. Businesses record higher profits when they are performing well in order to cover their expenses. Therefore, businesses should have a good operational capability as long as borrowed funds are limited to a low percentage of capital and earnings are high. Furthermore, a corporation will perform better the more efficiently its assets are managed (Vätavu, S., 2014). Examining a company's financial performance determinants is crucial, however since each sector operates and has unique characteristics, it is difficult for all sectors to have the same determinants. The subject of this study is the companies listed on the Belgrade stock exchange that belong to the manufacturing sector. The return on investment is extremely significant to investors, and a successful company may provide them with substantial, long-term profits. Additionally, a company's financial success will increase its employees' pay which further shows the importance of managing the tracking of company performance (Mirza & Javed, 2013).

The study is based on the use of independent variables of corporate capital such as short-term and long-term debt on profitability along with micro-indicators of company size and age. The study is divided into four main parts. In the first part of the study, an introduction to the theoretical part of the study is covered, along with a review of the literature, i.e. previous sites from this area. The second part of the study includes the definition and review of the methodology that will be applied in the empirical part of the study. In the third part of the study, the authors present the main findings, comment on the results, and compare them with previous findings from the area. The fourth and last part of the study includes concluding remarks, where a brief overview of the main limitations of the study and suggestions for further types of research are made.

2. LITERATURE REVIEW

Salim, & Yadav, (2012) revealed in their study covering the Malaysian listed companies that company performance measured by return of assets and return on equity had a negative relationship with short-term and long-term debt indicators. Studies such as (Habini et al. 2022; Huong, 202; Ilie & Vasiiu, 2022) examined the impact of the debt ratio on profitability ratios, including total liabilities to total assets and total equity to total assets. It was demonstrated that the leverage ratio significantly affected the return on assets ratio but less so for the return on equity, which is also reflected in the main studies of this particular study. According to the findings of Putra et al.'s (2021) study on Indonesian manufacturing enterprises, profitability was significantly impacted by business risk, company size, and asset structure, whereas capital structure was not significantly impacted by profitability. The impact of firm size, asset structure, and business risk on capital structure cannot be mitigated by profitability. Omondi & Muturi's (2013) examination of companies listed on the Nairobi stock exchange found that while company size significantly improved financial performance, it might have the opposite impact for too-large enterprises. Additionally, it confirmed that financial performance was significantly impacted negatively by leverage. The study's findings provided convincing evidence that a company's financial performance deteriorates and its risk of bankruptcy rises when its debt load exceeds an optimal level. Lastly, the study found that a company's age significantly improves its financial success. Also on the other hand the research investigation was conducted on the corporate capital structure stability of Chinese Stock Exchange-listed enterprises between 1990 and 2013. According to the results capital structure is significantly impacted by size, profitability, and investment prospects, but not by the tangibility of assets (Kyissima et al. 2019). The findings of Dalci's (2018) study of Chinese manufacturing companies showed that leverage had an inverted U-shaped effect on profitability. It was concluded that the tax shield may be the reason for the positive effect of financial leverage on profitability in this inverted U-shaped relationship, while the listed Chinese company's levels of financial distress, bankruptcy costs, serious agency issues, and information asymmetry may be the cause of the negative effect.

The findings of the regression study of US telecom businesses showed that although the ratio of total equity to assets had a substantial and positive influence on ROA, the ratio of total debt had a large and negative impact (Habibniya, et al., 2022). From the findings of previous studies, the numerous effects of profitability on other indicators as well as the effect of those indicators on profitability can be seen. In the example of a study by Sihombing, et. al., (2023) researching companies on the Indonesian stock exchange, it was discovered that while capital structure has a major impact on business value, liquidity and profitability have little effect. The link between profitability and company value is moderated by commodity prices, but not by liquidity or capital structure. These findings point to the importance of examining the profitability of companies in order to identify their sensitivity to the influence of other indicators.

In their research on the Croatian food and beverage sector, Pervan & Mlikota (2013) found that a negative sign for the debt ratio variable means that a large debt load brought on by high-interest payments has resulted in subpar business outcomes and low profitability. However, it was found that a firm's size had a favorable impact on its profitability, which was attributed to larger organizations' efficiency. According to the estimation findings of research by Soni, Arora & Le (2022), age, foreign earnings intensity, liquidity, and net asset turnover all significantly and favorably affect

profitability. On the other hand, company performance has been adversely affected by solvency and size. According to Batchimeg's (2017) results, the return on assets indicator had more determinants than the return on equity, including earnings per share and return on costs, which had positive effects. In contrast, the ratio of short-term debt to total assets and the cost-to-revenue ratio had negative effects. The empirical findings of the study by Opoku-Asante, et. al., (2022) researching the companies from Ghana and Nigeria suggested the presence of a significant negative relationship between capital structure and financial performance. The findings of Mirza & Javed (2013) demonstrated that ownership structure, risk management, and economic factors significantly influence how well Pakistani businesses perform financially. In the case of the age of companies, Loderer et al, (2009), discovered the presence of a positive and significant relationship between the age of a company and its financial performance proving that being older may make businesses more productive. However, Agarwal & Gort, (2002), pointed out that aging can also lead to organizational disintegration and render knowledge, skills, and talents outdated.

3. METHODOLOGY AND DATA

This study includes an analysis of 8 companies listed on the Belgrade Stock Exchange within the manufacturing sector of the Republic of Serbia. The companies are listed on the reference stock index BelexLine. The analysis period from 2007 to 2022 was used in this analysis and includes the relevant time period for implementing an adequate regression model. The data included are panel data, while the study itself includes 135 observations. The authors of the study employ indicators of return on assets (ROA) and return on capital (ROE) as interpreters of profitability, i.e. financial performance of companies as dependent variables, while independent variables are indicators of capital structure together with the age and size of companies. Indicators of the company's capital structure are represented by the variables of total (TD), short-term (SD), and long-term debt (LD). Indicators of age (LnAge) and size (LnSize) are also employed. The table below shows an overview of the main variables as well as their method of calculation.

Table 1:Used variables

Variable	Measure	Symbol
Dependant variables		
Return on assets	Total debt / Total assets	ROA
Return on equity	Total debt / Total assets	ROE
Independent variables		
Short-term debt	Short-term debt / Total assets	SD
Long-term debt	Long-term debt / Total assets	LD
Age	The Logarithm of Age of Company	LnAge
Size	The logarithm of the size of the company	LnSize

Source: authors

Based on defined segmentation criteria as well as dependent and independent variables, the authors generated the following equations:

$$ROA_{it} = \alpha + \beta_1 SD_{it} + \beta_2 LD_{it} + \beta_3 SIZE_{it} + \beta_4 AGE_{it} + \varepsilon \quad (1)$$

$$ROE_{it} = \alpha + \beta_1 SD_{it} + \beta_2 LD_{it} + \beta_3 SIZE_{it} + \beta_4 AGE_{it} + \varepsilon \quad (2)$$

Where are:

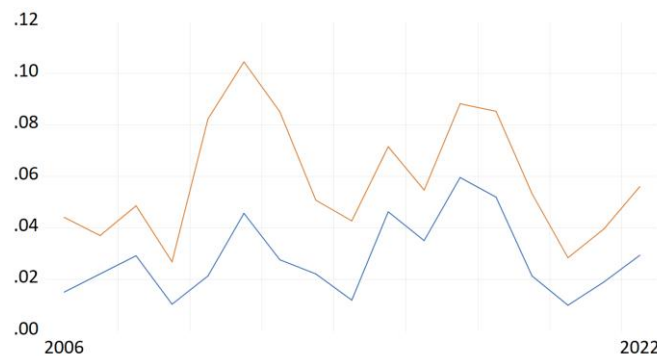
ROA_{it} = Return on assets ratio for the company I in time period t
 ROE_{it} = Return on equity ratio for the company I in time period t
 SD_{it} = Short-term debt to assets ratio for the company I in time period t
 LD_{it} = Long-term debt to assets ratio for the company I in time period t
 LnAge_{it} = Age of companies I in time period t
 LnSize_{it} = Size of companies I in time period t

Table 2: Descriptive statistics

	ROA	ROE	SD	LD	LNAGE	LNSIZE
Mean	0,035457	0,024573	0,357836	0,061232	3,600538	6,177141
Median	0,022545	0,056150	0,349000	0,015136	3,761200	6,342304
Max	0,268470	2,086700	0,996592	0,354000	4,343805	7,217814
Min	-0,242500	-2,853100	0,004000	0,000000	1,386294	5,041180
Std. Dev.	0,076310	0,410058	0,237068	0,092503	0,575885	0,517074
Obs.	136	136	136	136	136	136

Source: authors

In the table above the descriptive statistics of the used variables are shown. In the case of dependant variables, the indicators of return of assets showed a lower level of standard deviation compared to the return of equity indicators. This represents the presence of more volatility in the case of the return of equity variable. As per capital structure indicators. The short-term debt variable showed more volatility compared to long-term debt while also showing more of an overall presence in the debt financing structure of observed companies. In the case of long-term debt, it can be observed that the minimum value is equal to 0 which indicates that some companies in the sample did not use long-term debt as a financing option. In the case of age, the average age of companies exceeds the 30-year mark and the standard deviation indicators do not show a high level of volatility in the sample of companies used. Also observing the standard deviation of the size indicator, similar to age, it did not show a significant volatility in the sample of companies. The picture below shows the median values of the dependent variables of return on assets and return on equity. The red line represents Roa while the blue represents the Roe. It can be observed that the profitability of observed companies increased after the recession of 2008. and also decreased significantly during the COVID-19 pandemic period.



Picture 1: Median of dependent variables

Source: authors

4. MAIN FINDINGS AND DISCUSSION

To demonstrate the lack of multicollinearity and stationarity, the authors first provide the findings of correlation and unit root tests in this portion of the research. The authors established the lack of multicollinearity along the correlation matrix using the Variance inflation factor test. The outcomes of many panel unit root tests, including the Levin, Lin & Chu, Im, Pesaran & Shin, and Augmented Dickey-Fuller tests, are displayed in the table below. The presented coefficients indicate the presence of stationarity at a level for variables, return on equity, long-term debt, and age while, return on assets, short-term debt, and size after the 1st differentiation. The correlation matrix and variance inflation factors both indicate the absence of multicollinearity from these models.

Table 3: Correlation

	ROA	ROE	SD	LD	LNAGE	LNSIZE
ROA	1,000000	0,444975	-0,525895	0,004907	0,445634	0,006749
ROE	0,444975	1,000000	-0,365853	-0,049345	0,382273	0,135458
SD	-0,525895	-0,365853	1,000000	0,162755	-0,718091	- 0,150956
LD	0,004907	-0,049345	0,162755	1,000000	-0,141235	0,353162
LNAGE	0,445634	0,382273	-0,718091	-0,141235	1,000000	0,264511
LNSIZE	0,006749	0,135458	-0,150956	0,353162	0,264511	1,000000
Average VIF	1,7062					

Source: authors

Table 4: Unit root tests

Variables	Levin-Lin & Chu		Im, Pesaran & Shin		ADF	
	Level	1st	Level	1st	Level	1st
ROA	-1,1185 (0,1317)	-3,8099 (0,0001)	-2,1824 (0,0145)	-5,7003 (0,0000)	29,43 (0,0212)	63,38 (0,0000)
ROE	-1,7192 (0,0428)	-4,5212 (0,0000)	-2,5618 (0,0052)	-6,2787 (0,0000)	33,60 (0,0061)	70,16 (0,0000)
SD	0,6655 (0,7471)	-4,2613 (0,0000)	-0,2532 (0,4001)	-5,7503 (0,0000)	15,0995 (0,5174)	62,0368 (0,0000)
LD	-2,5992 (0,0047)	-8,8616 (0,0000)	-1,7794 (0,0376)	-7,1928 (0,0000)	24,5643 (0,0391)	71,6167 (0,0000)
LNAGE	-24,5487 (0,0000)	-22,9722 (0,0000)	-160,453 (0,0000)	- 150,959 (0,0000)	147,559 (0,0000)	147,365 (0,0000)
LNSIZE	-0,4857 (0,3136)	-2,8042 (0,0025)	2,0095 (0,9778)	-4,6170 (0,0000)	10,5743 (0,8350)	50,8243 (0,0000)

Source: authors

The table below provides an overview of the regression model results. The table also shows the results of diagnostic tests such as the Breuch-pagan and Pesaran CD tests. These tests were conducted to establish the adequacy of the panel regression model. The results of the Breuch-Pagan test indicate the presence of heteroscedasticity in the case of both models, while the Pesaran CD test indicates the presence of cross-sectional dependence in the first model where the dependent variable is return on assets, while in the case of the second model of return on capital cross-sectional dependence is not present. Based on the results of these diagnostic tests, the authors decided to apply the generalized least squares (GLS) model precisely because of its nature as a more adequate interpretation of the model where heteroscedasticity and cross-sectional dependence are present. As for the regression model, the first model indicates a statistically significant influence of all used independent variables, while in the case of the second model, the effect of only two variables is present. Short-term debt showed a negative effect in the case of return on assets and return on capital similar to Salim, & Yadav, (2012). In the case of the first model, statistical significance is present with 1% significance, while in the case of the second model with 10% significance.

The negative effect of the short-term debt indicator indicates that the companies in the sample, in case of an increase in the level of short-term debt in the capital structure, actually reduce the level of profitability of the business itself, similar to Omondi & Muturi (2013). In the case of long-term debt, statistical significance is present only in the case of the first model where the effect is positive, which is contrary to the findings of the effect of short-term debt. The age variable, similar to the short-term debt, showed a statistically significant and positive effect in the case of both models, implying that the older the company, the higher the level of profitability of the company over time. The size indicator showed a negative and statistically significant effect in the case of the first model, contrary to Omondi & Muturi's (2013) and Pervan & Mlikota (2013), which points to the conclusion that companies when increasing their assets and growth, reduce the level of profitability. The negative effect of short-term debt combined with the negative effect of size on the return on assets as a representative of profitability leads to the conclusion that most of the companies in the sample use short-term debt for the sake of their growth, i.e. increasing their assets, and at the same time negatively affect their profitability.

Table 5:Regression results

Variable	ROA		ROE	
			Coefficient	Prob.
SD	-0,1391	0,0001	-0,3323	0,0978
LD	0,1354	0,0425	-0,0062	0,9875
LNAGE	0,0270	0,0605	0,1653	0,0531
LNSIZE	-0,0251	0,0399	0,0361	0,6164
C	0,1351	0,1094	-0,6744	0,1781
R-squared	0,3176	0,0355	0,1652	0,0246
Adjusted R-squared	0,2968	0,0763	0,1397	0,4101
F-statistic	15,2443	1,1246	6,4827	1,7697
Prob(F-statistic)	0,0000		0,0001	
Breusch-Pagan test	48,85	0,0087	39,7	0,0703
Pesaran CD test	35,05	0,0000	170,33	0,0000

Source: authors

5. CONCLUSION

The results of this study indicated the presence of a statistically significant effect of capital structure indicators on profitability indicators. In the case of ROA, the effect of short-term debt (SD) is negative, where a 1% increase in debt indicates a -0.14% decrease, while in the case of long-term debt (LD), a 1% increase indicates a 0.13% increase. In the case of return on capital (ROE), only the indicator of short-term debt (SD) showed a statistically significant negative effect, where an increase of 1% causes a decrease of 0.33%. In addition to capital structure indicators, size (LNSIZE) and age (LNAGE) indicators were used. In the case of return on assets (ROA), both indicators indicated a significant effect. In the case of age, the effect is positive where a 1% increase causes a 0.03% increase while in the case of size (LNSIZE) a 1% increase causes a 0.025% decrease. In the case of return on capital (ROE), only the age indicator (LNAGE) showed a statistically significant and positive effect, where a 1% increase causes a 0.16% increase. The negative effect of short-term debt on profitability is in agreement with most of the previous findings from the area where the postulates of the trade-off theory are supported, which states that companies balance the benefits and costs of debt when deciding on the capital structure. Although debt can bring tax benefits, over-reliance on short-term debt can increase financial risk and refinancing costs, which negatively affects profitability. For legislators, investors, and business stakeholders attempting to negotiate the intricacies of financial decision-making in the manufacturing industry, these results offer insightful information. In order to get a more thorough knowledge of the financial dynamics within the Serbian manufacturing sector, future studies might examine the effects of regulatory frameworks on debt dynamics or go further into certain industrial segments. Additional study limitations include the assessment of a single nation's industrial sector and the usage of just eight enterprises in the sample. Research on the manufacturing industries of many nations for comparative analysis and the inclusion of more businesses in the sample are suggestions for future studies.

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EFFECTS OF THE IMPLEMENTATION OF THE BALANCED SCORECARD MODEL ON THE FINANCIAL PERFORMANCE OF COMPANIES IN THE REPUBLIC OF SERBIA

Abstract: The growing complexity and ambiguity of contemporary business environment imply the necessity for using holistic strategic performance measurement systems, such as the Balanced Scorecard Model (BSC Model). BSC has gained significant importance in recent years as a strategic management tool enabling organizations to align their business activities with the vision and strategy of the organization and improve their overall performance. For decades, measuring and evaluating organizational performance was limited to financial performance. In addition to lagging financial metrics, the BSC incorporated leading performance indicators from the perspective of customers, business processes, and learning and growth. A major assumption underpinning the use of BSC in companies is that it has a positive effect on overall performance. The paper aims to demonstrate the effects of the BSC model's implementation on financial performance, specifically on the profitability, i.e. ROA and ROE of companies. Although numerous studies have researched the impact of implementing the BSC on financial performance, these studies have predominantly focused on developed economies, while research in the Republic of Serbia is scarce. Therefore, the contribution of the paper is reflected in the fact that the designed model aims to fill the research gap by investigating the impact of BSC implementation on the financial performance of companies in the Republic of Serbia, i.e. on ROA and ROE, as the most significant measures of company's profitability. The research covered 11 companies in the territory of the Republic of Serbia. The internal consistency of the statements used to measure the variables of the developed model was calculated based on the Cronbach's α coefficient. The multiple regression analysis was used to test the main effects. The results of the empirical research show that there is a positive statistically significant impact of the implementation of the Balanced Scorecard on the ROA and ROE of companies. Our research offers meaningful implications for managers who wish to consider adopting and using BSC. We indicate that using the BSC represents an effective means of enhancing organizational performance and designs of managerial practices that might be suitable for pursuing specific strategic priorities. Managers should first align the objectives of the BSC model with the mission and long-term goals of the company. Bonuses, rewards, and promotions of employees should be linked to key performance indicators from the different perspectives of the BSC model that impact the company's profitability. From the customer perspective, the BSC model is used to enhance the value of the market offering. Also, through appropriately set goals from the internal process perspective, it is possible to increase profitability by reducing product and service realization times, improving inventory management, and automating production processes. Additionally, managers should continuously monitor the implementation of the BSC model to identify deficiencies, respond promptly, and adjust the goals of different perspectives to the current business situation. The research was conducted

on a limited sample and within the territory of the Republic of Serbia, which means the results cannot be generalized or applied to employees from other countries. Accordingly, future models may include additional variables.

Keywords: Balanced Scorecard model, financial performance, ROA, ROE

1. INTRODUCTION

The characteristics of the contemporary business environment require the introduction and application of new, integrated, and holistic strategic performance measurement systems and models for strategy implementation control (Domanović, 2019). In this context, profitability and operational efficiency emerge as key predictors of achieving competitive advantage (Punniyamoorthy & Murali, 2008). Simultaneously, to maintain market position in today's environment, companies must continuously innovate their strategic initiatives by leveraging knowledge-based competitive advantages (Dzenopoljac et al., 2018). In this regard, intellectual capital is crucial, particularly for companies seeking to enhance their performance, increase profitability, and sustain competitiveness in a dynamic and unpredictable environment (Abdullah & Sofian, 2012). In the modern business environment, the main source of competitive advantage lies in intangible assets and intellectual capital, which underscores the need for the implementation of integrated and holistic performance evaluation models from various perspectives, such as the Balanced Scorecard (BSC) model. Therefore, companies must simultaneously possess intangible assets, the capability to manage customer satisfaction and loyalty, and efficient operational processes to create conditions conducive to the development of sustainable and innovative products (Sands et al., 2016). The value generated through intellectual capital is contextual, as it depends on its alignment with the company's strategy (Janošević et al., 2013). In this regard, the Balanced Scorecard can be of significant benefit as a completely new management model, where strategy is at the core of the company's operations (Domanović, 2016). Additionally, Wu (2005) argues that the application of the BSC model contributes to the creation, organization, and measurement of intellectual capital, as well as more comprehensive reporting on intellectual capital. The financial perspective, customer perspective, internal processes perspective, and learning and growth perspective within the BSC model lead to better management of intellectual capital. Furthermore, Wu (2005) asserts that the learning and growth perspective in the BSC serves as a predictor of innovation and human capital within intellectual property, while the strategic objectives within the internal business processes perspective of the BSC represent factors of structural capital. The customer perspective in the BSC influences relational capital within intellectual capital, ultimately driving the maximization of company value and improving organizational performance. It is important to emphasize that the Balanced Scorecard model does not undermine the financial perspective; on the contrary, the financial dimension remains primary, but not the sole factor in evaluating the overall effectiveness and efficiency of business operations. It is crucial to assess and analyze performance from non-financial perspectives, such as the customer perspective, internal business processes, and employee learning and development, as these non-financial factors increasingly serve as predictors of future financial performance.

Furthermore, a large number of studies have examined the impact of the implementation of the BSC model on the financial performance of companies (Malagueno et al., 2018; Davis & Albright, 2004; Braam & Nijssen, 2004). However, these studies have predominantly focused on developed economies, while research in the Republic of Serbia remains very limited (Domanović, 2010). Therefore, this study aims to fill the research gap by demonstrating the effects of the BSC model's implementation on financial performance, specifically on the profitability, i.e. ROA and ROE of companies.

The expected theoretical contribution of the paper involves addressing the identified gap in the literature, which, according to the authors' knowledge, highlights the scarcity of research dealing with examining the impact of Balanced Scorecard application on ROA and ROE in companies. From a practical standpoint, the research can provide guidelines for companies to enhance profitability through the application of the BSC model.

The paper is structured into several interrelated sections. The literature review presents some of the key theoretical concepts of BSC model application. In the second part, the hypotheses and research model are outlined. The methodology used in the research is then discussed, explaining the process of collecting and analyzing primary and secondary data. The results of the empirical research and their discussion are covered in the fourth and fifth parts of the paper. Finally, certain conclusions are drawn, implications are identified, and the limitations of the research are outlined.

2. LITERATURE REVIEW

Traditional accounting-based efficiency measures are overly historical in nature, lack predictive power, reward incorrect behaviors, fail to prompt key business changes until it is too late, and provide inadequate consideration of resources such as intellectual capital (Domanović, 2010). Therefore, the Balanced Scorecard (BSC) model was developed, based on the assumption that companies can no longer achieve sustainable competitive advantage solely through managing

and reporting on tangible resources (Ling Sim & Chye Koh, 2001). In other words, the BSC emerges as a performance management system that can be used by companies of all sizes to align their vision and mission with internal business processes (Punniyamoorthy & Murali, 2008). The BSC model is considered a modern performance management model, a tool for strategic management and managerial accounting, a strategic performance measurement system, and a model for strategic control (Domanović, 2019). When properly applied, the BSC model allows companies to integrate the strategic planning and budgeting processes to the extent that it can entirely replace traditional control systems (Atkinson, 2006). Malagueño et al. (2018) state that the BSC is a multidimensional and multi-perspective framework that relies on a set of performance measures (financial and non-financial, long-term and short-term, internal and external). The term "balance" in the model's name refers to the equilibrium between financial and non-financial measures, internal and external performance perspectives, and historical and predictive indicators of company success (Al Mseden & Nassar, 2015). Concrete goals, tasks, initiatives, and measures are hierarchically defined from the established vision and strategy (Domanović, 2019). Thus, the BSC model can be seen as a strategic management system that links long-term and short-term organizational goals (Punniyamoorthy & Murali, 2008). Furthermore, Atkinson (2006) notes that the BSC model enables companies to effectively link operational with strategic goals, integrate financial and non-financial performance measures, and direct business activities towards fulfilling customer requirements. Kaplan & Norton (1996) identify four primary perspectives within the BSC model: financial perspective, customer perspective, internal processes perspective, and learning and growth perspective. The performance observed within these perspectives is closely related and interdependent (Punniyamoorthy & Murali, 2008). Within the customer perspective, target segments are identified, and the company's business success is viewed in relation to customer satisfaction and market share (Punniyamoorthy & Murali, 2008). For example, continuous performance evaluation in relation to the goals set for the customer perspective can help managers track competitors and understand what they offer, as well as why current customers buy or do not buy the company's products and how satisfied they are (Malagueño et al., 2018). The primary goal of the customer perspective is to create value through differentiation from competitors (Chen et al., 2006). On the other hand, underperformance in the customer perspective is considered a significant indicator that could potentially impact future financial performance (Cohen et al., 2008). Further, the internal processes perspective identifies key processes in which the organization must specialize to continue adding value for customers (Domanović, 2010). Atkinson (2006) emphasizes that the essence of the internal processes perspective is to enable the achievement of financial goals and customer satisfaction. This perspective is also considered crucial for the organization's success, as it ensures that the company's products and services meet customer needs (Cohen et al., 2008). The learning and growth perspective identifies the capabilities in which the organization must excel to achieve superior internal processes that create additional value for customers and shareholders (Punniyamoorthy & Murali, 2008). The primary goals of this perspective are to identify the jobs (human capital), systems (structural capital), and organizational environment (relational capital) necessary to support internal business processes, with a focus on people, their attitudes, knowledge, development, and learning and advancement capabilities (Cohen et al., 2008). Similarly, Chen et al. (2006) state that the primary goal of the learning and growth perspective is to create an organizational climate that supports change, innovation, and risk-taking. Measures in the financial perspective indicate whether the implementation of a strategy, detailed through the measures selected from other perspectives, leads to better overall results (Domanović, 2010). In other words, the financial perspective emphasizes shareholder satisfaction, with key goals and measures including: gross and/or net profitability, return on invested capital, economic value added, sales growth rate, market share, and cash flow (Hasan & Chyi, 2017).

3. HYPOTHESES AND RESEARCH MODEL

The Balanced Scorecard (BSC) is a significant management tool, as it enables alignment between short-term objectives and long-term strategy of a company (Chen et al., 2006). The application of the BSC model can influence a company's financial performance in various ways. For example, objectives within the learning and growth perspective, such as increasing employee competence through training and development, contribute to innovative improvements in internal processes, which further imply growth in financial performance (Sands et al., 2016). Similarly, Malagueño et al. (2018) identify a statistically significant impact of BSC implementation on innovation and financial performance, particularly ROA, in small and medium-sized enterprises. Abueid et al. (2023) state that all four perspectives of the BSC model have a significant impact on financial performance in the banking sector. The same study also highlights that the internal processes perspective has the strongest impact on bank performance, as it focuses on improving quality while reducing costs, increasing efficiency, innovation rates, and decreasing delivery times. Al Mseden & Nassar (2015) conclude that implementing the BSC leads to increased profitability, identifying a statistically significant impact on the financial performance of companies (ROA and ROE). Davis & Albright (2004) assert that the BSC can be used to improve the financial performance of companies, demonstrating that firms utilizing BSC outperform those that do not. Additionally, Sweiti & Lele (2016) identify positive effects of BSC implementation on performance in shareholder companies, observing financial indicators over a five-year period. The structure and comprehensiveness of information contained within the BSC model positively influence the cognitive processes of managers, thereby contributing to how

managers approach information when making strategic decisions (Malagueño et al., 2018). This characteristic of the BSC stands out particularly in that it emphasizes knowledge sharing and continuous learning within the organization (Grafton et al., 2010). The application of BSC allows companies to develop a comprehensive overview of their operations, better aligning all operational and investment activities with strategic and short-term objectives (Punniyamoorthy & Murali, 2008). Furthermore, continuous use of the BSC leads to greater alignment of various internal processes, competencies, and functional units within the organization, which consequently reflects on organizational performance (De Geuser et al., 2009). De Geuser et al. (2009) identify a significant impact of BSC application on organizational performance, with the key benefits of the model being its continuous impact on managerial practices and aligning the company's resources with its strategic objectives. Thus, Cohen et al. (2008) argue that the application of the BSC model, particularly the learning and growth perspective, leads to improved financial performance, including ROE. The application of BSC improves performance in the customer, internal process, and learning and growth perspectives, concurrently enhancing short-term financial performance, contributing to the accumulation of intellectual capital, and ultimately leading to long-term competitive advantage (Tseng, 2006). Furthermore, Hussien & Aledwan (2017) identify a statistically significant impact of the application of all four BSC perspectives on ROE, emphasizing that, through this approach, companies achieve strategic goals, improve overall business performance, and strengthen competitive advantage. Additionally, research conducted by Nisha (2017) shows that companies that increased investments in activities covered by the learning and growth, internal process, and customer perspectives have recorded improvements in financial indicators, including return on equity (ROE). In line with the analyzed impact of BSC application on company profitability, the following hypotheses have been formulated:

H1: The implementation of the Balanced Scorecard has a positive statistically significant impact on the company's ROA.

H2: The implementation of the Balanced Scorecard has a positive statistically significant impact on the company's ROE.

4. RESEARCH METHODOLOGY

The empirical research was conducted based on the analysis of primary and secondary data. First, the statements used to measure the degree of implementation of the BSC model were derived from an appropriate review of the literature. The variable "Implementation of Balanced Scorecard" was measured through twelve statements. All statements used to measure this variable were adapted according to Mehralian et al. (2018) and Giannopoulos et al. (2013). Respondents' answers were measured using a five-point Likert scale, where a response of 1 represented strong disagreement with the given statement, and a response of 5 represented complete agreement with the statement. On the other hand, the financial performance indicators of the companies (ROA and ROE) were calculated based on the regular financial reports from 2023 of companies operating within the territory of the Republic of Serbia.

To identify the statistically significant impact of the implementation of the BSC model on the financial performance of the company, an empirical study was conducted between September 1 and September 15, 2024, in the Republic of Serbia. For collecting primary data and examining employees' attitudes toward the implementation of the BSC model, a survey method was applied. Within this method, the technique of online interviews was used, with a questionnaire as the instrument. Eleven companies participated in the study, and surveys were distributed to their employees online. Respondents were informed in advance that the survey was part of a research study and that their responses would remain fully confidential. Additionally, secondary data for calculating the financial indicators ROA and ROE were collected from the regular annual financial reports, publicly available on the website of the Serbian Business Registers Agency (APR). Data analysis was performed using the Statistical Package for Social Sciences (SPSS 26.0). The internal consistency of the statements used to measure the variables in the developed model was calculated based on the Cronbach's α coefficient.

5. RESEARCH RESULTS

5.1. Sample Characteristics

The structure of the sample is presented in Table 1. The study included only large companies that meet the requirements stipulated by Article 6 of the Accounting Law. Furthermore, out of the total of 11 companies included in the empirical research, 9.09% (1 company) are public enterprises and limited partnerships, while 54.55% (6 companies) are limited liability companies, and 27.27% (3 companies) are public limited companies by legal form. Among the studied companies, the majority are privately owned (72.73%), followed by mixed ownership (18.18%), and finally, state-

owned (9.09%). Finally, 3 companies (27.27%) fall under the manufacturing sector, while 8 companies (72.73%) are in the services sector.

Table 1: Sample structure

		Number	Percentage
Company Size	Small companies	0	0%
	Medium companies	0	0%
	Large companies	11	100%
	Total	11	100%
Legal Form	Public enterprise	1	9.09%
	Limited partnership	1	9.09%
	LLC	6	54.55%
	Public limited company	3	27.27%
	Total	11	100%
Ownership Type	State-owned	1	9.09%
	Private domestic	2	18.18%
	Private foreign	6	54.55%
	Mixed domestic	0	0%
	Mixed foreign	2	18.18%
	Total	11	100%
Type of Activity	Manufacturing company	3	27.27%
	Service company	8	72.73%
	Total	11	100%

Source: Authors

5.2. Calculation of financial indicators

Table 2 presents the profitability indicators (ROA and ROE) of the companies in the sample. ROA is calculated as the ratio of net profit to average assets, while ROE is calculated as the ratio of net profit to the company's average equity. In order to protect the privacy of the companies examined, all presented data is anonymous.

Table 2: ROA and ROE of the observed companies

Company	Net profit (1)	Average assets (2)	Average equity (3)	ROA (1/2)	ROE (1/3)
Company 1	343.816	9.929.864	4.339.321	0,035	0,079
Company 2	472.091	15.742.778	4.750.000	0,030	0,099
Company 3	1.933.166	65.796.759	17.436.785	0,029	0,111
Company 4	157.115	6.578.898	952.176	0,024	0,165
Company 5	338.784	3.358.386	2.629.019	0,101	0,129
Company 6	41.914.628	521.431.280	369.068.491	0,080	0,114
Company 7	12.029.767	396.328.771	130.087.602	0,030	0,092
Company 8	7.737.554	97.399.323	47.205.863	0,079	0,164
Company 9	1.799.145	75.021.094	35.879.878	0,024	0,050
Company 10	3.893.053	67.251.740	50.077.043	0,058	0,078
Company 11	9.031.010	41.660.069	30.291.907	0,217	0,298

Source: Authors, based on data obtained from the website of the Agency for Business Registers, www.gov.rs

5.3. Reliability analysis

Table 2 shows the results of the reliability analysis. The reliability of the variables included in the research model, i.e., the internal consistency of the statements used, was measured through the value of Cronbach's α coefficient. The value is 0.924, which indicates a high level of reliability, considering that Cronbach's α exceeds the threshold of 0.70, which is recommended by Nunnally (1978).

Table 3: Reliability analysis results

Variable	Cronbach's α
Implementation Balanced Scorecard-a	0.924

Source: Authors

5.4. Testing of main effects

The testing of the effects of the implementation of the BSC on company profitability (ROA) was carried out using multiple regression analysis (Table 4). It can be concluded that the implementation of the Balanced Scorecard has a statistically significant impact on ROA, which supports hypothesis H1. Similarly, multiple regression analysis (Table 5) was applied to test the effects of the BSC model on ROE as a measure of company profitability. It can be concluded that the implementation of the Balanced Scorecard has a statistically significant impact on ROE, which supports hypothesis H2. Furthermore, it can be stated that there is no issue of multicollinearity, as the VIF value is below 5 (Shrestha, 2020).

Table 4: Results of the multiple regression analysis (dependent variable: ROA)

Independent variables	β	t	Sig.	VIF
Implementation of the Balanced Scorecard	0.846	8.493	<0.00	2.484

Source: Authors
*** $R^2=0.458$; $F=22.349$ ($p<0.00$)

Table 5: Results of the multiple regression analysis (dependent variable: ROE)

Independent variables	β	t	Sig.	VIF
Implementation of the Balanced Scorecard	0.603	7.036	<0.00	2.120

Source: Authors
*** $R^2=0.311$; $F=21.385$ ($p<0.00$)

6. DISCUSSION OF THE RESULTS

The conducted research examines the impact of the implementation of the Balanced Scorecard (BSC) model on the financial performance of companies. First, a statistically significant impact of the implementation of the BSC model on the company's ROA and ROE was identified, which is consistent with the research conducted by Al Msedden & Nassar (2015, who emphasize the need for companies to focus on implementing various perspectives within the BSC model in order to improve their profitability. Unlike the observed sample, Malagueño et al. (2018) examine small and medium-sized enterprises, but reach the same conclusion, identifying a statistically significant impact of the implementation of the Balanced Scorecard on the financial performance of companies. Furthermore, Nisha (2017) concludes that the learning and growth perspective, the internal process perspective, and the customer perspective significantly affect the ROA and ROE of companies in the banking sector, which aligns with the research findings. Davis & Albright (2004) argue that companies implementing the BSC model achieve superior financial performance, which is consistent with the conducted research. The same authors conclude that companies implementing the BSC model achieve higher levels of employee loyalty, satisfaction, and productivity. Similarly, Cohen et al. (2008) conclude that companies that invested more in improving the activities within the learning and growth perspective increased their profitability during the observed period. Additionally, the research conducted by Ling Sim & Chye Koh (2001) shows that manufacturing companies implementing the Balanced Scorecard achieved significantly higher business performance, which aligns with the confirmed hypotheses. However, in contrast to the obtained results, Braam & Nijssen (2004) argue that the implementation of the Balanced Scorecard will not automatically lead to increased company performance, but will depend on the context in which it is applied. The BSC model aligned with corporate strategy will lead to increased financial performance, while the BSC model that is not aligned with corporate strategy may even lead to a decline in performance.

7. CONCLUSION

Based on the established research objective, the results obtained point to the following relevant conclusions. The results of the conducted empirical research show that there is a positive statistically significant impact of the implementation of the Balanced Scorecard (BSC) model on the ROA and ROE of companies. This research contributes to the existing literature, considering that there is insufficient research on this topic in the Republic of Serbia, which adds to the originality of the study.

In accordance with the presented results, theoretical and practical implications can be drawn. The theoretical contribution of the paper lies in addressing the identified gap in the literature, which refers to the fact that, to the best knowledge of the authors, there are not many studies examining the impact of the implementation of the BSC model on the ROA and ROE of companies. In practical terms, the research can provide guidance for companies to increase profitability through the implementation of the BSC model. Specifically, managers should first align the BSC model's goals with the company's mission and long-term objectives, ensuring alignment with critical areas such as customer

satisfaction, internal processes, and employee development. Furthermore, the system of incentives and compensation should be based on key performance indicators of the Balanced Scorecard. This means that bonuses, rewards, and promotions for employees should be linked to key indicators from the various perspectives of the BSC model that impact the company's profitability. Additionally, company management should continuously monitor the implementation of the BSC model to identify deficiencies, respond promptly, and adjust the goals of different perspectives to the current business situation. Each critical indicator within the various areas should have a designated manager responsible for its monitoring. This ensures accountability for the Balanced Scorecard's objectives at all levels. Through the customer perspective, the BSC model can be used to enhance the value of the market offering. By considering customer feedback and monitoring market trends, companies can innovate products and services and ensure greater satisfaction and customer loyalty, leading to increased market share. Also, through appropriately set goals for the internal process perspective, it is possible to increase profitability by reducing product and service realization times, improving inventory management, and automating production processes. By building a culture of continuous innovation, a system can be created within which employees can provide feedback on internal processes, customer needs, and operational inefficiencies. This will foster a culture of continuous improvement that aligns with profitability goals. Furthermore, through programs aimed at retaining talented employees, such as reward systems and opportunities for advancement, managers can reduce employee turnover, thereby preserving knowledge and lowering the costs of training new employees. Companies should also invest further in technology development, which contributes to the collection, storage, and dissemination of knowledge. This can include databases, software, or specific communication tools that facilitate employee collaboration. It is essential to document best practices, employee experiences, and knowledge so that they can be easily adopted and shared. By emphasizing employee knowledge and enabling their training, professional development, and mentorship in relevant areas, managers contribute to the accumulation of intellectual capital. Additionally, the BSC model can be used to improve the company's relationship with relevant stakeholders, aiming to enhance the company's relational capital. For example, within the customer perspective of the BSC model, strategies can be developed that prioritize customer feedback, as well as the analysis of their satisfaction and loyalty.

The limitations of the conducted empirical research are related to the fact that the study was conducted on a limited sample, which makes it impossible to generalize the implications. Therefore, it is recommended that future research include a larger number of respondents. Second, the research was conducted in the Republic of Serbia. Thus, certain implications cannot be transferred to employees in other countries. However, future research directions involve a detailed analysis of the relationship between the implementation of the BSC model and the profitability of companies in other countries, ensuring international comparison, identifying potential irregularities or best practices in other economies, which will then be applied in companies in corresponding countries based on cultural compatibility. Third, the model could include mediating/moderating variables, such as creativity, employee satisfaction, and innovation, as well as different dimensions of organizational structure and culture.

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TAX DISCLOSURE AS A KEY ELEMENT OF SUSTAINABILITY REPORTING: A CRITICAL REVIEW OF GRI 207 STANDARD

Abstract: To combat tax avoidance and enhance corporate accountability, several global initiatives and frameworks have been established. OECD BEPS (Base Erosion and Profit Shifting) Action 13 requires as mandatory Country-by-Country Reporting (CbCR) for large MNCs, ensuring disclosure of taxes paid per jurisdiction. The EU Public CbCR Directive (2021/2101) requires companies operating in the EU to publicly disclose tax payments in each member state, while CSRD (Corporate Sustainability Reporting Directive) includes tax as part of broader ESG disclosures. There are also examples of national tax disclosure requirements (in the USA and UK), and sector-specific reporting requirements (Extractive Industry Transparency Initiative – EITI or UN Principles for Responsible Investment).

GRI 207: *Tax 2019* is the first comprehensive voluntary tax transparency standard applied across all industries, that combined elements from above mentioned reporting frameworks. The privately organized Global Reporting Initiative (GRI) has created an approach with the GRI 207 standard that declares tax aspects to be relevant to sustainability. GRI 207 was introduced in December 2019 and became effective on January 1, 2021, as the first standalone tax transparency standard within the GRI framework.

The GRI 207: *Tax 2019* Standard is designed to improve corporate tax transparency and accountability. It requires disclosures about tax governance, control frameworks, about how tax strategy aligns with business and sustainability goals (GRI 207-1 and 207-2), and how companies engage with stakeholders regarding tax matters (207-3). Moreover, multinational companies are required to provide tax-related data per jurisdiction, including revenues, profits, taxes paid, and employee numbers (GRI 207-4). Despite positive aspects related to GRI 207 application (alignment with ESG principles or Country-by-Country reporting), it also suffers from weakness and limitations, such as its voluntary nature, enforcement challenges and comparability.

Keywords: Sustainability reporting, GRI 207: Tax 2019, tax transparency, Country-by-Country Reporting.

1. INTRODUCTION

The growing focus on sustainable business requires the integration of environmental, social, and governance (ESG) factors into companies' strategies. Key issues include economic, ethnic and gender inequality, environmental impact and climate change. Traditional financial statements are no longer sufficient for investors and other stakeholders, which increases the need for non-financial and sustainability reports. Users of these reports are looking for reliable, comparable, and standardized information, which has led to the development of numerous standards and regulatory requirements. Among the key sustainability reporting frameworks, the GRI, SASB and TCFD stand out, which set guidelines for more

transparent and consistent ESG disclosure (more about the different reporting standards in: Denčić-Mihajlov, Pavlović & Spasić, 2024).

Along with climate change, sustainability and digitalization, as global trends that shape this century, the transparency of corporate tax information has gained importance in recent years. However, OECD (2024) has estimated that \$100-240 billion (equivalent to 4-10% of global corporate income tax revenue) is lost annually due to tax avoidance by MNCs. Taxation is critical in achieving the UN Sustainable Development Goals and provides main mechanism through which multinational companies (MNC) contribute to society, economic development, and social welfare. In 2019, the Global Reporting Initiative (GRI) introduced a dedicated tax reporting standard, GRI 207: Tax 2019, which became mandatory after January 2021, with promoted early adoption. The GRI emphasized that tax matters should be explicitly connected to sustainability goals and integrated into a corporate social responsibility (CSR) approach to management. "According to the United Nations, taxes play a vital role in achieving the Sustainable Development Goals and are a key mechanism by which organizations contribute to the economies of the countries in which they operate. Organizations also benefit from clear and comprehensive tax reporting because it reinforces their community contribution as part of their sustainability impact, strategy, and performance" (GRI, 2019). Furthermore, tax is a vital yet often overlooked component of ESG. In the environmental pillar, it influences corporate sustainability through green tax policies. Companies can utilize tax incentives to advance decarbonization efforts, invest in clean technology, and promote energy efficiency. Tax transparency demonstrates a company's commitment to society. Ethical tax practices and clear disclosures build trust and reinforce corporate values, while opacity can lead to reputational risks. Finally, tax supports reinforce ethical governance through compliance and disclosure. As indicated by PwC study (2023), "by integrating tax into ESG strategies, companies can strengthen investor confidence, improve market trust, and enhance long-term sustainability efforts".

Even though tax may not be of material importance for many companies, which can suggest that the company is not required to disclose tax in its reports, an increasing amount of organizations choose to disclose tax-related information voluntarily. A recent GRI survey (GRI, 2024) based on 71 world largest public companies shows that 30% of the selected companies mention tax as a material topic, either as a stand-alone material topic, or as part of wider subject (such as responsible business conduct). According to the Principles for Responsible Investing (PRI, 2018), the amount of corporate income tax a company pays is material to its profitability. Investors therefore seek to understand the extent to which future cash flows are based on the performance of the underlying business, and the extent to which they rely on other factors such as access to subsidies and the use of artificial tax structures which may be challenged in the future.

Tax transparency fosters stakeholder trust by emphasizing a company's commitment to fair and responsible tax practices. Beyond legal compliance, fair tax involves openness and a societal contribution mindset. As indicated by Grant Thornton (2024), companies that embrace tax fairness enhance their reputation and influence their business network positively. Detailed tax disclosures on strategy, governance, and payments align with best practices and address stakeholder concerns about fairness and corporate integrity. In this regard, Adhering to GRI 207: Tax 2019 reporting standard (hereafter GRI 207) is expected to enhance tax transparency, thereby strengthening public trust in corporate tax practices and the overall tax system. As suggested by Arnaud & Giordano-Spring (2024), the new reporting framework seeks to reshape the perception of taxation, positioning it as a societal contribution rather than merely a cost to be minimized. In this context, tax is recognized as an integral element of corporate social responsibility.

Taking into consideration the role of tax transparency in sustainability, the main aim of this study is to analyze the growing importance of corporate tax transparency and evaluate how global initiatives and reporting frameworks contribute to combating tax avoidance and promoting corporate sustainability and accountability, with a special focus on GRI 207 standard. Having discussed possible actions against tax evasion in the function of corporate responsibility, we review in Section 2 the key national and global tax disclosure frameworks. The paper critically assesses the impact of GRI 207: *Tax 2019*, by discussing how it aligns tax reporting with sustainability principles (Section 3) and by identifying its limitations in application (Section 4). The final Section concludes.

2. THE FIGHT AGAINST TAX EVASION IN THE FUNCTION OF CORPORATE RESPONSIBILITY

The issue of corporate transparency and accountability is an increasingly important item in global sustainability reporting. One of the key aspects of corporate responsibility is the disclosure of tax policy. Modern business conditions impose tax evasion at the international level as a central issue of the tax policy of every national economy. To ensure the equality of taxpayers, the governments of individual countries resort to the exchange of information at the international level. The exchange of information provides access to information of importance to tax authorities that they otherwise do not have access to. In this way, the exchange of information has the task of helping to fight against tax evasion and improving the transparency of tax policy at the international level.

In the fight against tax evasion, many directives and initiatives have been adopted at the regional level, such as in the European Union, then in the USA, Great Britain, and also at the global level. Each initiative sets transparency and disclosure of tax information as a basic goal (see Table 1). Their application is conditional on signing and acceptance by state authorities, and information transparency ranges from being available only to tax authorities for a more effective fight against tax evasion to public reporting. MNCs' pursuit of multiple non-taxation leads to significant losses of public revenues in the budgets of national economies. The global character of this phenomenon indicated the need to define a

standard that would take MNC business out of the gray zone and initiate corporate responsibility. The GRI 207: TAX 2019 standard represents a very significant step towards tax transparency, as its application contributes to increasing the reputation of companies, better assessment of investment risks and financial stability of companies, as well as the global fight against tax evasion.

Table 1: Comparison of selected major global tax transparency frameworks

Framework	Year Introduced	Scope	Key Requirement	Public Disclosure	Limitations
OECD BEPS Action 13	2015	Large MNCs (€750M+ revenue)	Country-by-Country Reporting (CbCR) to tax authorities	No (only shared with tax authorities)	Not public, limited to tax authorities
EU Public CbCR Directive	2021	Large MNCs (€750M+ revenue)	Public CbCR for EU operations and selected tax havens	Yes (but only for EU states + non-cooperative jurisdictions)	Limited scope, excludes many non-EU operations
EITI (Extractive Industry Transparency Initiative)	2003	Oil, gas, and mining	Disclose payments to governments, including taxes	Yes	Industry-specific (extractives only)
UN PRI Tax Guidance	2018	Institutional investors & companies	Encourage responsible tax policies in ESG reporting	No (voluntary)	No mandatory reporting requirements
UK Tax Strategy Disclosure	2016	Large UK-based companies (£200M+ revenue)	Publish tax strategies, risk management, and governance	Yes	UK-focused, no detailed tax payment data required
GRI 207: Tax 2019 Standard	2019	Any company reporting under GRI	Public CbCR, tax strategy, governance, stakeholder engagement	Yes	Voluntary, lacks enforcement

Source: Authors' comparison

The exchange of information between countries is, under certain circumstances, regulated by treaties and agreements between countries, mainly when the government of one country requests information on the income of its residents. The contribution of this, now traditional way of fighting to ensure the equal treatment of all taxpayers, is not easy to determine considering the difficulties that need to be overcome to see all activities aimed at tax evasion (Dharmapala, 2016). The modest probability of detecting cross-border tax evasion contributes to the diversity of tax policies between countries, as well as the existence of the so-called tax havens. The jurisdiction of these countries is attractive to taxpayers precisely because of the lack of transparency of tax data, and the protection of client data by banks, and it is not rare even to refuse data exchange with their resident countries.

Due to the nature of MNC business, they are subject to international taxation, and solving the problem of double taxation through different organizational structures, transfer pricing and hybrid financial instruments (Martinez, 2023) leads to its opposite - double non-taxation. To combat tax evasion and increase corporate responsibility, several global initiatives and frameworks have been established. The main goal of OECD Base Erosion and Profit Shifting (BEPS) Action 13 (OECD/G20, 2020) is directing tax revenues to the place of generating economic values against the erosion of the tax base and the transfer of profits between countries to avoid paying taxes. The main characteristic of this act is that it represents a regulatory instrument whose operationalization is based on the exchange of data between the tax administrations of the countries. In this way, the tax authorities, through a kind of supervision over the tax policy of MNCs, have the possibility of influencing the redirection of realized profits by increasing the transparency of the tax obligations of MNCs. The method of implementation of OECD BEPS Action 13 is the responsibility of the states. However, the signatories of the Multilateral Agreement on the exchange of CbCR data are obliged to exchange data on the operations of MNCs. To identify potential abuses in the field of taxation, data exchange is carried out at the level of tax administrations of countries, but there is no obligation to make data available to the general public.

The EU Directive on Public CbCR (European Commission, 2021) aims to increase transparency and greater control of the relationship of MNCs to the taxation of profits. This Directive requires MNCs whose consolidated revenues exceed the amount of 750 million euros and whose operations take place on the territory of several EU member states to provide the general public on an annual basis with certain information on the amount of tax paid in the territory of a particular country (Deloitte, 2024). The CSRD (Corporate Sustainability Reporting Directive) requires large companies, and those companies listed on the stock exchange, to publish regular reports on the social and environmental risks they face, as well as on how their activities affect people and the environment (European Commission, 2022). This way of reporting, whose application begins in the financial year 2024, with reports published in 2025, contributes to all interested parties to assess the performance of companies in terms of sustainability. Amendments to the Directive from February 2025 provide that,

to simplify application, CSRD applies only to the largest companies, i.e. those for which there is a high probability of a significant impact on people and the environment.

The OECD BEPS CbCR does not have an obligation to make data public, which suggests a lack of access to meaningful information about taxes paid by companies. Also, the submission of information on the tax paid, which only applies to large MNCs with an income of over 750 million euros, excludes from the records those MNCs that do not generate the said income. CbCR requirements are applied depending on the way of implementation of the regulations of individual countries, which lacks the desired level of harmonization in the application of the regulations. In addition to all of the above, the effectiveness of the implementation of the Directive is also reduced by the fact that it only covers certain countries, which gives companies some room to omit data on the results of operations in countries with special tax advantages, that is, tax havens.

The tax disclosure requirement in the US is governed by Internal Revenue Service Form 8975 - Country-by-Country Report (IRS, 2020) and includes reporting on an annual basis for MNCs that in the previous reporting period generated annual revenue of \$850 million or more. These reports include basic information in the field of tax policy and do not have a public character, which means that they are exchanged only between competent tax administrations in accordance with international agreements.

U.S. Securities and Exchange Commission (SEC) Disclosure Rules regulate mandatory reporting for public companies (U.S. SEC, 2024). They aim to improve and standardize the publication of data related to the state of public companies, to provide access to information on the financial effects of risks that accompany business operations and the management of those risks. The data has a public character and is available in the SEC database.

The U.S. The Corporate Transparency Act (CTA) - 2021 went into effect on January 1, 2021, and requires small business owners in the US to file corporate transparency reports with beneficial ownership information (U.S. Chamber, 2021). This law introduces new rules that require the reporting of data on the ownership structure of companies, which may have an indirect impact on tax transparency. Data from these reports are not publicly available but are used only for regulatory and tax purposes.

Country-by-Country Reporting (CbCR) - UK Implementation of BEPS 13 in Great Britain obliges MNCs with revenues above 750 million euros to submit CbCR reports that are not public. The UK Tax Strategy Disclosure Finance Act 2016, Schedule 19 obliges companies that generate revenue of more than 200 million pounds or have a balance sheet in the amount of more than 2 billion pounds to publish their tax strategy on their websites (HM Revenue & Customs, 2016). These data have a public character and are available to interested subjects.

EITI (Extractive Industries Transparency Initiative) is a global standard for improving transparency and accountability in the extractive industries sector, such as mining, oil, and gas (EITI, 2023). The main goal of this standard is the fight against corruption, the management of natural resources, and the creation of conditions for income from extractive industries to contribute to the development of society. To ensure this goal, governments and companies are obliged to disclose data on the amounts of taxes paid, mining fees, concession fees, and other transactions related to natural resources. The report is publicly available and contains data on income and how it is used by companies. The independence and objectivity of reporting are ensured by the participation of governments, the private sector, and civil society in the entire process. The governments of individual countries are obliged to ensure the smooth implementation of the EITI through active operational engagements. Reporting companies are expected to publish an anti-corruption policy that shows how the company manages the risk of corruption, as well as beneficial ownership information. Conditions for the participation of civil society must also be ensured when adopting the appropriate laws, regulations, and rules, as well as regarding the practical implementation of the EITI.

This United Nations Principle for Responsible Investing Guidance on tax (UN PRI, 2024) is a global framework designed primarily to help investors engage with companies, encouraging greater corporate tax responsibility. This includes fostering a more responsible approach to tax practices through improved disclosure and transparency, strong governance, and effective management of tax-related risks.

3. STANDARD GRI 207: TAX 2019 IN THE CONTEXT OF GLOBAL BUSINESS AND SOCIAL RESPONSIBILITY

GRI 207: Tax 2019 is the first global tax standard that promotes proactive transparency through voluntary disclosure of tax data and strategies (Global Reporting Initiative, 2019). The GRI 207 standard has four basic components.

GRI 207-1 is a tax strategy and the first component of this standard which focuses on the transparency of companies' tax policies. Companies that adopt this standard are required to disclose information about:

- the way of solving issues in the field of tax policy,
- tax compliance in the sense of ensuring the minimum of this compliance as opposed to an ethical tax approach,
- the connection between tax and business strategy in terms of supporting long-term sustainability,
- method of identification, assessment, and management of tax risks, as well as
- the relationship with the tax authorities and their tax obligations.

GRI 207-2 is a component that focuses on internal management and control mechanisms that ensure compliance with tax regulations. The main goal is the disclosure of subjects within the company who are responsible for making key decisions in the area of tax policy (board of directors, financial director, tax department). The data should show that tax decisions

are not made on an arbitrary basis, but that there is a clear structure of responsibility. Preventing tax abuses and financial risks, and strengthening investor confidence in the company's management mechanisms are also positive effects of applying GRI 207-2.

GRI 207-3 defines how companies communicate with stakeholders regarding their tax policy and strategy. This aspect of the standard emphasizes the importance of dialogue and data transparency between the company and the various participants:

- Governments and regulatory bodies - data on the way of communication with state institutions about tax issues;
- Investors - providing information to investors about their approach to tax planning, risks and compliance strategies and
- The public and citizens' organizations - transparency regarding the company's contribution to local communities through the payment of various forms of public duties.

GRI 207-4: Public Country-by-Country Reporting (CbCR) is a component of the GRI 207 standard that requires companies to disclose detailed financial and tax information by country in which they operate. These data increase the transparency of the data on the one hand, and on the other hand, reduce the possibility of intensifying the shifting of profits to jurisdictions with low tax rates. The data disclosed refers to:

- The total revenue that the company achieves in a certain country,
- The financial result expressed before tax calculation, which gives an insight into the profitability of business in the specific country,
- The amount of income tax actually paid in each country in which the company operates,
- The number of employees in a certain country, which allows seeing the economic impact of the company and
- Data on the total value of assets and capital in each country where the company operates.

By publishing the above data, companies contribute to the global fight against tax evasion, but also to their corporate rating, while investors can make a more accurate assessment of the tax risk and financial stability of companies. Unlike regulatory frameworks such as the OECD BEPS CbCR or the EU Public CbCR, the application of GRI 207-4 does not have a binding character, which opens up the possibility of avoiding the publication of sensitive information. In this way, the volume of published data is limited, which leads to a decrease in the usefulness of the obtained reports. The issue of lack of standardization of presented data appears as a disadvantage, which makes comparison between companies difficult.

Although GRI 207-4 represents a significant step towards a higher level of tax transparency, the effect of its application is limited in the first place due to its non-binding character based on (dis)interest in the application. Those companies that choose to apply this standard demonstrate a proactive approach to corporate responsibility, which can have a positive impact on their rating and relationship with interested parties.

4. GRI 207: CRITICAL ASSESMENT AND CHALLENGES IN IMPLEMENTATION

Even though the GRI 207 Standard is designed to improve corporate tax transparency and accountability, it also suffers from weakness and limitations, such as its voluntary nature, enforcement challenges and comparability. In the first place it should be emphasized that unlike mandatory tax disclosures required by governments, GRI 207 is a voluntary framework. This means that companies may choose to report selectively or avoid full compliance without facing legal consequences. GRI 207 also poses challenges due to its complexity and compliance burden, requiring extensive resources for country-by-country reporting. As indicated in the Deloitte report (2024), there are significant differences to country-by-country reporting according to OECD CbCR and GRI 207 in qualitative information as well as in the figures. Therefore, the implementation of GRI 207 reporting should be seen as an independent project. Deviations between the OECD CbC reporting and the reporting according to GRI 207 arise regarding the qualitative information in the areas such as units to be included, information on the included entities, country-level activities etc. The requirement for detailed disclosures, particularly country-by-country reporting, can be challenging for multinational corporations with extensive operations. It may require significant administrative resources to compile and report the necessary data (Deloitte, 2024). Another challenge related to GRI 207 application is possible greenwashing, a situation when companies mislead stakeholders by presenting themselves as environmentally or socially responsible while engaging in practices that contradict these claims. In the context of tax transparency, as indicated by Bilicka et al. (2021), "greenwashing requires firms to depict themselves as good citizens while continuing to aggressively tax plan" (by using loopholes, tax havens, and complex financial structures to minimize their tax burden). While GRI 207 primarily aims to enhance tax transparency and reduce corporate greenwashing, it can also have some unintended negative consequences, in the first place a superficial compliance with GRI 207 reporting requirements without any change of their tax behavior. By reporting according to GRI 207 companies may selectively highlight tax data that makes them look responsible while hiding or downplaying aggressive tax practices, i.e. may still continue to engage in tax avoidance which allows greenwashing to persist in a more sophisticated form. Moreover, companies may use GRI 207 compliance as a marketing tool, suggesting that tax transparency alone makes them sustainable and ethical, and by doing so, they can divert attention from other environmental or social issues (e.g., carbon emissions, labor exploitation).

A special challenge is related to the approach to stakeholder engagement and management of stakeholder concerns related to tax, which is required by the GRI 207-3. As empirical studies show (KPMG, 2024), many companies have implemented processes to collect and consider the views of stakeholders on their ESG risks and sustainability impacts but tend not to cover tax in these processes. Poor coordination between public affairs, sustainability, and tax functions can create inconsistencies between a company's commitments and its lobbying efforts, leading to accusations of hypocrisy. In addition, considering that GRI 207 requires detailed country-by-country tax reporting, its requirements can overload stakeholders with complex data (a false perception of accountability), a situation where it becomes difficult to spot unethical tax practices.

Last but not the least, disclosing detailed tax data according to GRI 207 may put companies at a competitive disadvantage by exposing sensitive business information. As mentioned, GRI 207 suppose country-by-country reporting (CbCR), requiring companies to disclose where they generate profits, pay taxes, and operate subsidiaries. Competitors can analyze this data to gain insights into supply chains, pricing strategies, and profit margins, i.e. can potentially use this information to undermine market positions or target key markets. While tax transparency can build trust (Bloomberg Tax, 2023), the disclosure of sensitive tax data under GRI 207 may expose companies to competitive risks, regulatory scrutiny, and reputational damage. Having that in mind, companies must balance transparency with the need to protect strategic business information while ensuring compliance with GRI 207 and other evolving tax regulations.

CONCLUSION

Corporate transparency and accountability in the field of tax policy are becoming an increasingly important segment of global sustainable business initiatives. Tax evasion at the international level remains a key challenge that requires coordinated efforts by states and regulatory authorities through the exchange of information and the adoption of regulatory frameworks. In this context, the OECD BEPS initiative, the EU directives on public CbCR, as well as the regulations of the US and the United Kingdom are important mechanisms in the fight against tax evasion and the improvement of tax transparency. However, there are still challenges in their implementation, such as limited availability of data to the public, non-harmonized regulations between countries, and the existence of tax havens that allow taxpayers to avoid obligations. GRI 207: Tax 2019 represents a significant step forward in fostering voluntary tax transparency, enabling companies to disclose information about their tax strategy, tax risk management and relationship with tax authorities. A key advantage of this standard lies in its potential to increase investor confidence, improve the assessment of tax risks and contribute to the financial stability of companies. However, its non-binding nature limits its application, as companies can selectively report or avoid publishing data altogether without legal consequences. Despite progress in regulating tax transparency, there remains a need for further unification of standards and increased reporting obligations. The introduction of global regulatory mechanisms with stricter tax disclosure obligations could significantly contribute to curbing tax evasion and strengthening corporate accountability. Focusing on long-term benefits, including increased stability and reputation for companies, is key to achieving a fairer tax system globally.

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Fiscal Policy Effects on the EU Real Economy: Pooled Mean Group Approach

Abstract: This paper analyzes the key activities and scope of fiscal policy functioning, providing a balance between stimulating economic growth, as opposed to additional burden on economies due to the financing of public expenditure through borrowing. The subject of the econometric analysis is how the dynamics of public expenditure affect the real gross domestic product (*RGDP*) in the long-term on a sample of 27 member states of the European Union (EU) in the period 2004q1-2024q2. Based on the results of the research using the macro panel data method (Pooled Mean Group), the conclusion is drawn that there is a long-term positive equilibrium relationship between the increase in public expenditure and the growth of *RGDP*, confirming the theoretical assumption of the existence of Keynesian effects. However, the speed of adjustment of individual economies to the long-term equilibrium relationship is heterogeneous, due to the absence of a unified fiscal policy within the EU. Individual adjustments were the most intense in small open economies, Slovenia and Slovakia, which implies that in these economies the effects of public expenditure to stimulate the real economy were recorded to a greater extent. Less intense, but statistically significant adjustments were recorded in the central EU: France, Germany and Belgium, as well as the peripheral economies of the EU: Portugal, Spain and Italy. The observed effects imply economic policy makers reconsideration whether this measure of using the fiscal policy mechanism is justified, taking into account the sources of financing public expenditure.

Keywords: Fiscal policy, Public expenditure, GDP growth, Pooled Mean Group approach.

1. INTRODUCTION

Fiscal policy represents one of the most important instruments of economic policy, through which the state apparatus tries to ensure, first of all, economic stability, then economic growth, including the sustainability of

public finances. The structure of public expenditure is extremely important for providing the vitality of the economic system. Fiscal expansion mediated by the growth of public expenditure, and directed towards investments in infrastructure, economy and education, can have a long-term and positive impact on economic growth. However, activities of increased public expenditure aimed at administration may have fewer effective implications (Tcherneva, 2011). Also, it is essential to consider the relationship between the growth of public expenditure and the growth of real gross domestic product (*RGDP*). The increased level of public expenditure due to the accumulation of economic activities opens the problem of fiscal deficit, if it is not accompanied by a simultaneous increase in public revenues. The lack of financial resources in the state budget can be provided through various models of foreign borrowing. In that case, it is necessary to assess whether the expected rates of economic growth in the coming years will be sufficient to service the state's debt. Also, an excessively high level of public expenditure can have negative effects, generating excessive and uncontrolled aggregate demand, which would potentially open the issue of rising inflationary pressures. Economic policy, which is based on the Keynesian postulates, indicates that the increased level of public expenditure can stimulate production, that is, positive effects on economic growth. This effect is especially present at times when the macroeconomics of a country is faced with stagnant economic activities, which may be followed by a deepening crisis, i.e. economic decline (Alesina and Ardagna, 2013). Also, a generous fiscal policy can achieve positive repercussions even in those moments when there is an insufficient level of interest on the side of aggregate demand. However, the effectiveness of public expenditure depends on the size of the multiplier. If the multiplier level is high, it will mean that a small increase in public expenditure can have significant and far-reaching effects on the real economy and economic growth. However, if the level of the multiplier is low, then even a high level of public expenditure would produce smaller effects on the real economy. Stated implies that the accumulation of public expenditure and fiscally generous economic policy can achieve economic growth, but only under certain conditions (Ramey, 2011). It is of crucial importance that public expenditure is used efficiently and financed sustainably, in order to avoid the negative consequences of excessive debt levels and potential inflationary pressure. Public expenditure as an instrument of fiscal policy represents the most complex mechanism of action on the real economy, which is manifested through continuous debates between economic policy makers. Therefore, a comprehensive analysis and observation of the long-term effects of fiscal policy on GDP growth in EU countries can provide relevant insights into the effectiveness of this instrument of economic policy, as well as indicate potential risks associated with expansive fiscal policy (Brender and Drazen, 2008). The effects of fiscal policy on the real economy are the subject of numerous academic discussions, especially in the context of economic integration and the heterogeneity of fiscal strategies among EU member states. This paper has a three-fold objective: (1) to analyze and provide a theoretical interpretation of how the dynamics of public expenditure affects the real gross domestic product in the long run, (2) that descriptive statistics show the dynamics of public expenditure and its impact on *RGDP* growth in the period 2004q1-2024-q2 on a sample of 27 EU member states, (3) and that, using heterogeneous panel models analyze whether there is a long-term equilibrium relationship between public expenditure and *RGDP* growth in the period 2004q1-2024-q2 on a sample of 27 EU member states. The hypotheses analyzed in the paper are as follows:

- H₁: Long-term equilibrium relationship exists between public expenditure growth and real gross domestic product (RGDP) growth in a sample of 27 EU member states in the period 2004q1-2024q2.*
- H₂: The speed of adjustment of individual economies to the long-term equilibrium relationship is heterogeneous in the sample of 27 EU member states in the period 2004q1-2024q2.*

The rest of this paper is organized as follows: after the introductory part, the second section provides a literature review, the third section provides a descriptive analysis of the dynamics of public expenditure and *RGDP*, the fourth section provides an empirical analysis of the key determinant of *RGDP* based on Pooled Mean Group (PMG) estimator, while the last section interprets the key considerations.

2. LITERATURE REVIEW

The discussion of economic policy makers on the effects of fiscal expansion on the real economy and economic growth is one of the most important topics of economic doctrine. Ensuring strong and stable economic growth that will be a generator of unemployment reduction and accumulation of economic activities, while not endangering the stability of public finances and the level of indebtedness, is the key goal of fiscal policy. Among

the economists who provided a thorough theoretical and empirical framework, including a comprehensive analysis of expansionary fiscal policy measures, investigating the dynamics of public expenditure and debt levels with the aim of stimulating economic activities and the real economy, are Blinder and Solow (1976), De Constance, Cédex & Mihov (2001), Blanchard and Perotti (2002), Perotti (2004), Arpaia and Turrini (2007), DeLong and Summers (2012) and Glavaški and Becker Pucar (2020). Schumpeter and Keynes (1936) concluded in their research that the use of fiscal expansion as a tool can ensure the stimulation of economic activities, especially in periods of stagnation or economic decline. That is, that the growth of public expenditure directed towards investment activities can have a stimulating effect on the growth of aggregate demand and on the reduction of unemployment. In their work, Zagler and Dürnecker (2003) confirm the Keynesian thesis that the growth of public expenditures and revenues can have long-term and positive implications for productivity and economic growth. Kasasbeh (2021) indicates that the use of fiscal policy as an economic program in the form of adjusting public revenues and expenditures during different phases of the economic cycle can have positive effects on the real economy. It also indicates that positive effects in the form of an increase in total production, productivity, including economic growth itself, are possible only if fiscal policy measures are used in an efficient and appropriate manner. In their research, Galí, López-Salido & Vallés (2007) analyze the effects of growth in public expenditure and indebtedness on economic growth in developed countries. They conclude that an increase in the level of indebtedness in order to achieve greater public expenditure aimed at investments can ensure positive effects on the real economy and thereby fulfill the Keynesian assumptions. Battaglini and Coate (2008) point out that the global economy in the 21st century was hit by major crises, which directly contributed to the increasing participation of the state in economic activities. Deep economic crises have inevitably led to increasingly frequent state interventions in the form of increased public expenditure, in order to avoid economic stagnation and, at the same time, the collapse of the economic system. They also point out that government interventions can produce positive effects on the economy not only by increasing aggregate demand, but by contributing to raising productivity and the growth rate of the economy. In their research, Battaglini and Coate (2008) provide a valuable answer to the question of whether economic policymakers should implement fiscal expansion measures with the aim of stimulating the real economy or not, depending on the level of indebtedness of the analyzed country. It concludes that it is justified to increase the level of public expenditure and indebtedness, only if the resources are directed towards increasing productivity and improving economic results, as well as maximizing household well-being. This confirms the Keynesian thesis. Alesina (2012) in his work indicates that the financial crisis of 2008 affected a large number of countries, and that fiscal policy, as a reflex instrument, took a central position. His research analyzes the effectiveness of discretionary fiscal policy measures during crisis circumstances with the aim of stimulating the real economy. In his concluding remarks, he points out that the increase in public expenditure compared to the reduction in tax rates was more effectively reflected in the real economy and GDP growth. This confirms that the countercyclical action of the fiscal policy created positive consequences for the macroeconomics, meaning non-Keynesian effects. While on the other hand, authors like Barro (1974), in their research, developed the hypothesis of Ricardian equivalence, which suggests that increased public expenditure can be neutralized, if it occurs by a sharp decrease in private consumption due to negative expectations, and an increase in future tax burdens. Stated implies that rational individuals reduce current consumption due to future tax increases necessary to service the debt and thereby neutralize the effects of fiscal expansion. Camous and Gimber (2018) point out that if the public debt is at an optimal level, without endangering the fiscal parameters, tax policy can be countercyclical in the form of the government reacting to lower production with reduced tax rates and higher public expenditure. However, this creates the possibility of a "fiscal policy trap ". In periods when production is low and fiscal policy is very generous, rational individuals, i.e. households, can reduce the level of personal consumption and investment due to greater fiscal burdens in the future and thus threaten the actions of fiscal authorities on the real economy. In his work, Uhlig (2010) investigates the interaction of fiscal and monetary policy using Bayesian VAR models. Based on the research results, he concludes that the implementation of an expansionary fiscal policy can have fewer effective effects, if simultaneously, restrictive monetary policy is implemented. Based on a comprehensive review of the literature, we can conclude that research on the effects of fiscal policy on the real economy indicates that there is significant heterogeneity of results, where the effectiveness of fiscal derivatives, including the degree of indebtedness of the economy, the level of cooperation with other economies, as well as the interaction with monetary policy itself, is of essential importance. Economists who advocate the Keynesian model of economic policy emphasize the positive and long-term effects of expansionary fiscal policy on real GDP. Whereas, supporters of neoclassical economic thought and Ricardian theory point to potential negative consequences, such as the growth of public debt and the reduction of private investment and consumption. In the context of EU analysis, where there is no single fiscal policy, the analysis of the effects of fiscal policy becomes far more complex, requiring careful empirical research, explaining the specific characteristics of each economy. The contributions of this work are diverse, as they provide a detailed theoretical and empirical analysis, indicating the existence of a long-term and positive relationship between the growth of public expenditure and the growth of RGDP (Keynesian effects), during the analyzed period 2004q1-2024q2 on a sample of 27 EU member states.

3. DESCRIPTIVE STATISTICS - EFFECTS OF PUBLIC EXPENDITURE ON REAL GDP

Fiscal policy and its effects on the real economy represent one of the central issues in macroeconomics, especially in the context of the functioning of the EU. The very nature of the functioning of fiscal policy measures requires a thorough analysis. The key reasons are manifested through the fact that the EU member states are first of all facing different economic challenges, the goals they strive for in terms of economic indicators, but also due to heterogeneous fiscal policy. The question that arises is whether the increase in public expenditure contributes to the growth of *RGDP* or, on the contrary, causes long-term economic distortions, deepening the crisis (Alesina and Giavazzi, 2013).

Figure 1 shows the average movement of public expenditure and the movement of the average real GDP in a sample of 27 member states of the European Union during the period 2004-2024, using annual data. Namely, the dynamics of the movement of these variables are similar, which implies that one of the key factors in the growth of *RGDP* during the observed period was precisely the growth of public expenditure. Namely, not only did the growth of public expenditure have a positive effect on the functioning of the real economy and economic growth, but we can conclude that the interventions of economic policy makers, implemented through the growth of public expenditure, provided countercyclical effects during the two crisis periods of 2008-2010 (Global financial crisis) and 2020-2021 (Pandemic crisis) year. During the mentioned years, the level of *RGDP* decreased, but the fiscal authorities responded with an expansive fiscal policy through the growth of public expenditure. This economic intervention aimed to preserve production, investments and productivity, but also to minimize the negative effects of crisis periods.

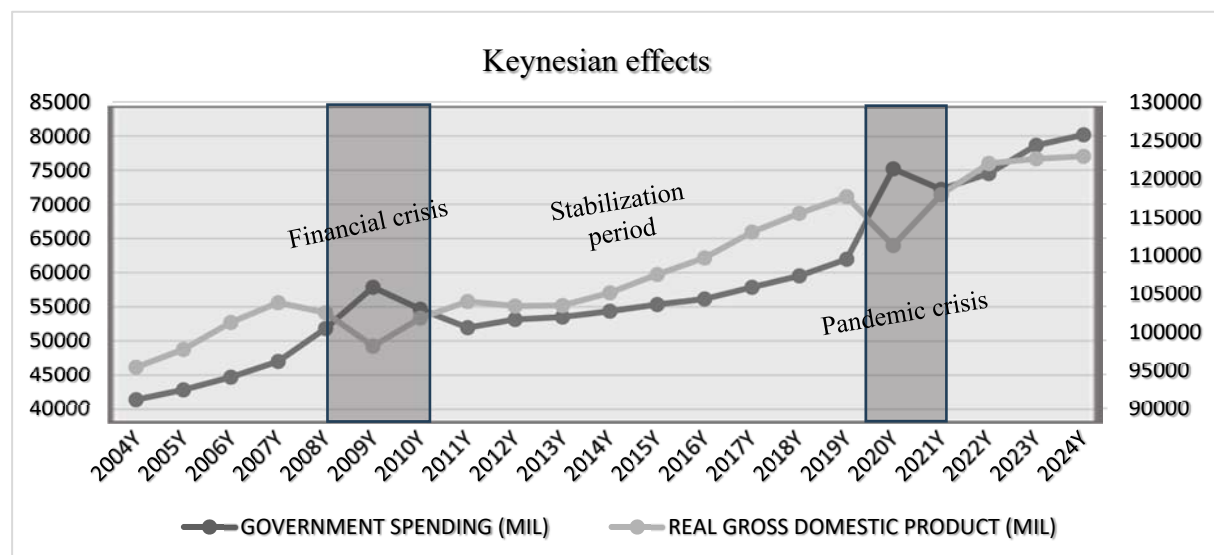


Figure 1: Average public expenditure and average *RGDP* in 27 European Union economies (2004-2024)

Source: Authors according to EUROSTAT.

Of course, it is necessary to point out that during the observed period 2004-2024, not all EU members implemented the same fiscal policy measures. During the observed period, countries such as Germany, Slovenia, Slovakia and France used public expenditure as a generator of economic growth, but also as a countercyclical factor during recessionary episodes.

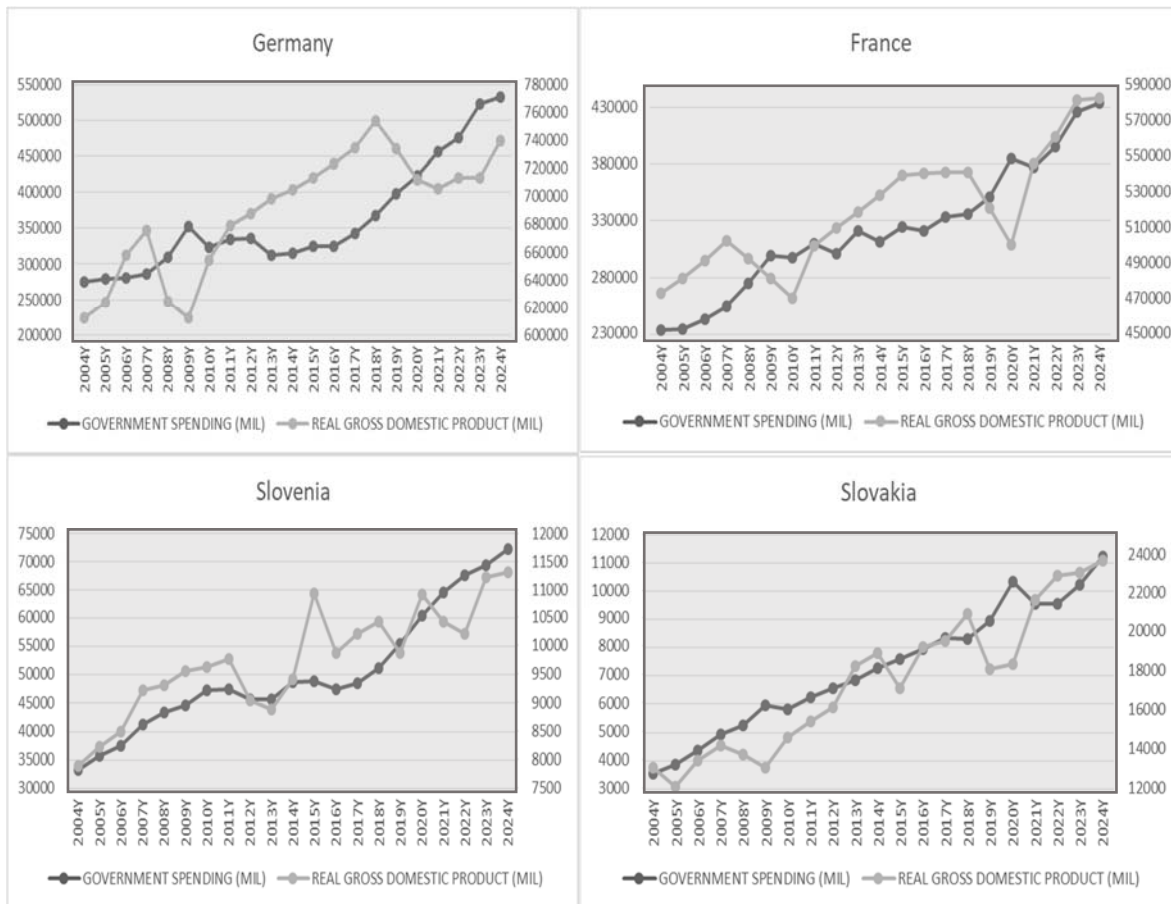


Figure 2: Pronounced Keynesian effects in Germany, Austria, Slovenia and Slovakia in the period (2004-2024)

Source: Authors according to EUROSTAT.

Also, on the other hand, it is necessary to point out that during the observed period, countries such as Portugal and Italy used public expenditure to a lesser extent as a mechanism of *RGDP* growth. One of the key reasons of the economic policy makers for this type of functioning of the fiscal policy is reflected in the fact that the aforementioned economies detected that an expansive fiscal policy can become unsustainable because it can lead to an increase in public debt and a fiscal crisis. Also, these countries have a traditionally high level of public debt, which can further burden the economy of these countries.

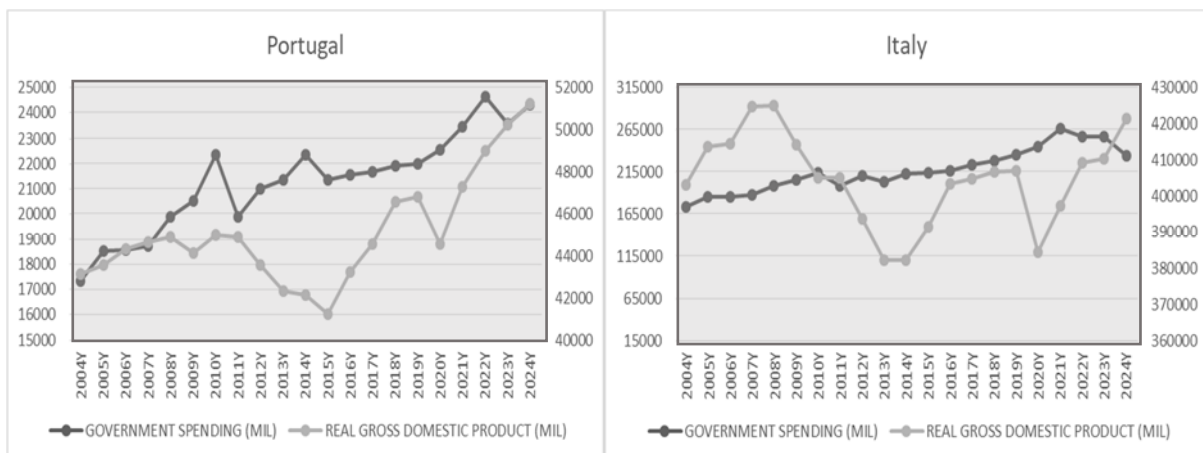


Figure 2: Less pronounced Keynesian effects in Portugal and Italy in the period (2004-2024)

Source: Authors according to EUROSTAT.

Based on the conducted research, it can be concluded that in the absence of a single fiscal union, economic policies should be adapted to the specifics of each country, in order to avoid the negative effects of borrowing and macroeconomic instability.

4. EMPIRICAL ANALYSIS IN EU MEMBER COUNTRIES

The empirical analysis is based on a panel analysis containing 27 cross-sectional units (27 EU member states) during the period 2004q1-2024q2. Thus, the number of observations included in the panel is 2187, where the variable *RGDP* represents the real gross domestic product used as the dependent variable. There are large differences in the case of minimum and maximum values of real gross domestic product, which is expressed in billions (mil). The lowest level of *RGDP* was recorded in the 1st quarter of 2004 in Malta (1378.6 million), while the highest level of *RGDP* was achieved in Germany in the 3rd quarter of 2022 (770584.3 million). The independent variable *PUBLIC EXPENDITURE*, also expressed in billions, recorded the minimum value in Malta (499 million) in the 1st quarter of 2004, while the highest level of *PUBLIC EXPENDITURE* was detected in Germany (553640 million) during the 3rd quarter of 2023.

Table 1 shows the Pesaran CD, Pesaran CIPS and Westerlund cointegration test. Based on the Pesaran CD test, we conclude that there is cross-sectional dependence (CSD) because the analyzed countries are mutually dependent. Based on unit root tests (Im et al. 2003), the analyzed variables: real gross domestic product and public expenditure are non-stationary, i.e. panel unit root tests fail to reject the null hypothesis of variable non-stationarity at the 5% significance level, which means that the variables *RGDP* and *PUBLIC EXPENDITURE* are non-stationary. Then, the stationarity of the first differences of the variables is tested. The results of the Pesaran CIPS test showed the stationarity of the variables in the first difference, that is, all the variables in the model are integrated of the first order, which is the basis for the cointegration relationship. Using Westerlund's (2007) test, it is estimated whether there is a cointegrating relationship. The null hypothesis indicates that there is no cointegrating relationship, compared to an alternative relationship that indicates the existence of cointegration between non-stationary variables. The results based on the Westerlund test show that the null hypothesis is rejected, which means that *RGDP* and *PUBLIC EXPENDITURE* are cointegrated. Mean Group (MG) and Pooled Mean Group (PMG) methods defined by Pesaran et al. (1997, 1999) are further used to assess the existence of a long-term equilibrium relationship between real gross domestic product and public expenditure, as well as the dynamics of adjustment of individual economies to the long-term relationship.

Table 1: Pesaran CD test, Pesaran CIPS test and Westerlund cointegration test

Variables	Pesaran y CD test	p- values	Lags	CIPS panel unit root test in the level	p- values	CIPS test at the first differences	p- values	Westerlund cointegration test		Robust p-values (bootstra p)
<i>GDPR</i>			0	-24.456	0.000	-5.076	0.000	Gt	-2.072	0.021
	49.16	0.000	1	-17.983	0.399	-0.257	0.000	Ga	-1.508	0.015
			2	-4.567	0.997	2.790	0.000			
<i>PUBLIC EXPENDITURE</i>			0	-19.567	0.000	-16.002	0.000			
	134.85	0.000	1	-14.321	0.481	-9.482	0.000	Pt	-3.069	0.012
			2	-6.798	0.999	-4.351	0.000	Pa	-0.207	0.029

Source: Author's calculation.

Table 2, using the MG and PMG methods, examines the existence of a long-term equilibrium relationship between real gross domestic product and public expenditure, as well as the speed of adjustment of individual economies to the long-term equilibrium relationship. Based on the results obtained in both cases, the cointegration ratio of the analyzed variables is statistically significant and positive: 0.6466 in the PMG model, and 0.7822 in the MG model. In comparing these two methods, a higher long-term coefficient is estimated in the MG method. Given that the error correction parameter is significant and negative, indicating the speed of adjustment towards long-term equilibrium, the total adjustment in the PMG model is -0.1094, indicating that 10.94% of the deviation is corrected in one year, while the adjustment in the MG model is -0.1357, indicating that on average, 13.57% of the deviation is corrected in one year. Moreover, short-term coefficients show that in average increase of public expenditure increase *RGDP* (average magnitude of influence is low, but still significant: 0.04 in PMG and 0.026 in MG specification). However, Hausman's test for the long-term homogeneity of the relationship showed that the PMG method provides an optimal specification, with efficient estimates, given the heterogeneous implementation

of the fiscal policy of the observed countries (heterogeneous adjustments) with common fiscal rules (homogeneous long-term relationship).

Table 2: Results of PMG and MG estimator for homogeneous coefficient for 27 European Union economies in the period from 2004q1-2024q2

Dependent Variable <i>GDP</i>	Long-Term Equilibrium		Error Correction		Δ <i>PUBLIC EXPENDITURE</i>		μ	
	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
PMG	0.6466	0.000	-0.1094	0.000	0.040	0.092	12770.99	0.071
MG	0.7822	0.000	-0.1357	0.001	0.026	0.033	14755.31	0.048
Hausman test statistic	0.47	0.52						

Source: Author's calculation

Table 3 shows the heterogeneous impact of public expenditure growth on real gross domestic product using the PMG method. Based on the obtained results, we conclude that there is a heterogeneous long-term equilibrium relationship between the growth of public expenditure and real gross domestic product. This effect was most pronounced in France, Germany, Slovenia, Slovakia and Belgium, while a weaker but statistically significant effect was present in Italy, Spain, Bulgaria, Austria and Portugal.

Table 3: Results of the PMG Estimator for the heterogeneous coefficient for 27 European Union economies in the period from 2004q1-2024q2

PMG ESTIMATOR	Error Correction		Δ <i>PUBLIC EXPENDITURE</i>		μ	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Belgium	-0.2691	0.001	-0.4276	0.111	16156.56	0.001
France	-0.5929	0.000	-0.7912	0.039	187698.4	0.000
Croatia	-0.0921	0.151	-0.218	0.033	779.9956	0.124
Italy	-0.0919	0.014	-0.1654	0.018	24561.78	0.015
Spain	-0.1489	0.026	-0.2797	0.021	29713.73	0.022
Greece	-0.0152	0.445	-0.0539	0.023	817,395	0.386
Ireland	-0.0046	0.813	-0.0442	0.033	436,810	0.543
Estonia	-0.0768	0.058	-0.1561	0.002	240.8054	0.050
Germany	-0.5989	0.047	-0.5944	0.002	47469.73	0.040
Denmark	-0.0106	0.729	0.0708	0.049	672.86	0.608
Czech Republic	-0.052	0.148	0.1230	0.018	1768,526	0.104
Bulgaria	-0.0571	0.044	-0.1128	0.008	437.3968	0.020
Cyprus	-0.0406	0.325	-0.1128	0.102	177.7878	0.235
Latvia	-0.0717	0.117	-0.1214	0.142	289.0418	0.085
Lithuania	-0.0067	0.793	-0.1614	0.119	103.9554	0.514
Luxembourg	-0.0614	0.156	-0.0576	0.044	547.8935	0.113
Hungary	-0.0784	0.091	0.1463	0.023	1590.293	0.067
Malta	-0.0209	0.219	-0.1696	0.012	4.6951	0.866
Netherlands	-0.0399	0.359	0.0124	0.064	5231.124	0.302
Austria	-0.1629	0.007	-0.0125	0.045	8127.048	0.007
Poland	-0.0011	0.947	-0.2819	0.438	755,683	0.531
Portugal	-0.1612	0.006	-0.0311	0.033	5026.93	0.006
Romania	-0.015	0.284	0.2768	0.445	125.6822	0.744

Slovenia	-0.7881	0.000	-0.5599	0.316	253,722	0.000
Slovakia	-0.7994	0.000	-0.0561	0.237	5403.411	0.000
Finland	-0.0262	0.458	-0.095	0.237	875,566	0.411
Sweden	-0.0468	0.101	-0.102	0.073	3497.966	0.062

Source: Author's calculation.

Also, based on the presentation in Table 2, it can be seen that the speed of adjustment of individual economies to the long-term equilibrium relationship is of a heterogeneous character. For example, individual adjustment to the long-term equilibrium relationship was most intense in small open economies: Slovenia, Slovakia, and in the central EU economies: France and Germany, which means that precisely those economies used fiscal expansion mechanisms to a greater extent as a generator of economic growth and a means of countercyclical action. While, on the other hand, a slower intensity of adjustment, i.e. a lower level of use of public expenditure as a mechanism of real gross domestic product growth, was recorded in peripheral EU economies: Portugal, Italy, Ireland, Croatia, Greece and Spain. Moreover, short-term coefficients show that public expenditure has significant additional effects on *RGDP* growth in France and Poland, while, additional increase of public expenditure in Greece would lower *RGDP*, and *vice versa*, showing non-Keynesian effects. The conclusion is that during the analyzed period 2004q1-2024q2, all EU members used the mechanism of fiscal expansion, which was realized by an increased level of public expenditure, but with different intensity. The reasons that directly argue the interpreted results are: (1) the absence of a unified fiscal policy in the EU, which indicates the existence of heterogeneous behavior of economic policymakers within the EU member states. Cooperation between EU member states regarding key variables (public expenditure, taxes) is based only on flexible coordination, which provides the opportunity for Governments to independently make decisions on the functioning of public finances; (2) countries with a traditionally high level of indebtedness and fiscal deficit (Greece, Portugal, Spain, Italy and Ireland) did not use fiscal expansion mechanisms to a large extent during the analyzed period. One of the key reasons for this behavior is reflected in the fact that the additional growth of public expenditure would deepen the fiscal deficit, create a new burden in the form of public debt and thus further threaten the already threatened sustainability of public finances; (3) states that formulate their economic policy on expectations based on Keynesian effects, and which are not over-indebted, use the mechanism of public expenditure expecting positive effects on the real economy. Countries with high public expenditure: Finland and Denmark spend more than 50% of GDP on public expenditure (Eurostat, 2023); (4) states that expect non-Keynesian effects as the final consequence of the implemented measures of fiscal expansion, believe that if there is an increase in public expenditure, which is not accompanied by an increase in public revenues (increase in tax rates), they could face additional borrowing, and at the same time, a decrease in available capital directed to the private sector. On the other hand, the increase in taxes would depreciate the purchasing power of the household and negatively affect investments and production. Stated implies that high public debt, high taxes and fiscal deficit can potentially reduce economic growth and act as a disincentive for the real economy (Reinhart and Rogoff, 2010). Finally, we conclude that hypothesis 1 and hypothesis 2 are confirmed, i.e. that there is a long-term equilibrium relationship between the growth of public expenditure and the growth of real gross domestic product, as well as that the dynamic of adjustments of individual economies to the long-term equilibrium relationship is heterogeneous during the analyzed period 2004q1-2024q2 on a sample of 27 EU member states.

5. FINAL CONSIDERATIONS

Based on the conducted econometric analysis that investigates the scope of action, as well as the effects of expansive fiscal policy on the real economy, based on the use of heterogeneous panel models, more specifically, on PMG method in the period 2004q1-2024q2 on a sample of 27 EU member states. It showed that there is a long-term equilibrium relationship between the growth of public expenditure and real gross domestic product, which implies the confirmation of hypothesis (H_1). The obtained results confirm the Keynesian hypothesis about the stimulating effects of fiscal expansion, based on the growth of public expenditure. It is necessary to point out that the creators of economic policies used accumulated public expenditure, not only in periods of stable economic activities, as a generator of economic growth, but identical reactions of economic authorities were also detected during periods of crisis (Global financial 2008-2010 and Pandemic crisis 2020-2021), in order to mitigate economic shocks and thereby contribute to the stabilization of economic activities. Also, the research identified significant heterogeneities in the adjustment of individual countries to the long-term equilibrium relationship. The most intense effects of fiscal expansion on real gross domestic product were recorded in Slovenia and Slovakia,

which suggests that smaller, open economies with more flexible labor markets used fiscal stimulus more effectively to stimulate growth. The central economies of the EU (Germany, France) also showed positive effects of fiscal policy, while the peripheral economies of the EU (Portugal, Spain, Italy) had weaker but statistically significant effects. We can conclude that hypothesis (H_2) is also accepted, which indicates that the speed of adjustment of individual economies to the long-term equilibrium relationship is different in the sample of 27 EU member states in the period 2004q1-2024q2. The key interpretations that argue these results are reflected in the heterogeneous conduct of fiscal policy within the European Union, different levels of public expenditure, the tax system and the level of indebtedness, but also expectations based on Keynesian and non-Keynesian effects after the implementation of fiscal expansion measures. Countries with high public expenditures (France and Belgium) achieved more stable GDP growth, but with a greater fiscal burden. On the other hand, countries with a traditionally high level of public debt (Portugal, Italy) have limited the stimulating mechanisms of fiscal policy, due to the fear of creating additional debt. These results indicate the importance of the implications of fiscal policy on the real economy within the EU member states. Although fiscal expansion can be an effective mechanism for stimulating economic growth, it is necessary to ensure the sustainability of public finances and carefully balance between government spending, the level of indebtedness and tax policies. According to that, the choice of implemented fiscal policy activities is of crucial importance so that negative externalities do not occur. Economic policy makers must take into account the specifics of each country, including the dynamic of economic cycles, in order to make optimal decisions that will stimulate economic growth and at the same time preserve macroeconomic stability.

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THE IMPACT OF ENERGY PRICES AND THE REAL EXCHANGE RATE ON THE TRADE BALANCE: THE CASE OF SERBIA

Abstract: The Republic of Serbia consistently records a trade balance deficit (TBD), as the value of imports exceeds the value of exports, with energy import dependency being a significant contributing factor. The aim of this paper is to examine the impact of changes in energy prices, measured by the Energy Price Index (EPI), and the real effective exchange rate (REER) on the TBD in the context of the competitiveness of the national economy. Empirical findings are based on estimated Vector Autoregression (VAR) model comprising the variables of TBD, EPI and REER in order to reveal their dynamic interdependence in the period 2009M1-2023M12 when National Bank of Serbia operates under the monetary framework of inflation targeting. It is expected that REER appreciation and EPI growth will worsen the TBD, which is supported by the results of the estimated VAR model and derived impulse response functions (IRFs). Republic of Serbia, as a small and open economy in the process of real convergence with developed European economies, is highly vulnerable to external shocks and turbulences at international market. Reducing the chronic TBD and energy dependence requires strategic investments in renewable energy sources and energy efficiency on one hand, and improving export performance via structural reforms on the other.

Keywords: energy prices, real exchange rate, trade balance, Republic of Serbia, VAR model

1. INTRODUCTION

The trade balance is a crucial indicator for identifying external (im)balance, reflecting the difference between the value of exports and the value of imports of goods and services. In the case of the Republic of Serbia, the trade balance continuously records a deficit, indicating significant dependence on imports and insufficient competitiveness of the national economy in the international market. One of the key factors contributing to this deficit is energy dependence, given that Serbia imports energy sources to a significant extent. During periods of sharp increases in global energy prices, import value rises, deepening the imbalance. The appreciation of the REER also negatively affects the external trade position. In this regard, understanding the impact of energy prices and the exchange rate on the trade balance becomes essential for shaping appropriate economic policy.

REER and energy prices represent two important determinants of the competitiveness of the domestic economy and the state of the trade balance. REER appreciation, which implies the strengthening of the domestic currency relative to the currencies of trading partners, can negatively impact export competitiveness by making domestic products more expensive on the international market. At the same time, the rise in energy prices (expressed by the Energy Price Index - EPI) increases production costs and further worsens the trade balance, especially in economies highly dependent on

energy imports. Therefore, analyzing the interdependence of these variables can provide valuable insights into the mechanisms shaping economic flows within the national economy.

The paper is structured so that, following the introductory considerations, there is a literature review (Section 2) discussing EPI and REER as determinants of the trade balance. Within the descriptive statistics (Section 3), these variables are analyzed in more detail from the perspective of national economic competitiveness. This is followed by the part related to the econometric analysis (Section 4), where the research results are interpreted. Finally, the paper concludes with final considerations and recommendations for economic policymakers (Section 5).

2. LITERATURE REVIEW

The study of the relationship between energy prices, exchange rates, and the trade balance is a significant topic in international economics from both a theoretical and empirical perspective (Allegret, Mignon & Sallenave, 2014; Kurtović, 2019). Due to the increasing integration of national economies with the rest of the world, developments in the international environment, crises, and external shocks spill over from the global to the national level.

One of the most significant external shocks affecting national economies is the rise in energy prices. Many countries worldwide depend on the import of oil and other energy sources. Combined with an exceptionally high level of financial integration, oil shocks become a key exogenous variable for a large number of countries participating in the global economy (Hammoudeh & Li, 2005). Energy price fluctuations have significant macroeconomic consequences, especially for countries heavily reliant on energy imports (Stojkov, Beker Pucar, Glavaški & Beljić, 2023). Oil is an essential resource in the production process, directly influencing the real economy, inflation, and the balance of payments position of oil-importing countries (Stojkov, Beker Pucar, & Sekulić, 2023). The increase in energy prices, primarily oil prices, directly affects production and transport costs, leading to rising prices of goods and services. Due to inflationary pressures (disruption of internal balance), competitiveness worsens, leading to a trade balance deficit, (threat to external balance). (Basher et al., 2015; Wesseh & Lin, 2018). Additionally, there are negative effects in the context of financial stabilization, particularly on financial markets. Given the transmission of crises from the global to the national economy, identifying triggers or external shocks is of crucial importance for economic policymakers. Changes in energy prices complicate economic policy management (Rahman & Serletis, 2010). Coordinated and countercyclical economic policy responses can mitigate the depth of crisis consequences (Beljić & Glavaški, 2021).

An important indicator of national economic competitiveness is the Effective Exchange Rate (EER), which can be nominal (NEER) or real (REER). The effective exchange rate reflects the value of the national currency relative to a basket of the most significant trading partner currencies. When calculating NEER or REER, the first step is selecting the currency basket against which the domestic currency's value will be determined. Second, EER is calculated as the weighted average of bilateral exchange rates. Accordingly, it is necessary to determine weights based on imports and exports. Import weights are calculated as the relative significance of each partner country in total imports, while determining export weights is a more complex task. Namely, when determining export weights, there are bilateral and double-weighted export schemes. The bilateral weighting approach considers only the competitiveness between the domestic economy and direct trading partners, neglecting indirect competition in third markets. In contrast, the double-weighting approach includes competition in third markets to which domestic exporters are indirectly exposed. Besides selecting the currency basket and calculation method, it is necessary to determine the base year relative to which exchange rate changes are measured (Đorđević, 2023). The difference between REER and NEER lies in the fact that REER accounts for inflation differentials between countries, making it a more relevant indicator of foreign trade competitiveness (Dhakhir, Fuadah & Haji Alias, 2014).

3. DESCRIPTIVE ANALYSIS

3.1. TRADE DEFICIT AND ENERGY PRICES

The Republic of Serbia is highly dependent on its foreign trade partners and imports, making it particularly vulnerable to external shocks, supply chain disruptions, energy price volatility, and other factors. This dependence can also be confirmed by the Index of Trade Openness (ITO) presented in Figure 1, which shows a growing share of trade (the sum of imports and exports) relative to GDP, increasing from 63% in 2009 to 114% in 2023. This trend indicates a strong integration of the national economy into global trade flows.

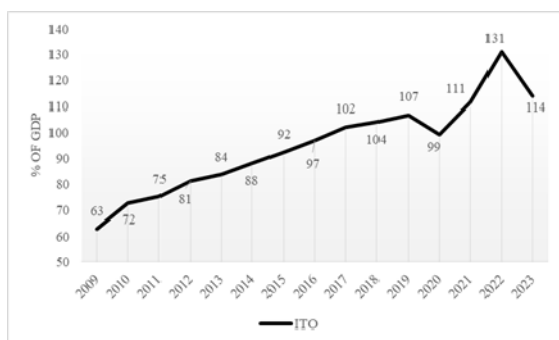


Figure 1: Index of Trade Openness
Source: Authors according to National Bank of Serbia

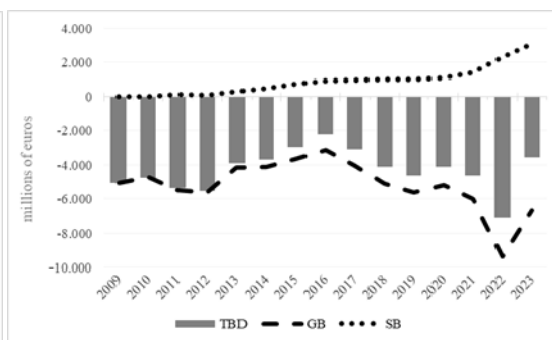


Figure 2: Trade Balance
Source: Authors according to National Bank of Serbia

The trade balance is a crucial indicator for assessing balance of payments (im)balances. The Republic of Serbia has been running a persistent trade deficit, primarily due to higher imports of goods. Figure 2 illustrates the deficit position of the trade balance (TBD) along with its components: the goods balance (GB) and the services balance (SB). During recent global crises, primarily the Pandemic and later the Geopolitical crisis, foreign trade remains unfavorable, with the negative balance deepening. The COVID-19 pandemic led to a decline in economic activity and a slowdown in global trade, yet the deficit continued to grow. A record-high deficit was recorded in 2022 with the outbreak of the Geopolitical crisis. The trend of surplus in service trade contributes to reducing the negative balance; however, it is insufficient to offset the chronic negative balance of goods trade.

To understand the trade linkages of the national economy with foreign markets and analyze the challenges related to import dependence, it is crucial to examine the structure of imports. Figure 3 presents the sectors with the highest import values, among which are: Machinery and transport equipment, Manufactured goods classified chiefly by material, Mineral fuels, lubricants and related materials, Chemicals and related products, not elsewhere specified, and Food and live animals (Statistical Office of the Republic of Serbia, 2025).

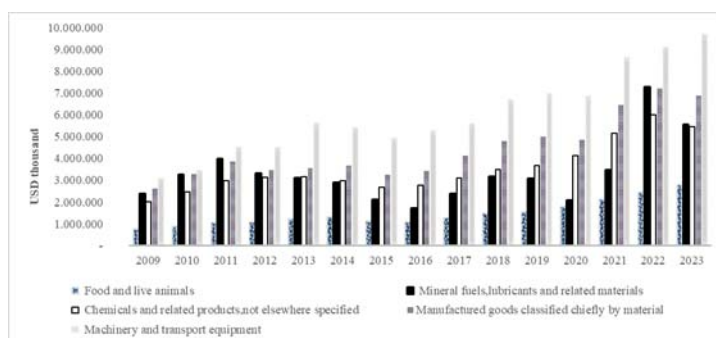


Figure 3: Value of Imports by Sector
Source: Authors according to Statistical office of the Republic of Serbia

If we direct our attention to energy sources, we can see that import value varies over the observed period depending on import volume (Figure 4) and prices (Figure 5). The energy sector holds a crucial position in Serbia's industry. Given Serbia's limited domestic reserves of oil and natural gas, the country is highly dependent on imports (Brkić, 2023). In 2020, energy imports drastically declined, which was linked to the COVID-19 pandemic and its economic consequences. Global lockdowns, border closures, and restricted international trade slowed economic activity and reduced energy consumption, especially in industry and transportation (Ćorović, Gvozdenac Urošević & Katić, 2022). The escalation of the conflict in Ukraine led to a sharp increase in energy and raw material prices, intensifying global inflationary pressures (Mathilde, Garima & Hakan, 2023). Energy prices are measured using the Energy Price Index (EPI) (Figure 5). The index rose from 67.1 in 2009 to as high as 133.8 and 299.9 in 2022 and 2023, respectively. During this period, Serbia significantly increased electricity imports, driven by internal structural issues in the power sector. It is also important to note that agricultural production requires high energy consumption. The costs of agricultural production directly or indirectly depend on energy prices: irrigation, the use of agricultural machinery, product processing, transportation, and other activities rely on oil and electricity (Kirikkaleli & Darbaz, 2021).

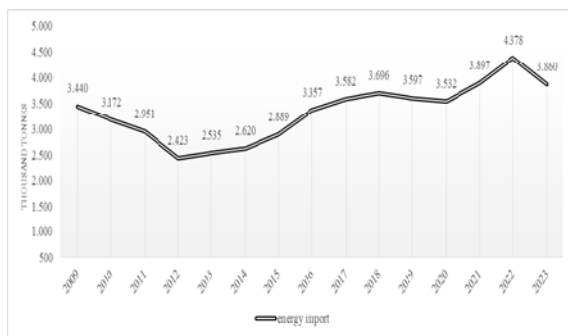


Figure 4: Import of oil
Source: Authors according to Eurostat

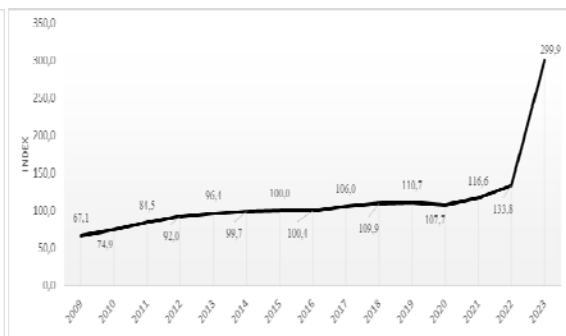


Figure 5: Energy Price Index
Source: Authors according to World Bank

The combination of rising prices, increased import volumes, and higher transportation costs has led to a record-high trade balance deficit. Countries that are more dependent on energy imports typically experience stronger inflationary pressures (Ramadani Mehmedi, 2024). A sharp increase in energy prices also triggers financial destabilization, particularly affecting financial markets (Stojkov et al., 2023).

3.2. REAL EFFECTIVE EXCHANGE RATE AS AN INDICATOR OF COMPETITIVENESS

Since the start of the transition period, the central bank of Serbia has implemented various exchange rate regimes in accordance with the challenges and objectives of the national economy. From 2000 to 2009, the exchange rate was used as a nominal anchor (fixed regime) to curb inflationary pressures (Bungin, Reljić & Ivković, 2015). Starting in 2009, the National Bank of Serbia has adopted an inflation-targeting regime and a managed floating exchange rate regime. To mitigate excessive exchange rate fluctuations of the dinar against the euro, maintain price stability, ensure financial system stability, and maintain an adequate level of foreign exchange reserves, the National Bank of Serbia conducts interventions in the foreign exchange market (National Bank of Serbia, 2008). Between 2009 and 2023, two sub-periods can be distinguished: i) *de jure* and *de facto* managed floating (2009-2017) and ii) *de jure* managed floating but *de facto* stable dinar exchange rate (2017-2023). Graph 6 presents the movement of the Nominal Exchange Rate (NER) RSD/EUR and the Real Effective Exchange Rate (REER) index (2005=100) for the period 2009M1-2023M12. An increase in NER implies a decrease in the value of the domestic currency (depreciation), while an increase in REER is interpreted conversely, as a strengthening of the national currency (appreciation). The domestic currency experienced nominal depreciation until 2017, while REER fluctuated. After that, the dinar exchange rate stabilized between 117 and 118 RSD/EUR until the end of the observed period. Notably, from 2017 onward, REER appreciated. A stronger national currency implies that domestic products become more expensive in foreign markets, making exports costlier, while foreign products become more affordable in the domestic market, thus reducing import costs. Under such conditions, exports are expected to decline, while imports rise, contributing to a trade balance deficit. It can be concluded that maintaining a stable (*de facto* fixed) exchange rate leads to an overvaluation of the national currency, REER appreciation, and a deterioration in the competitiveness of the domestic economy.

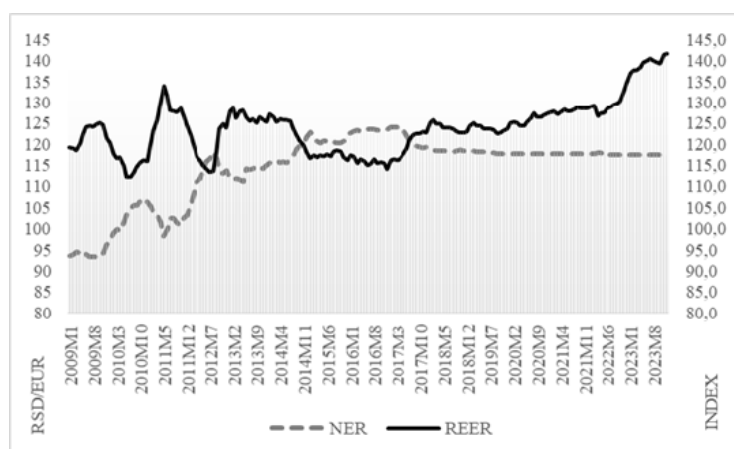


Figure 6: Nominal Exchange Rate (NER) & Real Effective Exchange Rate (REER)
Source: Authors according to National bank of Serbia

A de facto stable exchange rate does not function as a shock absorber or as a stimulus for export competitiveness. Nevertheless, it serves as a nominal anchor due to the "fear of floating" and "fear of inflation," which is characteristic of more vulnerable economies. Under such circumstances, monetary authorities prevent the depreciation of the domestic currency (Beker Pucar, 2020). The escalation of the Pandemic and Geopolitical crises has brought strong inflationary pressures as a result of rising food and energy prices on a global scale. Given the nature of these inflationary pressures, a significant number of countries are also experiencing stagflationary pressures, characterized by a combination of inflation and recession (Pejčić, Sekulić & Glavaški, 2024). The vulnerability of the domestic economy to external shocks and the spillover of global crises into the national economy are key reasons for using the exchange rate as a nominal anchor. This is based on the fact that further depreciation of the dinar would exacerbate inflationary pressures (Bungin, Reljić & Ivković, 2015).

4. ECONOMETRIC ANALYSIS

This study applies Time Series Analysis (TSA) to examine the interdependence between the Energy Price Index (EPI) and the trade balance (TBD), as well as between the Real Effective Exchange Rate (REER) and TBD. TSA analyzes a set of random variables under the assumption that they exhibit dependency or correlation. The goal is to assess the dynamic correlation between these variables over time using an appropriate mathematical model, based on pre- and post-estimation results. The econometric analysis examines EPI, REER, and TBD from January 2009 to December 2023. The analysis relies on monthly data from the World Bank (WB) and the National Bank of Serbia (NBS), as shown in Figure 7.

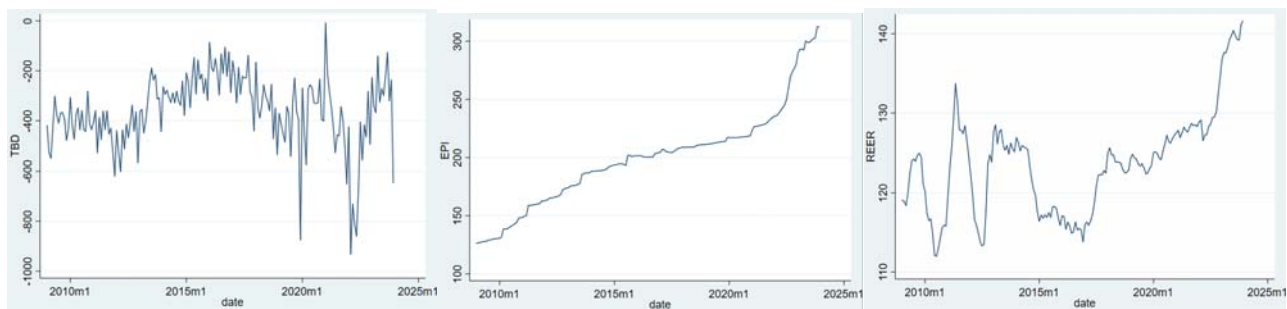


Figure 7: TBD, EPI & REER
Source: Author's research using Stata 15

The research on the interdependence of these variables is based on two hypotheses. The first hypothesis is that rising energy prices worsen the TBD (a negative relationship). Serbia is a country dependent on energy imports, and an increase in their prices raises the value of imports, leading to a higher TBD. The second hypothesis assumes that the appreciation of the REER also increases the deficit TBD (a negative relationship). In the case of an appreciation (strengthening) of the national currency, exports become more expensive, while imports become cheaper. When an economy imports more than it exports, deficit TBD is generated. Therefore, a negative relationship is expected between the increase in the EPI and TBD, as well as between the appreciation of the REER and TBD.

Informal (graphical representation, correlogram at lag 1) and formal stationarity tests (Dickey-Fuller and Phillips-Perron) reveal different levels of integration among the time series. TBD is stationary at $I(0)$, implying a predictable movement, whereas EPI and REER are non-stationary with a single unit root $I(1)$, indicating an unpredictable pattern over the analyzed period. However, the first differences of EPI and REER are stationary at $I(0)$. The results of the stationarity tests are summarized in Table 1 and Table 2. When the values of the AC and PAC coefficients in the correlogram are close to 1, this indicates non-stationarity, confirming that the EPI and REER time series are non-stationary $I(1)$, while TBD is a stationary time series $I(0)$ (Table 1).

Since the test statistics of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for TBD are lower than the critical values (in absolute terms), the null hypothesis (H_0) is rejected, confirming that this time series is stationary. For EPI and REER, the ADF and PP test statistics are greater than the critical values in absolute terms, meaning the null hypothesis (H_0) is accepted, indicating that these two series are non-stationary at their levels. The results of the ADF and PP tests for the first differences of EPI and REER confirm their stationarity (Table 2).

Table 1: Correlogram

CORRELOGRAM						
TBD	In the Level		p-value	At the First Differences		p-value
	AC	PAC		AC	PAC	
	0,5253	0,5372	0,0000	-	-	-
	In the Level		p-value	At the First Differences		p-value

EPI	AC	PAC		AC	PAC	
	0,9703	1,0109	0,0000	0,2552	0,2554	0,0006
REER	In the Level		p-value	At the First Differences		p-value
	AC	PAC		AC	PAC	
	0,9521	0,9963	0,0000	0,4003	0,4004	0,0000

Source: Authors based on Stata 15.

Table 2: Results of Formal Stationarity Tests

Variable / Test	ADF in the Level	ADF in the First Differences	PP in the Level	PP in the First Differences
TBD	p-value			
	0,0218	-	0,0000	-
	Test Statistic			
	-	-	-82,874	-
	-3,170	-	-7,192	-
	Critical Value (5%)			
	-	-	-13,858	-
	-2,575	-	-2,885	-
EPI	p-value			
	1,0000	0,0000	1,0000	0,0000
	Test Statistic			
	-	-	3,010	-131,002
	0,786	-7,330	1,293	-10,188
	Critical Value (5%)			
	-	-	-21,016	-13,856
	-3,440	-2,885	-3,439	-2,575
REER	p-value			
	0,3723	0,0000	0,6648	0,0000
	Test Statistic			
	-	-	-5,206	-106,530
	-1,816	-5,278	-1,220	-8,677
	Critical Value (5%)			
	-	-	-13,860	-13,860
	-2,885	-2,885	-2,885	-2,885

Source: Authors based on Stata 15.

The continuation of the empirical research involves applying the VAR model with a prior transformation of first differences to achieve stationarity. The pre-estimation procedure for selecting the lag order in the VAR model suggests that the dynamic relationship between the time series should include three lags. The post-estimation steps indicate that the estimated VAR model is stable and that there is no serial correlation. The derived impulse response functions enable an analysis of the impact of EPI and REER shocks on TBD over a six-month period in this specific case.

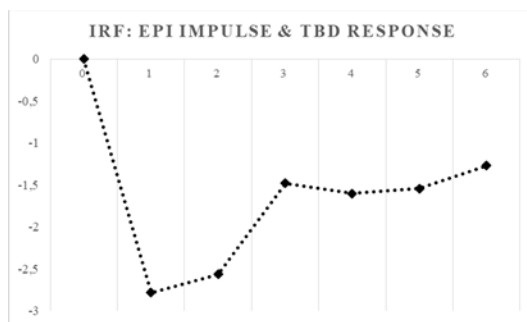


Figure 8: IRF: EPI & TBD
Source: Authors' estimations

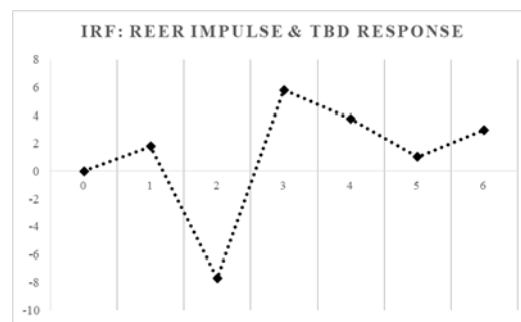


Figure 9: IRF: REER & TBD
Source: Author's estimations

Graph 8 illustrates the impact of an EPI shock (increase in energy prices) on the TBD. The impulse response function (IRF) confirms a negative relationship between these two variables over a six-month period. A shock on the EPI side (increase) leads to a sharp TBD deficit in the first and second months. The effect gradually weakens by the end of the observed period. Graph 9 presents empirical findings regarding the impact of REER appreciation on trade balance

growth. After an initial decline (deterioration) in the trade balance position, a gradual adjustment occurs over a six-month period.

5. CONCLUDING REMARKS

The fundamental trade balance deficit is a problem characteristic of developing countries, including the Republic of Serbia, on its path to real convergence with the developed economies of Europe. An analysis of trade openness confirms Serbia's increasing integration into global economic flows but also highlights its vulnerability to external shocks. During the observed period from 2009 to 2023, the trade deficit remained persistent, with a record-high deficit in 2022, which can be linked to rising energy prices in the global market and an increase in import value. These factors underscore the importance of energy policy and the need for a strategic reduction in energy import dependency.

The exchange rate policy has significant implications for the trade balance. With the shift in monetary strategy, the National Bank of Serbia has applied a managed floating exchange rate regime and inflation targeting since 2009. There is a noticeable period of *de jure* and *de facto* managed floating between 2009 and 2017, followed by a period of *de jure* managed floating and *de facto* stable exchange rate from 2017 until the end of the observation period. The appreciation of the real effective exchange rate, resulting from nominal stability, combined with higher inflation in Serbia compared to its main trading partners, reduces the price competitiveness of domestic products in foreign markets, further deepening the trade deficit.

The empirical research results confirm a negative relationship between rising energy prices and the trade balance, as well as a negative relationship between real exchange rate appreciation and the trade balance in terms of increasing the deficit. These findings emphasize the importance of adjusting exchange rate and trade policies to mitigate negative effects. Given the identified challenges, Serbia's economic policy should focus on reducing structural imbalances in trade. Diversifying the export structure and increasing the share of products with higher added value are key factors for the long-term sustainability of the trade balance. At the same time, the energy strategy should prioritize expanding renewable energy capacities and improving energy efficiency to reduce import dependency.

Furthermore, the results indicate the need for greater exchange rate flexibility to enhance the competitiveness of the domestic economy. In this context, the coordination of monetary and trade policies plays a crucial role in achieving macroeconomic stability and increasing the economy's resilience to global shocks.

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PUBLIC-PRIVATE PARTNERSHIP AS A CONCEPT FOR STRENGTHENING THE COMPETITIVENESS OF SMALL AND UNDERDEVELOPED LOCAL GOVERNMENTS

Abstract: Bosnia and Herzegovina is a rural country; therefore, rural development should be the primary goal of the development policies of the entire country. Depopulation of villages, migration of rural population, weak economic power and poverty are characteristics of rural communities in Republika Srpska. Small underdeveloped municipalities do not have answers to the challenges and problems that are imposed on them. Given that BiH is gravitating towards the EU, the development policies of rural areas of western countries can offer sustainable solutions for these areas. On the example of the municipality of Kalinovik, primary research was conducted in order to prove the hypotheses of the scientific research. The subject of research in this paper is the applicability of the public-private partnership model in the municipality of Kalinovik and the possibility of adopting this concept as an optimal solution in encouraging rural development in order to strengthen the competitiveness of above-mentioned municipality. The aim of the research within this paper is to offer scientifically based answers to the possibilities of accelerating the process of rural development itself with the application of modern European methods and a comprehensive approach to solving specific problems of the local community in the Republika Srpska. The main hypothesis of this research is that the public-private partnership model represents the optimal solution for encouraging rural development in the Kalinovik municipality. The results of the research show that there is an interest in the development of public-private partnership in the Kalinovik municipality and that the application of this model with the involvement of all levels of government through an integral, multiple approach will bring good results in encouraging rural development and strengthening the competitiveness of this area.

Keywords: rural development, public-private partnership, local action group, European integration

1. INTRODUCTION

The disproportions in the development of passive regions and urban areas in the Republika Srpska are easily noticeable, so that urban areas are quite populated with active economic life, while rural underdeveloped areas are depopulated and characterized by a weak economy, unemployment and poverty as a common denominator of most rural local communities. The unfavorable trends of the death of settlements, the emigration of vital groups of residents and the economic decline

of rural local communities continue, and the differences in basic infrastructure and the delivery of public services between urban and rural areas are becoming increasingly large. About 60 percent of the population in Bosnia and Herzegovina lives in the countryside, that is, in rural areas. Therefore, the development of these areas is of crucial importance for the overall economy. Along with Montenegro, Finland and Ireland, Bosnia and Herzegovina is at the very top of the countries in terms of the number of inhabitants in rural areas in the world. It can be confirmed with certainty that small municipalities in Republika Srpska face a number of challenges in stimulating local development and that this topic is extremely topical and represents an almost insoluble enigma for local officials, leaders and citizens as a whole.

Namely, in the Republika Srpska there is a disparity in the size, development, demography and economic strength of municipalities. On the one hand, there are large differences in the ability to deliver public services between developed and underdeveloped municipalities, and on the other hand, the legislation does not distinguish between municipalities in terms of their competencies. Given the limited budgets and other ways of financing local administrations in the Republika Srpska, rural areas face the problem of financing projects for the construction of communal infrastructure, agricultural incentives, the development of rural tourism, as well as other innovative ideas that could improve the competitiveness of less developed municipalities. In short and clearly stated, "small" municipalities do not have money, and what little they have in their budgets they spend mostly on the salaries of their employees. Therefore, in order to trigger local development and create jobs in order to prevent depopulation and youth exodus, municipal administrations are looking for new sustainable ways of financing.

One of the possible solutions is a public-private partnership. It is necessary to emphasize that the implementation of public-private partnership has as its ultimate goal the delivery of higher quality and more efficient public services, which is particularly reflected in the development of the local community. The forms of public-private partnership can be very diverse and can have different goals, size and number of participants, but it should be emphasized that partnership relations must in any case be regulated by a contract.

The subject of this research is the applicability of the public-private partnership model in the municipality of Kalinovik and the possibilities of adopting this concept as an optimal solution in stimulating rural development in the function of strengthening the competitiveness of the municipality. During the research, an attempt will be made to correlate the positive aspects of the bottom-up concept, citizen participation in decision-making when creating local development policies and the mobilization of local entrepreneurial capacities and public administration in achieving common interests. It will also be examined whether there is interest among decision-makers at the municipal level and entrepreneurs in the research area for this type of cooperation, i.e. for the implementation of projects through forms of public-private partnership, and the level of knowledge and capacity of the local administration for project implementation will be assessed. The aim of the research in this paper is primarily to offer scientifically based answers to the possibilities of accelerating the process of rural development itself by applying modern European methods and a comprehensive approach to solving specific problems of the local community in the Republika Srpska, which are specified on the example of the extremely underdeveloped municipality of Kalinovik. Of course, one of the goals is to stimulate new ways of thinking and encourage the application of innovative methods in the research area. Several hypotheses were tested within the framework of this research:

- *H0. By obtaining the status of candidate for accession of BiH to the EU, which implies free access to IPA fund programs, the public-private partnership model will represent the optimal solution for stimulating rural development in the area of the Kalinovik municipality.*
- *H1. The local community of the Kalinovik municipality has an interest in developing a public-private partnership model for the purpose of stimulating rural development.*
- *H2. The municipal administration does not have a sufficient number of trained personnel for the implementation of public-private partnership projects.*
- *H3. Citizen participation in the development of local community development strategies as well as in making decisions on launching projects at the municipal level will strengthen the links between the public and private sectors and will positively influence the mobilization of all interested stakeholders.*

The research concept in this paper was based on the following scientific methods: historical method - through the use of scientific and professional literature from the field of research; comparative method - in the sense of comparing public-private partnership models in the world and in the country; descriptive method - in order to better describe the research issue; questionnaire and survey method - in the function of collecting data during the testing of the research hypotheses in the municipality of Kalinovik and on the population in the research area. In addition to the above methods, other

scientific methods were also applied during the preparation of the scientific paper, primarily the methods of analysis and synthesis, induction and deduction, abstraction and concretization, and classification.

2. PUBLIC-PRIVATE PARTNERSHIP – LITERATURE REVIEW

The challenges of the modern era require changes in the traditional organizational structures of local and rural development management, which implies that the state begins to share its competencies and funds with a large number of partners in order to deliver public services more efficiently and improve the quality of life in rural areas. Therefore, one of the forms of decentralization is represented by public-private partnerships. In the broadest sense, this concept can be defined as a set of joint initiatives of the public sector and the private profit and non-profit sectors in which each entity makes certain resources available and participates in planning and decision-making, while in a narrower sense, the term PPP refers to cooperative ventures in which the public and private sectors pool resources and expertise in order to meet a public need through appropriate allocations of resources, risks and rewards.

PPP have achieved excellent results in their application so far, in different regions in Europe and the world and in various economic sectors, which clearly indicates the effectiveness and success of the application of this concept (Hodge & Greve, 2007). PPP are complex contracts that require careful design and planning of their financial structure to ensure long-term success and fair risk sharing between private and public sector partners (Yescombe, 2011).

Berg et al. (2002) classify the most powerful drivers of PPP development into four groups. First, they cite changes in the public services market, as there is a change in the way of thinking about the provision, delivery and management of public goods. Second, the attractiveness of PPP lies in the simple combination of public and private sector approaches in infrastructure development. Third, the concept of partnership, in addition to the philosophy of partnership itself, also represents a technical aspect as a contribution to development, most specifically in the field of organization. Fourth, forms of private sector financing. The development of sophisticated financial techniques, which arose as a result of the development of financial markets, has particularly contributed to the development of the PPP concept.

PPP are characterized by the following elements (Sredojević, 2010): long-term partnership, the source of financing for the project or service is the private sector, the allocation of responsibilities between private and public sector partners, and the allocation of risks between public and private sector partners. Also, public-private partnerships, combining resources and expertise from both sectors, are increasingly used in the implementation of public projects, which contributes to increasing overall social well-being (Roehrich, Lewis, & George, 2014).

Each country separately develops and applies the PPP concept in its own way, most often due to the existence of a large number of types of PPP (the PPP concept differs in the Netherlands, Great Britain, Australia, the USA, France, etc.). However, in addition to these differences, it is possible to distinguish general common characteristics for all types of PPP (Bult-Spiering, M. & Dewulf, 2006): participants, relationship between participants, division of responsibility and risk, investment of resources (money, ownership, reputation, authority, etc.), continuity provided by the contract, risk allocation, focus on services, costs throughout the entire cycle, innovation.

Public-private partnerships enable (local) authorities, the business sector and civil society to take responsibility for development and to improve their environment through joint action. Public-private cooperation is today developing into a specific, widely applicable form and method of improving social development. European trends in numerous mergers, acquisitions and the establishment of mutual cooperation, especially at the local level, which have been implemented through a variety of policies and instruments of the EU and its member states, point to the conclusion that the future of sustainable development lies precisely in the mutual cooperation of all market actors, that is, in joining the joint forces of the public and private sectors. Given that the actions of the state administration are conditioned by the efficient management and allocation of available resources and the judgment of the public and the satisfaction of the citizens themselves, it can be said that successful PPP also implies the acceptability of the projects themselves by the broad public. It is certain that society does not directly manage economic processes, but taking into account that citizens are the ultimate users of public services, attitudes towards the implementation of projects must be positive and the projects themselves should reflect the fulfillment of the needs of the local and wider community. Of course, it is also necessary to respect the requirements of the private sector, primarily in terms of the profitability of the projects themselves.

According to Grimsey and Lewis (2004), there are two models of PPP organization, the traditional and the financial approach, depending on who leads the organization of the arrangement. The traditional approach implies that the sponsors of the project company assume both responsibility and commitment to the project and its completion within the stipulated time and budget. The financiers participate in terms of a minority stake in the capital of the project company. The financial approach implies specialized investment banks that take an active role in the management of the project company from the very beginning of the project.

According to Grimsey and Lewis (2004), there are two models of PPP organization, the traditional and the financial approach, depending on the OECD's principles for managing PPP, which define a public-private partnership as a long-term contractual agreement between a government and a private partner, under which the private party implements and provides financing for public services using capital assets, with the distribution of the associated risk. A public-private partnership can imply an accepted cooperation between the private and public sectors, either at the central or local community level, based on agreed development goals for a particular public order. A PPP, according to Mijatović (2007), is characterized by the following: it leads the organization of the arrangement. The traditional approach implies that the project company sponsors assume both responsibility and obligation for the project and its completion within the foreseen time and budget. Financiers participate in terms of a minority stake in the capital of the project company. The financial approach involves specialized investment banks that take an active role in managing the project company from the very beginning of the project.

- This is a long-term project relationship that includes various forms of cooperation between public and private partners.
- The private entrepreneur participates in part in the financing of the project, and the remaining value is compensated by the public body from its budget. The relatively long duration of the relationship (maximum up to 40 years) enables the private entrepreneur to recover the invested funds.
- The private partner plays an important role by participating in various phases of the project (design, construction, reconstruction and extension, implementation, financing), while the public partner focuses on determining the goal that lies in the public interest, the quality of the service offered and the pricing policy, and assumes responsibility for respecting these goals.
- There is a division of risk between the public and private partners, i.e. the transfer of part of the risk to the private partner. However, this does not mean that it bears the entire risk of the project.

Literature and case studies on many PPP that have been implemented so far in Europe and the world indicate the following categories of risks present (Perez, 2004): technical risk, construction risk, operational risk, revenue risk, financial risk, regulatory risk, environmental risk, risk of project failure. The interests of stakeholders in PPP projects can be diverse, so the public partner, generally wants to improve efficiency and effectiveness in achieving objectives of a public, general nature, and this can be achieved through a number of activities such as:

- improving the infrastructure for providing public services (water, electricity, natural gas, and other services),
- expanding financial sources and increasing financial opportunities,
- building new, developing and modernizing existing infrastructure and other projects in the short term,
- protecting the environment,
- developing the local market,
- achieving greater value for money and better services for the same price.

The goals of the private partner are mainly reflected in the need to make a profit, develop capacity by creating a new workforce and means of production, open new markets, as well as use of resources under favorable conditions and a number of others. According to Vasiljev (2014), cooperation between the public and private sectors can be systematized into five types of contractual relationships:

- service contracts,
- management contracts,
- rental/leasing,
- BOT models,

- concessions.

Thus, contracts that define joint activities of public and private participants can be: service contracts, management contracts, lease contracts, concession contracts and all variants of BOT contracts. The application of the concept of public-private partnership in rural development covers a much wider scope than the traditional, i.e. narrow application of this model in infrastructure projects and similar public-private sector cooperation ventures. In rural areas, there is great untapped potential for strengthening cooperation, taking into account the increase in the volume of food production, market liberalization and the underdevelopment of rural infrastructure itself. Of course, it should also be emphasized that the rich natural potential and opportunities for promoting rural tourism and organic food production are not being used. Based on previous foreign experiences, cooperation between the public and private sectors on projects and activities in rural areas has moved in several directions:

- Improving the general business environment and entrepreneurial environment in the local community in order to attract investment,
- Improving agricultural production,
- Improving the quality of life in rural areas by expanding the availability of social services,
- Developing the local economy based on the sustainable use of community resources.

Due to difficulties and delays on the European path, BiH has lost huge sums of EU money intended for development projects because it failed to meet the conditions. In 2013, 45 million euros were lost, primarily due to the failure to implement the judgment of the European Court of Human Rights in the Sejdić and Finci case, and then it lost an additional five million euros for agricultural and rural development due to the failure to establish an agricultural paying agency and a managing body.

In the 2007-2013 programming period, around 11.5 billion euros were allocated to all countries using IPA funds. The total allocation of funds for BiH in that period amounted to around 650 million euros, however, due to non-fulfillment of conditions, BiH has only used half of the funds available to it overall. For comparison, the European Union member states have withdrawn around 350 billion euros from the EU Structural Funds and Cohesion Fund in the same period.

In the Republika Srpska, several PPP projects have been developed in the past. This area is regulated by a special law and bylaws adopted in 2009, as well as a number of other regulations related to PPP and concessions, and the aforementioned legal norms protect the rights of investors, that is, they regulate the complex relations between the public and private sectors during the implementation of projects. The most common public partner in the Republika Srpska during the implementation of PPP projects was the local government unit. It is obvious that the funds that municipalities receive from the budget are not sufficient to finance infrastructure projects necessary for the balanced and modern development of the local environment. Therefore, there is a need to find other, additional sources of financing for individual projects. One of the possible solutions offered to local governments is the PPP model.

3. RESEARCH METHODOLOGY

The subject of research, in this case, refers to two phenomena, namely the public-private partnership model and rural development, and their mutual relationships and connections. Thus, the determination of the subject of research itself included two elements, first defining the key phenomena between which the connection is determined and then establishing the nature of the connections themselves and the mutual interactions of the characteristics and indicators of the phenomena in question.

The operational determination of the research subject was carried out to concretize the theoretical determination of the research subject. The model of local public-private partnership, i.e. local action groups in the function of rural development, the possibilities of application and perspectives of this concept in the municipality of Kalinovik, induced the further course of the research and determined the research hypotheses. The research concept of this work includes the theoretical and empirical part and is based on secondary and primary sources, while the following scientific methods were used during the research technique itself, the formulation and explanation of the obtained results:

- historical method through the use of scientific and professional literature from the field of research;

- comparative method in terms of comparing public-private partnership models in the world and the country;
- descriptive method in order to better describe the research issue;
- questionnaire and survey method in the function of collecting data during the testing of the research hypotheses in the municipality of Kalinovik and the population in the research area.

In addition to the above methods, other scientific methods were also applied during the preparation of the scientific paper, primarily the methods of analysis and synthesis, induction and deduction, abstraction and concretization, and classification. When proving the hypotheses set in this research, the questionnaire method was applied. When choosing the method of research for the defined subject and problem, the decisive role was played by the fact that this is a small number of cases from practice, which are also in the early stages of implementation. The research, using the questionnaire method, was conducted on a sample from the municipality of Kalinovik, with the primary goal of examining the level of awareness of citizens, local officials and entrepreneurs about the applicability of this model as well as the advantages of the bottom-up principle when making key decisions at the local level.

Questionnaire number one covered the municipal administration in Kalinovik in order to investigate the existence of interest in the application of the local public-private partnership model in the municipality itself, as well as the capacity of local government employees to implement the concept itself. The second questionnaire tested various entities in the municipality of Kalinovik (population, entrepreneurs, associations) with the aim of examining awareness of rural development and the level of interest in the application of the PPP model and the formation of LAGs in order to stimulate rural development and strengthen the competitiveness of this area.

Considering the complexity of the subject and research problem, as well as the complexity of the phenomenon itself and the limitations in applying this model in practice, the questionnaire method represents the optimal choice of basic scientific methods for analyzing the characteristics of observed cases of this phenomenon at the present time in the municipality of Kalinovik and the broader social environment of the Republic of Srpska and Bosnia and Herzegovina.

4. RESEARCH RESULTS AND DISCUSSION

The sample on which the empirical research was conducted is represented by employees in the private and public sectors in the territory of the Municipality of Kalinovik. The research included two target groups that were surveyed using a questionnaire. The first group consists of employees in the municipal administration of the local self-government of Kalinovik. The second group of respondents includes the population of the Municipality of Kalinovik. When researching the attitudes and opinions of the population, all categories and ages of members of the local community with different occupations and different educational structures were included. The primary research was implemented through two questionnaires that were adapted to the respondents. The aforementioned questionnaires asked several identical questions in order to examine the existence of significant differences between the opinions and attitudes of municipal administration employees on the one hand and residents on the other hand regarding certain statements regarding local development in the municipality. The population sample included respondents from all three sectors, private, public and civil, bearing in mind the nature of the local public-private partnership itself.

The employees of the Municipality of Kalinovik were surveyed using questionnaire number one. Out of a total of 19 employees, 12 were surveyed, which is 63.1%. Taking into account the structure of the respondents, education, jobs, as well as the size of the sample itself, it can be considered representative. The educational background of the respondents is as follows: 5 people (41.6%) with secondary education and 7 people (58.3%) with higher education.

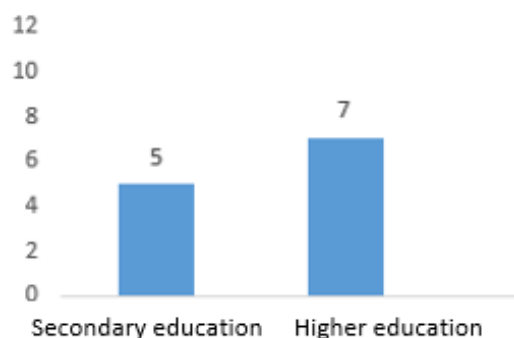


Figure 1. Educational background of surveyed municipal officials

Source: Author's processing

Of the total number of surveyed employees of the local government of Kalinovik, 4 people are female and 8 people are male. Of the total number of respondents from the Municipality of Kalinovik, the largest number of them, 5 (41.6%) belong to the age group of 31-40 years, 4 (33.3%) to the group of 41-50, 1 (8.3%) to the group of 51-60 years and two people (16.6%) are over 61 years of age.

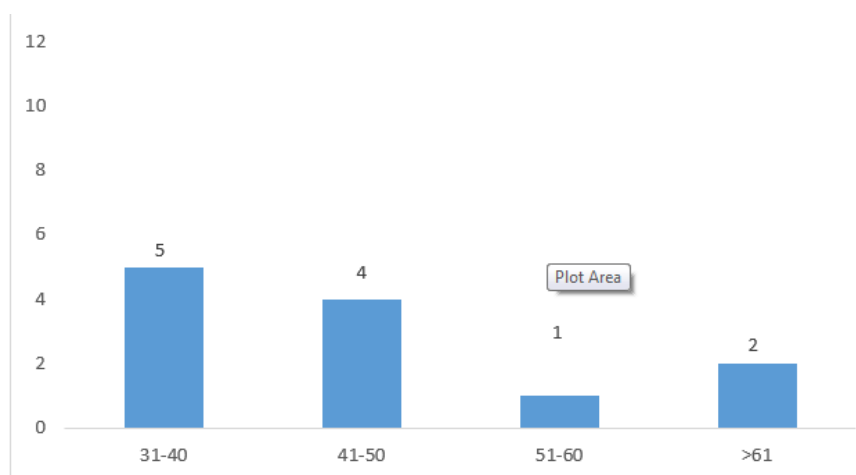


Figure 2. Age background of surveyed municipal officials

Source: Author's processing

Questionnaire number 2 surveyed the population of the Municipality of Kalinovik. The survey was carried out through 100 questionnaires, which represents 4.9% of the total population in the Municipality of Kalinovik. Of the surveyed persons, 73 reside in the settlement of Kalinovik, making up 7% of the total population of the settlement of Kalinovik, while 27 surveyed persons live in the surrounding villages belonging to the municipality, making up 2.73% of the total population of rural settlements in the Municipality of Kalinovik. The survey covered persons from all three sectors (public, private and civil) and 49 (49%) from the public, 45 (45%) from the private and 6 (6%) from the civil sector were surveyed.

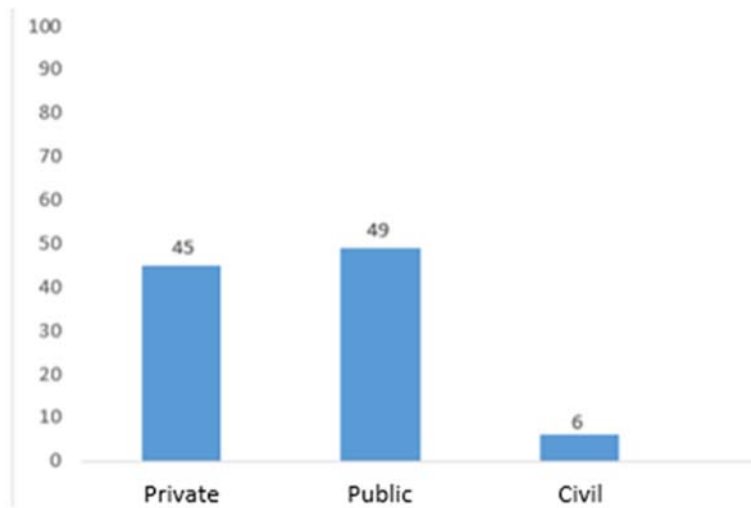


Figure 3. Selection of respondents by sector
Source: Author's processing

Of the total number of respondents, 57 (57%) have completed secondary school, 12 (12%) have completed higher professional education, and 31 (31%) have a higher education. The gender structure of the respondents is 47 men and 53 women.

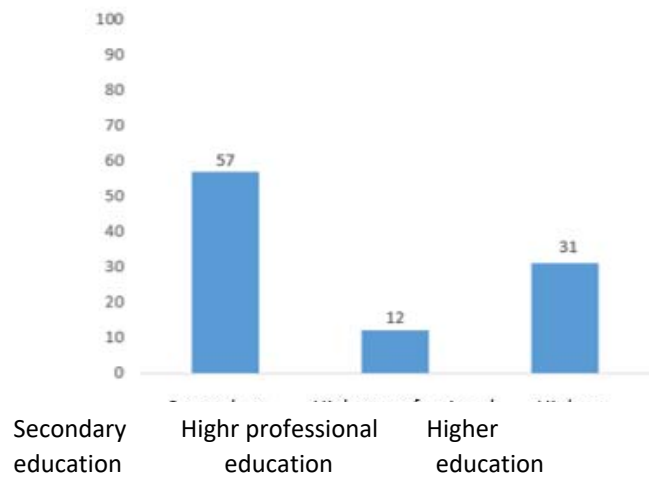


Figure 4. Education of surveyed residents
Source: Author's processing

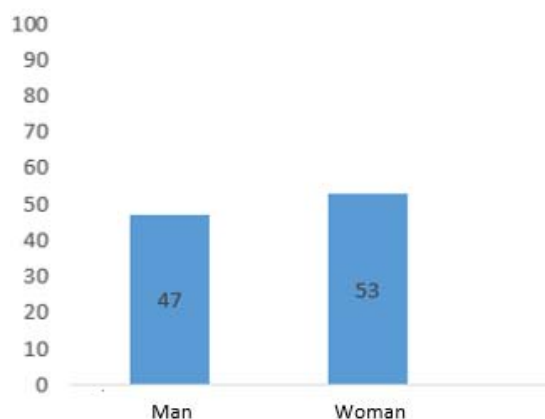


Figure 5. Gender structure of surveyed residents of the municipality of Kalinovik

Source: Author's processing

Of the total number of surveyed residents from the Municipality of Kalinovik, 10 (10%) people fall into the age group of 21-30, 34 (34%) into the group of 31-40, 20 (20%) into the group of 41-50, 21 (21%) into the group of 51-60, and 15 (15) people are over 61 years of age.

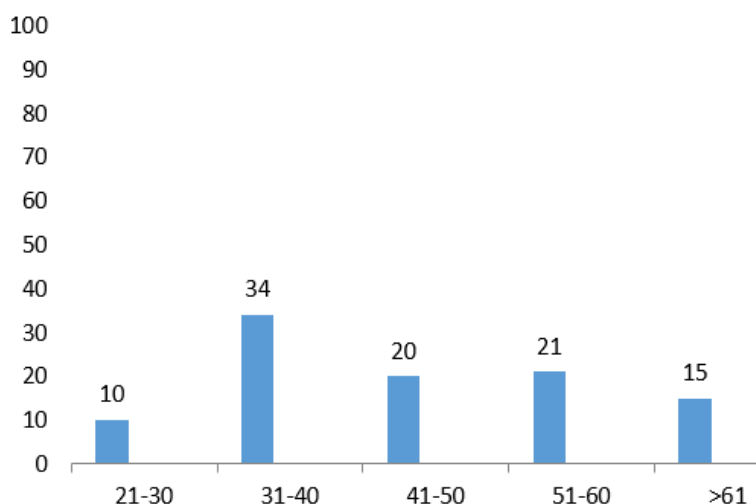


Figure 6. Age structure of surveyed residents of the municipality of Kalinovik

Source: Author's processing

Considering the complexity of the observed phenomenon as well as the fact that the phenomenon of public-private partnership, i.e. local action groups in the function of stimulating rural development, has been insufficiently researched in this area, and that the application of this specific form of public-private partnership is limited to a small number of cases in the RS, the questionnaire method was applied when proving the main hypothesis. The primary research, which was implemented through two questionnaires in the area of the Kalinovik municipality, completed the process of proving the validity of the hypotheses. Testing of auxiliary hypotheses with the aim of confirming or rejecting them for the purpose of proving or confirming the main hypothesis was set in the following order: H1, H2, H3.

First auxiliary hypothesis (H1) - in the local community of the municipality of Kalinovik there is an interest in developing a public-private partnership model for the purpose of stimulating rural development. The auxiliary hypothesis (H1) was tested using data collected through a questionnaire, a targeted search of websites, as well as theoretical knowledge from relevant scientific literature. The quantification of the variable "existence of interest" was measured based on the perception of respondents on a five-point Likert-type scale within the research questionnaires.

Table 1. Research results

Claim: Local resources are fully utilized	Municipal employees	Population
I don't agree at all	50%	42%
I mostly disagree	25%	20%
I partially agree	16,6%	20%
I mostly agree	8,3%	6%
I completely agree	0	12%
Total respondents	12	100

Source: Author's processing

The largest number of respondents from the municipal administration and population disagree with this statement, which supports the assumption that local resources are not fully utilized. Developing the potential of the municipality, allocating its unused resources in the function of initiating rural development requires the creation of sustainable projects that will contribute to the increase in jobs. It is clear that the small, underdeveloped municipality of Kalinovik does not have enough funds to initiate key projects that would strengthen the competitiveness of this area and activate available underdeveloped resources. Accordingly, it is necessary to find alternative sources of funds for the implementation of projects in addition to existing financing methods. Accordingly, the claim was made that there is an interest in the local government in seeking alternative sources of financing for development projects, and based on this, the attitudes of employees in the Municipality of Kalinovik were surveyed. Analysis of the responses from the questionnaire revealed that 41.6% of the surveyed municipal workers fully agree with this statement, while 16.6% mostly agree. Partial agreement was expressed by 16.6% of the respondents, and 16.6% mostly disagree, while 8.3% completely disagree with this statement. Therefore, based on the opinions of the respondents, it can be concluded that there is interest in finding new ways to finance projects in the Municipality of Kalinovik. Problems of underdeveloped communal infrastructure as well as slowness or complete absence of public service delivery are characteristic difficulties faced by residents of passive communities. The surveyed residents of the municipality of Kalinovik disagree with the statement that the municipal infrastructure is fully functional, with 36% of them completely disagreeing, 30% mostly disagreeing, 26% partially agreeing, 8% mostly agreeing, while no respondent fully agreed with this statement. The perception of public service delivery was examined by the attitude that public services in the municipality are delivered in a quality and timely manner. The evaluation of the questionnaire determined that 22% of respondents completely reject this attitude, 34% mostly disagreeing, 20% partially agreeing, 16% mostly agreeing, while 8% fully agree with this statement. From the above results, it can be concluded that the majority of the surveyed citizens believe that the municipal infrastructure is dysfunctional and that public services are not delivered in a quality and timely manner. The connection between citizens and the local community, and the sense of belonging and cohesion, is the strongest foundation of the bottom-up approach. All projects start with an individual, with an idea and energy, as well as the will and enthusiasm to initiate change. The projects are tailored to the needs of the individual, the group and the local community. Accordingly, primary research in the local environment of the municipality of Kalinovik examined the claim that projects proposed by citizens can contribute to the accelerated development of the municipality's competitiveness. The research results are presented in the following table.

Table 2. Research results

Claim: Projects proposed by citizens can contribute to the accelerated development of the municipality's competitiveness	Municipal employees	Population
I don't agree at all	33,3%	4%
I mostly disagree	16,6%	4%
I partially agree	25%	26%
I mostly agree	16,6%	28%
I completely agree	8.3%	38%
Total respondents	12	100

Source: Author's processing

From the presented results, it is evident that the majority of residents fully agree, or rather mostly agree, with this statement. On the other hand, employees of the Kalinovik municipality do not share this opinion. Namely, the majority of respondents from the Kalinovik municipality disagree, or rather mostly disagree with this statement, while 25% of respondents partially agree, 16.6% mostly agree, and 8.3% fully agree.

The differences in opinions and attitudes between respondents from the two target groups can be explained by traditional approaches to solving rural development problems, which are guided by top-down principles, the implementation of development policies through a pyramidal centralist structure as a methodology that is still represented in local municipal administrations in Republika Srpska and BiH. In contrast, modern approaches to local development are community-led, strengthen the bottom-up approach, empower people's ideas through a policy of providing assistance in the development of rural areas with the ultimate goal of exploiting their full potential and mobilizing all available resources.

The attitudes and perceptions of the respondents regarding the current cooperation within the local community of Kalinovik as well as the possibilities of joining forces and creating public-private partnerships were further examined. 41.6% of the municipal employees completely agreed with the statement that the municipality has good cooperation with entrepreneurs and the private sector, 50% mostly agreed, while 8.3% mostly disagreed with this statement. Thus, it can be concluded that the respondents believe that the current mutual cooperation between the public and private sectors is at a good level.

The majority of the respondents from the municipal administration believe that the municipality is interested in cooperation with neighboring municipalities in terms of stimulating rural development. Namely, 25% of them completely agree with this statement, 33.3% mostly agree, 25% partially agree, while 8.3% mostly disagree, and 8.3% of the respondents completely disagree. Inter-municipal cooperation is an important feature of local action groups, which are often formed for the territory of several municipalities, i.e. they cross official administrative borders depending on the cultural identification of local residents, the homogeneity of the space and the sense of community with the wider natural environment.

Municipal employees have a very positive attitude towards the possibility of developing and implementing the local action group model in the municipality. Thus, the view that the municipality is interested in developing and implementing local public-private partnerships, i.e. local action groups to stimulate rural development, is fully supported by 25% of respondents, 41.6% mostly agree, 16.6% partly agree, and on the other hand 8.3% mostly disagree and 8.3% completely disagree with this statement. Therefore, the majority of surveyed employees of the municipality of Kalinovik support the idea of implementing and developing local public-private partnerships in the function of stimulating rural development, which supports the proposed auxiliary hypothesis.

The surveyed residents do not believe that cooperation between participants in public life is at a good level; on the contrary, the statement that residents, business entities and civil society organizations have good cooperation with the municipal administration was assessed negatively by the majority of respondents, with 24% completely disagreeing with this statement, 28% mostly disagreeing, 34% partially agreeing, 8% mostly agreeing, while 6% completely agreeing with this statement. Residents are hesitant to state that local entrepreneurs actively participate in the implementation of projects supported by the local government, with 52% partially agreeing, 24% mostly agreeing, 12% mostly disagreeing and 12% completely disagreeing.

Analyzing the opinions of residents, it is evident that they believe that it is necessary to improve cooperation between participants in public life. The survey questionnaire examined the opinion of residents on the possibility of association in the territory of the municipality, and the view that the association of all relevant participants in public life when identifying and solving problems represents a good basis for initiating positive changes in society is supported by 50% of respondents in full, 18% mostly agree, 30% partially agree, while only 2% of respondents completely disagree. Residents believe that the association of all social actors for the purpose of solving problems is a good basis for initiating positive movements, which further supports the validity of the first auxiliary hypothesis. From all of the above, taking into account the results of the theoretical discussion of the research concepts as well as the results obtained from the primary research that arise from the attitudes and opinions of respondents from the two target groups of the sample from the municipality of Kalinovik, it can be concluded that the first auxiliary hypothesis is fully confirmed.

The second auxiliary hypothesis (H2) - the application of public-private partnership is at the very beginning, and the municipal administration does not have a sufficient number of trained personnel for the implementation of projects. The implications of the failure of European integration are reflected in the development of civil society, which was especially felt in rural areas and negatively worsened the position of domestic producers and farmers and had an unfavorable impact on the work of local action groups formed so far. The training of municipal administration staff in implementing local development projects, as well as the awareness and education of workers regarding modern European approaches to rural development, was tested using a questionnaire method through several statements. The responses of the surveyed persons from the municipality of Kalinovik are presented in the following table.

Table 3. Responses of municipal workers on the issue of staff education

Claim	I don't agree at all	I mostly disagree	I partially agree	I mostly agree	I completely agree
At the municipal level, there are trained personnel for the successful implementation of local economic development policies	0	0	50%	41,6%	8,3%
Proposals for implemented development projects come from employees of the municipal administration	8,3%	16,6%	41,6%	25%	8,3%
The municipality has good cooperation with scientific research institutions and centers in the Republic of Srpska	33,3%	16,6%	33,3%	16,6%	0
The municipality has a sufficient number of employees who are familiar with EU project cycle management methods.	33,3%	25%	16,6%	8,3%	16,6%
The education of municipal administration in the field of European approaches to rural development has been at a good level so far	25%	33,3%	16,6%	25%	0

Source: Author's processing

Based on the results obtained, it can be concluded that the employees of the municipality of Kalinovik believe that there are trained personnel at the municipal level to implement local economic development policies. 50% of the respondents partially agreed with this statement, 41.6% mostly agreed, and 8.3% completely agreed. It is visible that no one among the respondents completely rejects this statement. In contrast, the residents of Kalinovik are largely reluctant to accept this statement, with 46% partially agreeing, 18% completely disagreeing, 18% mostly disagreeing, 16% completely agreeing, and 2% of the respondents completely supporting this statement. Also, 33% of respondents do not agree at all with the statement that the municipality has a sufficient number of employees who are familiar with the methods of managing the EU project cycle, 25% mostly disagree, and 16.6% partially agree, while 8.3% mostly agree and 16.6% completely agree with this statement. The majority of respondents give a poor assessment of the current level of education in the field of European approaches to rural development. Furthermore, with the statement that the municipality has good cooperation with scientific and research institutions and centers in the RS, 16.6% mostly agreed, 33.3% partially agreed, 16.6% mostly disagreed, while 33.3% of respondents completely reject this statement. Therefore, according to the respondents, it can be said that cooperation with scientific and research institutions is not at a good level. The results

obtained further confirm the second supporting hypothesis, namely that the municipal administration is not sufficiently familiar with European rural development initiatives and EU project cycle methods.

Education of public servants as a continuous process, continuous improvement of knowledge, change of attitude towards citizens and adoption of new principles of work in the future will represent a great challenge for local self-government during the reforms and the process of European integration. Adaptation of local self-government to new concepts, strengthening of democratic mechanisms will be a priority of all levels of government in order to find simpler and more direct ways of solving problems and issues within the community itself. Taking into account the knowledge gathered through the theoretical part of the work and the data collected through primary research on a sample from the Municipality of Kalinovik, it can be concluded that the second auxiliary hypothesis is confirmed.

Third auxiliary hypothesis (H3) - citizen participation in the development of local community strategies and in decision-making on launching projects at the municipal level will strengthen the links between the public and private sectors and will positively influence the mobilization of all interested stakeholders. Area-based strategies encompass small, homogeneous, socially cohesive territories, with a common tradition, local identity, sense of belonging or common needs and expectations, and represent a target area for the implementation of certain development policies. Deciding on the implementation of a rural development strategy in this way facilitates the recognition of local values, strengths and weaknesses, threats and opportunities, as well as dangers and obstacles on the path to sustainable development. The term "area-based" essentially means at the local level. People, or rather the inhabitants of small local communities, identify with the projects, because they are made and designed according to their wishes and provide answers adapted to local needs. Within this program, residents recognize themselves as participants in the development of rural policies, and not just as mere observers and beneficiaries of vague projects that are imposed on them.

In this way, local stakeholders must get to know each other and, through dialogue, share their views and goals for the development of the rural area. This dynamic enables the sharing of energy and resources. It has been shown that collective decisions, accepted by more people, create a stronger community and stronger cooperation on future projects. Considering that local public-private partnerships gather and connect all available local resources and unite local actors on joint projects and multi-sector activities, there is a high probability that their actions will stimulate rural development. Partnerships in their organic structure should involve the critical mass needed to improve the economic competitiveness of the area. By strengthening dialogue, synergy, as well as overcoming differences and conflicts of interest groups, local partnerships direct the entire community towards the goal and better sustainable development.

Theoretical knowledge and findings presented in case studies support the confirmation of the auxiliary hypothesis. The validity of the hypothesis was additionally tested with questions from the questionnaire that were adapted to the population and municipal officials, and are directly related to the issue under consideration. The statement that the proposals for implemented development projects originate from employees in the municipal administration tested the perception of the population and municipal officials about the previous method and established practices of initiating projects in the municipality. The data obtained from the research are presented in the following table.

Table 4. Research results

Claim: The proposals for implemented development projects came from municipal administration employees	Municipal employees	Population
I don't agree at all	8,3%	16%
I mostly disagree	8,3%	10%
I partially agree	41,6%	36%
I mostly agree	33,3%	18%
I completely agree	8.3%	20%
Total respondents	12	100

Source: Author's processing

The population and municipal employees were generally reserved regarding this statement, with the majority of respondents expressing partial agreement. Municipal officials, 33%, mostly agreed with the statement, while 20% of the population fully supported the statement, and 18% of them mostly agreed. Furthermore, the research results show that municipal officials and the surveyed residents have a similar perception of the importance of direct citizen participation in the development of local development strategies, as well as its positive impact on strengthening mutual cooperation in the local community. The research results are presented in the following table.

Table 5. Research results

Claim: Citizen participation in the development of local development strategies will strengthen the links between the public and private sectors	Municipal employees	Population
I don't agree at all	0	0
I mostly disagree	8,3%	6%
I partially agree	33,3%	32%
I mostly agree	41,6%	30%
I completely agree	16,3%	32%
Total respondents	12	100

Source: Author's processing

By analyzing the research results, it can be concluded that residents and employees in the municipality have similar views and that more than half of them generally agree or completely agree with this statement. The results obtained support the confirmation of the third auxiliary hypothesis. By examining public opinion, that is, the views of the residents of Kalinovik, the third auxiliary hypothesis was additionally tested, and the results are shown in the following table.

Table 6. Research results, residents of the municipality of Kalinovik

Claim	I don't agree at all	I mostly disagree	I partially agree	I mostly agree	I completely agree
Civil society organizations and other citizens' associations are actively operating in the municipality with the goal and programs of improving the local community	38%	32%	18%	8%	4%
In our municipality, residents actively participate in the decision-making process that is important for local development	46%	28%	16%	2%	8%
All participants in local life in the Municipality of Kalinovik have an interest in strengthening mutual cooperation	18%	18%	10%	28%	26%
A local community, or municipality, if it is guided by ideas and	6%	8%	10%	32%	44%

projects that are tailored to the wishes and real needs of its residents, has great chances for good and accelerated development					
Citizens should participate in the key decision-making process in their local community.	0	2%	4%	24%	70%
Bringing together all relevant participants in public life when identifying and solving problems is a good basis for initiating positive changes in society	2%	0	30%	18%	50%

Source: Author's processing

The surveyed residents share a negative opinion about the active activities of civil society organizations in the municipality, so the vast majority do not support the above statement. As for the current active participation in the decision-making process, the citizens believe that participation is not at a good level, which was to be expected considering the overall situation in society. The surveyed residents mostly support the claim that there is a mutual interest of all participants in local life in the Municipality of Kalinovik to strengthen cooperation. In percentages of 44% completely agree and 32% mostly agree, the respondents agreed with the statement that a local community guided by the ideas of citizens has great chances for good and accelerated development, which directly supports the validity of this hypothesis. The confirmation of the hypothesis in question is supported by the fact that 70% of respondents fully agreed, 24% of them mostly agreed with the statement that citizens should participate in the process of making key decisions in their local community. Finally, the surveyed residents of the Municipality of Kalinovik mostly accepted the statement that the association of all actors of public life represents a good basis for initiating positive changes in society, which further strengthens the hypothesis. Taking into account all of the above as well as the analysis of the research results, it can be concluded that the third auxiliary hypothesis is fully confirmed.

Main hypothesis H0 - if Bosnia and Herzegovina obtains EU candidate status, and thus fully accesses the IPA funds program, the application of the public-private partnership model will represent the optimal solution for stimulating rural development in the area of the Kalinovik municipality. The Strategic Plan for the Development of Agriculture and Rural Areas of the Republika Srpska is aligned with the EU rural development policies, supports the development of local action groups, emphasizing that modern rural development policy must be based on a "bottom-up" initiative, i.e. on the active participation of representatives of the rural community in the planning and programming of rural development. In order to achieve this, it is necessary to improve the capacities of organizations in rural areas, the possibility of participation in the planning and implementation of pilot rural development programs at the local level, as well as to improve the level of strategic planning in the field of rural development at the local level.

Given the importance of planning, a survey of local officials from the Municipality of Kalinovik examined their views on the compliance of local development planning documents with national strategic documents. The analysis of the results revealed that 16.6% of those surveyed believe that the planning documents are fully compliant, 41.6% believe that they are mostly compliant, 33.3% partially agree, and 8.3% believe that the documents are mostly not compliant with national strategic documents. Furthermore, the questionnaire examined the opinions of municipal officials on the level of cooperation with national government institutions on all issues of local economic development. The majority of respondents positively assess the cooperation, 25% of them fully consider the cooperation successful, 41.6% mostly agree and 33.3% partially agree that the cooperation between the municipality and republican institutions is at a high level.

One of the goals of the strategic development of rural areas of the Republika Srpska, expressed through the rural development policy of the RS, is to retain the population in rural areas, because this is the basis for sustainable development of society, balanced territorial development, a prerequisite for the restoration and preservation of natural resources and the preservation of natural, cultural and social heritage. The implemented research using the questionnaire method surveyed the residents of the local community of Kalinovik regarding the statement that the lack of permanent employment is the key reason for leaving these areas, 24% of them fully agreed, 27% mostly agreed, 32% partially agreed with this statement, while 11% mostly disagreed and 6% completely disagreed. The majority of those surveyed believe that the key reason for leaving the municipality is the lack of permanent employment. The productivity of agricultural production is positively proportional to the degree of mechanization of work processes, which has caused a lower need for labor, and in the future, agriculture will not be a significant source of employment for the rural workforce. Thus, according to the rural development policy of the Republic of Srpska, solutions for creating jobs should be sought outside agricultural activities, but in rural areas, close to the place of permanent residence in order to prevent migration motivated by finding better and permanent employment. Accordingly, it is necessary to encourage all types of entrepreneurship in rural areas. Diversification of income and starting a microbusiness in or outside agriculture is the key to employment and increasing the living standards of the rural population.

Employees of the Kalinovik municipal administration were surveyed with the claim that the municipality's budget and local revenues are sufficient for the implementation of projects and the sustainable development of the local community. Contrary to the researchers' expectations, the municipality's employees mostly agree with this statement, namely 25% of them completely agree, 33.3% mostly support this statement, 25% are restrained, i.e. partially agree, 8.3% disagree and 8.3% completely disagree with this statement. On the other hand, the residents of the Kalinovik Municipality have a different opinion on this issue. 35% of respondents agree with the statement that the municipality does not have enough money to implement projects that could improve living conditions in our environment, 22% mostly agree, 15% partially agree, 15% mostly disagree, and 13% of respondents completely disagree with this statement.

The Policy and Strategic Plan for Rural Development of the Republic of Srpska stipulates that local government units should build partnerships and develop networks with representatives of the public and business sectors, as this is a model for sustainable planning and implementation of development programs, but also a model for using EU pre-accession funds. Unfortunately, BiH is not able to use the aforementioned EU pre-accession funds to their full capacity. The causes of the unfulfilled conditions from the European integration program stem from the overall political situation and the dysfunctionality of Dayton BiH. The consequences of the standstill and non-activation of the entire package of IPA pre-accession funds, and especially the IPARD instrument, have been felt by agricultural producers, small family farms and residents of rural communities.

Primary research examined the opinions of employees of the Municipality of Kalinovik on this issue. Regarding the statement that the unavailability of EU pre-accession assistance packages, and especially the IPARD instrument, negatively affects rural development and agricultural development, 41.6% mostly agreed with this statement, 25% of respondents fully supported this statement, while 25% partially agreed, and 8.3% mostly disagreed. The research results further support the thesis that the full activation of pre-accession funds will have a positive impact on rural development, as well as on the development of local public-private partnerships, i.e. local action groups in the research area. The statement that successful local economic development will increase employment and living standards in the coming period tested public opinion and employed officials in the Municipality of Kalinovik.

Table 7. Research results

Claim: Successful local economic development will increase employment and living standards in the coming period	Municipal employees	Population
I don't agree at all	0	8%
I mostly disagree	0	6%
I partially agree	8,3%	30%
I mostly agree	66,6%	30%
I completely agree	25%	26%
Total respondents	12	100

The analysis of the results shows that the residents and employees of the Municipality of Kalinovik are optimistic about the future development of their local community. Most respondents believe that a successful LED will increase employment and living standards in this area in the coming period.

The main hypothesis is also supported by the fact that all three auxiliary hypotheses were confirmed. The model of local action groups as a specific form of public-private partnership with the support of government institutions, recognizing the fact that rural development requires a multifaceted integrated approach, can offer good and sustainable solutions for stimulating rural development. The effectiveness of local action groups in stimulating rural development has been proven in numerous examples from practice because this model collects and combines human and financial resources from the public, private and civil sectors and promotes the activation of voluntary engagement of individuals from the local community. The application of the local action group approach in the Municipality of Kalinovik would strengthen the connection between local stakeholders around joint project and multi-sector activities in order to achieve synergy of efforts as well as the critical mass necessary to improve the competitiveness of this area. By strengthening dialogue and cooperation between different rural actors, reducing potential conflicts and facilitating negotiations and agreements through consultations and discussions and the interaction of different participants in local life, it is possible to facilitate the process of adaptation and change in the agricultural sector, integrate environmental protection issues, diversify the rural economy and improve the living and working conditions of the community.

The efforts of local action groups should be supported by all levels of government, as foreseen by the policies and plans of rural development in the RS and BiH. Public-private partnership can be the optimal solution for stimulating rural development in the territory of the Municipality of Kalinovik, for the sustainable development of this rural area, the revitalization of the entire space, the implementation of an integrated approach that will combine the capacities of the state, entities and local communities is necessary. Considering the theoretical discussion, the presented case studies from practice, primary research, successfully proven auxiliary hypotheses, it can be concluded that the main hypothesis of the work is confirmed.

CONCLUSION

Given the progression of the disappearance of small local communities in the territory of the Republika Srpska and Bosnia and Herzegovina, it is realistic to expect that some new generations will not have the opportunity to grow up carefree in the countryside, nor will they spend their school holidays in peaceful rural areas. The decline of villages, a decades-long process that leaves passive areas without inhabitants, has its peak in the mountainous regions of Eastern Herzegovina, and especially in the area of the Municipality of Kalinovik. In accordance with the real indicators that point to the complete emptying of several hundred villages in the Republika Srpska, it can be concluded that rural development policy has not been conducted in an appropriately rational manner that brings successful results to the extent that the question can be raised whether rural development is a myth or a reality.

Within the framework of this work, the basic concepts of research, the phenomenon of rural development and public-private partnership are theoretically explained. The dynamics of the European path of BiH are investigated, with its challenges and limitations and the analysis of the availability of IPA funds. The previous application of classical PPP models as well as the operation of local action groups in the research area are examined by evaluating the available scientific literature. The research is concluded by implementing the empirical part and testing the scientific hypotheses.

The problems of rural development, unfortunately, represent an insoluble enigma for local officials, leaders, citizens and society as a whole. The experiences of the development of rural areas in Europe can offer solutions for the initial phase of identifying specific problems and developing local development strategies in order to start the process of sustainable rural development. A local action group, as well as a specific, more comprehensive model of public-private partnership, can generate new positive changes in the local community. The application of this model in the Municipality of Kalinovik was tested through the implementation of primary research on public change and municipal administration officials. On the specific example of the Municipality of Kalinovik, a combination of scientific research methods confirmed the main and auxiliary hypotheses of the research.

A multifaceted, integrated approach to rural development is necessary for the sustainable development of rural areas. A sustainable solution requires a joint effort of the local community, the Republika Srpska, and society as a whole. The research results show that without financial support, an integrated planning process, and changes in the concept of managing local development, i.e. adapting development itself to the real needs of citizens, the functioning of local public-private partnerships is not possible. If Bosnia and Herzegovina becomes a member of the European Union, it is certain that modern rural development initiatives, with the availability of EU funds, will offer solutions for the long-term recovery of rural areas.

One of the goals of this research is to stimulate new ways of thinking and encourage the application of innovative methods in the research area. The expected contribution of this scientific work is primarily in expanding knowledge about the identified problem through classification, explanation of existing scientific achievements, as well as predicting possible trends in observed phenomena in the near future. A permanent process of verifying acquired knowledge is one of the goals of all scientific research, so criticism of the research work will be welcome and may encourage the implementation of new research, which will complete and expand knowledge about this issue.

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ATTACHMENTS

ANNEX 1: QUESTIONNAIRE FOR EMPLOYEES IN THE MUNICIPALITY OF KALINOVIK

Application of the public-private partnership/local action group model in stimulating rural development in the area of the Kalinovik municipality

Dear Sir/Madam,

The questionnaire before you is an instrument of scientific research on the application of modern initiatives to encourage rural development in the territory of your municipality. Considering your extensive experience and knowledge acquired while performing tasks within the scope of municipal administration, your opinion is extremely valuable to us in analyzing the subject matter. The data obtained will serve as parts and indicators of scientific research that will have its practical application in the function of improving local economic development and adopting models and experiences of European approaches to rural development.

Educational level: 1. Secondary education; 2. Higher secondary education; 3. Higher education;
4. Other

Age _____; **Gender:** M W

Please put a cross (x) next to the answer that represents your personal opinion:

Data	I don't agree at all	I mostly disagree	I partially agree	I mostly agree	I completely agree
At the municipal level, there are trained personnel for the successful implementation of local economic development policies.					
The municipality has successful cooperation with republican government institutions on all issues of local economic development.					
Successful local economic development will increase employment and living standards in the coming period.					
The budget and local revenues of the municipality are sufficient for the					

implementation of projects and the sustainable development of the local community.					
Local development planning documents are aligned with national strategic documents.					
Proposals for implemented development projects come from employees of the municipal administration					
The municipality has good cooperation with entrepreneurs and the private sector.					
Local resources are fully utilized					
The unavailability of EU pre-accession assistance packages, especially IPARD, negatively affects rural and agricultural development.					
The municipality is interested in the development and implementation of local public-private partnerships, i.e. local action groups to stimulate rural development.					
Citizen participation in the development of local development strategies will strengthen links between the public and private sectors					
Projects proposed by citizens can contribute to the accelerated development of the municipality's competitiveness.					

The municipality has good cooperation with scientific research institutions and centers in the Republic of Srpska.					
The municipality has a sufficient number of employees who are familiar with EU project cycle management methods.					
The municipality is interested in cooperating with neighboring municipalities in terms of encouraging rural development.					
There is successful cooperation with other municipalities in the implementation of projects.					
There is interest in local government in seeking alternative sources of financing for development projects.					
The education of the municipal administration in the field of European approaches to rural development has been at a good level so far.					

ANNEX 2: QUESTIONNAIRE FOR RESIDENTS OF THE MUNICIPALITY OF KALINOVIK

Application of the public-private partnership/local action group model in stimulating rural development in the area of the Kalinovik municipality

Dear Sir/Madam,

The questionnaire before you is an instrument of scientific research on the application of modern initiatives to encourage rural development in the territory of your municipality. Considering your extensive experience and knowledge acquired while performing tasks within the scope of municipal administration, your opinion is extremely valuable to us in analyzing the subject matter. The data obtained will serve as parts and indicators of scientific research that will have its practical application in the function of improving local economic development and adopting models and experiences of European approaches to rural development.

Employment: 1. Public sector; 2. Private sector;

Educational level: 1. Secondary education; 2. Higher secondary education; 3. Higher education;
4. Other

Age _____; **Gender:** M W

Please put a cross (x) next to the answer that represents your personal opinion:

Data	I don't agree at all	I mostly disagree	I partially agree	I mostly agree	I completely agree
Civil society organizations and other citizens' associations are actively operating in the municipality with the goal and programs of improving the local community.					
The utility infrastructure is fully functional.					
Successful local economic development will increase employment and living standards in the coming period.					
Citizens should participate in the key decision-making process in their local community.					

At the municipal level, there are trained personnel for the successful implementation of local economic development policies.					
Proposals for implemented development projects come from employees of the municipal administration					
Residents, businesses and civil society organizations have good cooperation with the municipal administration.					
Public services in our municipality are delivered in a quality and timely manner.					
Local resources are fully utilized					
In our municipality, residents actively participate in the decision-making process that is important for local development.					
The municipality does not have enough money to implement projects that could improve living conditions in our environment.					
Lack of permanent employment is the key reason for leaving these areas					
Citizen participation in the development of local development strategies will strengthen links between the public and private sectors					
Projects proposed by citizens can contribute to the accelerated development of the					

municipality's competitiveness.					
A local community, or municipality, if it is guided by ideas and projects that are tailored to the wishes and real needs of its residents, has great chances for good and accelerated development.					
All participants in local life in the municipality of Kalinovik have an interest in strengthening mutual cooperation.					
Local entrepreneurs actively participate in the implementation of projects supported by local government					
Bringing together all relevant participants in public life when identifying and solving problems is a good basis for initiating positive changes in society.					



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GREENFIELD INVESTMENTS IN THE WESTERN BALKANS: A CATALYST FOR ECONOMIC GROWTH AND DEVELOPMENT

Abstract: Greenfield investments are an important form of foreign direct investment (FDI) as they contribute to economic growth and development through the creation of new businesses, job creation and technology transfer. Over the last twenty years, Western Balkan countries have actively sought to attract foreign investors through various policy measures and incentives. Based on secondary data from official UNCTAD reports, this paper analyzes the characteristics and dynamics of FDI inflows to the Western Balkans and their impact on economic growth and development, with a special emphasis on new greenfield investments in the period 2015–2023. The results of the study show that the Republic of Serbia is the most attractive investment destination in the region and attracts the largest share of FDI. The Western Balkan countries can further improve their competitiveness in attracting these investments by reforming the institutional framework, improving the regulatory environment and implementing more efficient incentive measures. This analysis is particularly important for policy makers, investors and other economic actors seeking to improve the investment climate. It highlights the need for strategic reforms to maximize the impact of greenfield investments on the long-term and sustainable economic growth of the Western Balkans.

Keywords: Greenfield investment, FDI, Western Balkans, economic growth.

1. INTRODUCTION

Foreign Direct Investment (FDI) presents a strong driver of socio-economic development, especially in developing countries (Lazaj et al., 2024). The inflow of FDI plays a crucial role in enhancing national production, reducing unemployment rates, and advancing technological progress (Sridevi & Chandramohan, 2019; Alalawneh & Nessa, 2020; Sultana & Turkina, 2020). In recent years, increasing attention has been given to the role of greenfield investment, as a form of FDI as a key driver of economic growth (Gopalan et al., 2018), particularly in transition economies such as Western Balkans countries. Ercegovic & Pucar (2022) found that greenfield FDI inflows are positively associated with GDP growth rates in Western Balkan countries. Unlike mergers and acquisitions, Greenfield investments involve the establishment of new business operations, including new production facilities, offices, and infrastructure (Tripathi et al., 2019). This type of investment not only brings fresh capital into the host economy but also fosters job creation, technology transfer, and increased production capacity (Assamah & Yuan, 2024; Raza et al., 2021). Given its significant impact on economic growth, understanding FDI trends and their impact remains essential for policymakers and other stakeholders in the Western Balkans. This study examines recent FDI inflow trends and evaluates their impact on the economic development of selected economies. The analysis is based on data from the official United Nations Conference on Trade and Development (UNCTAD), providing insights into both the amount

and total number of implemented greenfield investment projects. By reviewing the existing literature has determined that the period from 2015 to 2023 has not yet been analyzed, nor has this approach been utilized. The aim of this paper is to analyze the characteristics and dynamics of FDI inflows to the Western Balkans and their impact on economic growth and development, with a special emphasis on new greenfield investments during the period 2015–2023. This paper is divided into four sections. After the introduction, the second section provides a review of contemporary literature on FDI as a key factor in economic growth and development of national economies. The third section presents research findings on the characteristics and dynamics of FDI inflows in the Western Balkans, highlighting their impact on economic growth and development, with a particular focus on new greenfield investments from 2015 to 2023. Finally, the fourth section summarizes the key conclusions drawn from the research.

2. LITERATURE REVIEW

In the context of the globalization of the international economy, foreign direct investment has a considerable influence on the growth and development of the national economy (Marjanović et al., 2022). The Western Balkans is a geopolitically strategic region facing competing partnerships with the EU, China, and other global economies. Foreign direct investment has been widely studied in the literature for its potential to spur economic growth and development (Nguyen, 2023; Barry, 2025; Aiyar et al., 2024). Foreign investment is seen in most of the world's economies as both an important development tool and the key to maximizing their own potential (Domazet, et al., 2018). One of the primary strategies for the business expansion of multinational corporations refers to investing in other regions and countries (Vujadinović & Marjanović, 2024). By expanding into foreign markets, multinational corporations can allocate their capital through various investment strategies, including: (1) Greenfield investments, where they establish new facilities and operations; (2) Mergers and acquisitions (M&A), involving the purchase or consolidation of existing businesses; and (3) Joint ventures, which entail forming strategic partnerships with local companies (Sandler et al., 2019). Among these, Greenfield investments are the most prevalent, as they allow companies to maintain total control over their operations. Empirical research indicates that greenfield investments are the most productive among different types of foreign market entry and promote long-term economic growth (Nguyen et al., 2021). In contrast, mergers are primarily driven by the pursuit of efficiency gains and the transfer of advanced technologies, enabling firms to optimize operations and enhance competitiveness (Stepanok, 2015). The analyzed literature provides extensive evidence that these kinds of investments not only drive corporate growth but also contribute to the economic development of host countries through job creation, technology transfer, and infrastructure improvements (Ha et al., 2021; Amoroso & Müller, 2018; Domazet et al., 2021). This form of investment is particularly advantageous in emerging markets, where host countries actively encourage FDI to stimulate industrial growth, create jobs, and enhance technological advancement. It can also create employment opportunities and increase competition, which can stimulate innovation and productivity in various sectors (Hajdini et al., 2023). Foreign Direct Investment, whether in the form of greenfield investments or cross-border mergers and acquisitions (M&As), generates positive spillover effects that stimulate domestic entrepreneurship (Marjanović & Domazet, 2021). Greenfield investments, however, are more beneficial in countries with higher levels of market capacity and institutional support, while cross-border M&As remain effective regardless of these factors (Nguyen, 2023).

3. DATA AND METHODOLOGY

Data for FDI and greenfield FDI inflows in millions of USD is collected from the official United Nations Conference on Trade and Development UNCTAD 2024, ensuring a robust and reliable foundation for the analysis. The methodology used in this research is a comparative and descriptive method. The research sample consists of five countries in the Western Balkans (Albania, Bosnia and Herzegovina, Montenegro, North Macedonia and Serbia). The analysis covered the period from 2015 to 2023 allows for the assessment of investment trends and their impact on the region's economic development. The aim of this paper is to present recent trends in the FDI inflows and new Greenfield investments (amount and total number of implemented projects), as well as to explore their impact on the development of selected economies. The study aims to provide useful insights and policy guidance for transition economies, particularly the Western Balkans countries, to enhance their competitiveness in attracting greenfield FDI. Understanding these trends is crucial, as previous capital inflows play a key role in the decision-making process for new investors targeting emerging markets. The existing literature finds evidence that FDI, especially Greenfield FDI inflows contribute to economic growth, therefore, this research strives to examine the characteristics and dynamics of FDI and new greenfield investment inflows to the Western Balkans during 2015–2023 (Ercegovic & Pucar, 2022; Marjanović & Đukić, 2020). This research problem is relevant to economic policy creators to raise the attractiveness of national economy for greenfield investments. Following study compares values of received FDI and new greenfield investment inflows by five Western Balkans countries with objective to find a potential link to the achieved economic development. The findings offer valuable insights for policymakers, investors, and economic stakeholders aiming to optimize the benefits of greenfield investments in the Western Balkans and strengthen regional economic development.

4. RESEARCH RESULTS

The presented research involves three segments of analysis: 1) descriptive analysis of received FDI inflows in Western Balkans (2015-2023), 2) descriptive analysis of the number of announced greenfield FDI projects in Western Balkans (2015-2023), 3) descriptive analysis of the value of announced greenfield FDI projects in Western Balkans (2015-2023).

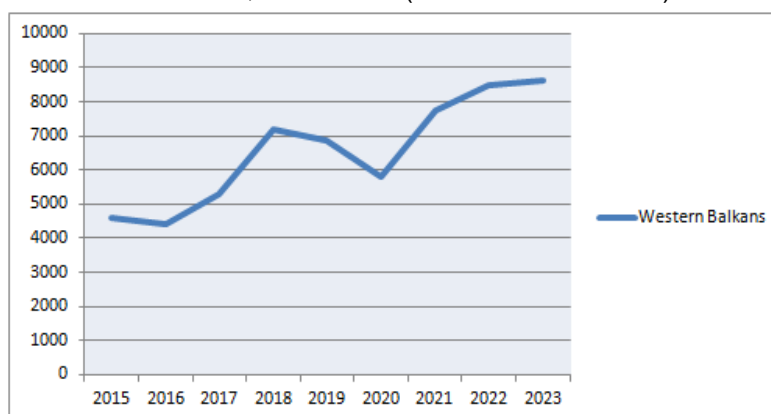
Table 1. FDI inflows, 2015-2023. (Millions of US dollars)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023
European Union	631254	363448	274520	305556	627335	154888	266502	-84830	58645
Western Balkans	4592	4401	5280	7174	6875	5817	7759	8466	8637

Source: UNCTAD (2025)

The Table1 shows FDI inflows for the European Union (EU) and the Western Balkans from 2015 to 2023. Although the inflow of FDI in the Western Balkans has significantly increased in recent years, it is still insufficient compared to EU countries. The Western Balkan countries remain behind developed EU economies in overall economic development, as evidenced by their significantly lower FDI inflows compared to the EU. FDI inflows in the European Union show significant fluctuations over the period. The highest inflows were recorded in 2015 (\$631,254 million) and 2019 (\$627,335 million). Then there was a sharp decline in FDI inflows in 2020 due to the COVID-19 pandemic, dropping to \$154,888 million. In 2022, the EU recorded negative FDI inflows (-\$84,830 million), indicating capital outflows. A partial recovery is observed in 2023 (\$58,645 million). On the other hand, FDI inflows in the Western Balkans were relatively stable, with a gradual upward trend. The lowest inflow was recorded in 2016 at \$4,401 million, while the highest inflow was recorded in 2023, reaching \$8,637 million. An interesting thing is that, unlike the EU, the Western Balkans did not experience a sharp decline in 2020, instead maintaining a more stable level of investment. The Western Balkan countries continue to fall behind the developed EU economies in overall economic development. Due to limited internal capital accumulation, they rely heavily on FDI as a crucial source of external financing. Attracting substantial foreign capital is a key objective for these nations, helping to bridge the gap between existing and necessary amounts of investment. The influx of new investments is expected to play a vital role in driving their economic growth.

Figure 1. FDI inflows in Western Balkans, 2015-2023. (Millions of US dollars)



Source: UNCTAD (2025)

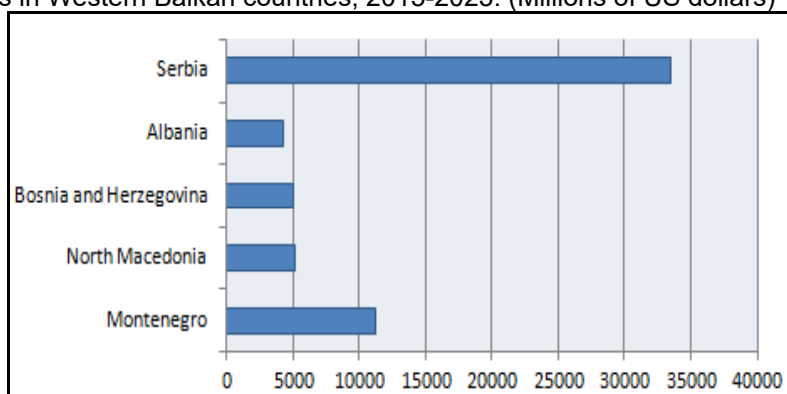
The Figure1 presents the trend of FDI inflows in the Western Balkans from 2015 to 2023. Initially, there was a moderate inflow in 2015, followed by a steady increase until 2018. A decline occurred in 2019, followed by a continued decline until 2020. The FDI inflows rebounded strongly in subsequent years, despite the global economic disruptions in 2020. The highest recorded inflows are observed in 2023, indicating a positive trend in attracting foreign investments to the region.

Table 2. FDI inflows in Western Balkan countries, 2015-2023. (Millions of US dollars)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023
Albania	945	1100	1148	1289	1287	1108	1233	1434	1630
Bosnia and Herzegovina	361	349	491	581	457	479	683	774	945
Montenegro	699	226	558	489	416	532	698	876	526
North Macedonia	240	374	205	725	446	230	556	784	666
Serbia	2347	2352	2878	4090	4269	3468	4589	4598	4870

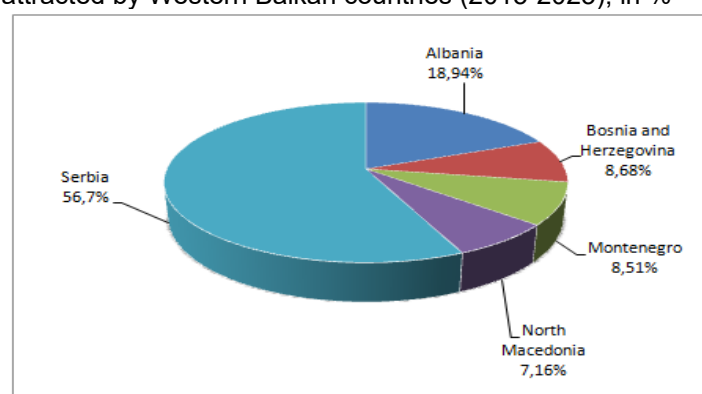
Source: UNCTAD (2025)

Table 2 presents the annual FDI inflows for five Western Balkan countries: Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia over the period from 2015 to 2023. During this period about \$ 59,001 million of FDI entered the Western Balkan region. From this table, it can be seen that Serbia consistently received the highest FDI inflows, peaking in 2023 with \$ 4,870 million. Also, Albania showed a positive trend, with inflows increasing from \$945 million in 2015 to \$1,630 million in 2023. Bosnia and Herzegovina had fluctuating inflows, with an overall upward trend, reaching \$945 million in 2023. Montenegro showed fluctuations, with a notable drop in 2016, followed by a peak of \$876 million in 2022, before declining to \$526 million in 2023. North Macedonia had inconsistent FDI inflows, with a peak in 2022 (\$784 million) and a decline in 2023 (\$666 million). Serbia stands out as the leading investment destination, largely due to its stimulative fiscal policy for foreign investments, which has helped create a competitive economic environment and attract significant foreign capital.

Figure 2. FDI inflows in Western Balkan countries, 2015-2023. (Millions of US dollars)

Source: UNCTAD (2025)

Figure 2 shows the total FDI inflows in Western Balkan countries over the period from 2015 to 2023. Serbia stands out as the dominant recipient of FDI, significantly surpassing the other countries in the region. It is followed by Albania, with a considerably lower value. Montenegro, Bosnia and Herzegovina, and North Macedonia attracted relatively lower FDI inflows, with Montenegro receiving a slightly higher amount. FDI has made significant contributions to the economies of the Western Balkans in recent years, as shown in Figure 2. It has played a key role in driving economic growth, creating jobs, and fostering innovation and technological advancement. Serbia was the leader in terms of FDI inflows.

Figure 3. Share of FDI attracted by Western Balkan countries (2015-2023), in %

Source: UNCTAD (2025)

Figure 3 illustrates the distribution of FDI inflows among the Western Balkan countries from 2015 to 2023. Serbia dominates the Western Balkan region in attracting FDI, with 56,7% of the total inflows, making it the most attractive investment destination. Albania, with 18,94%, holds second place, reflecting a significant share of regional FDI. Bosnia and Herzegovina and Montenegro received similar proportions of FDI, with 8,68% and 8,51%. North Macedonia attracted the lowest share, with 7,16% of total FDI inflows. This figure highlights Serbia's leading position in attracting foreign investments, while the other Western Balkan countries collectively account for less than half of the region's total FDI inflows.

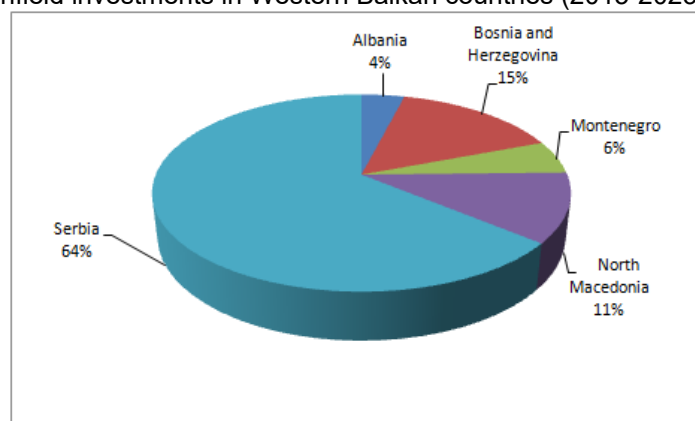
Table 3. Number of announced greenfield FDI projects in Western Balkan countries, 2015-2023

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023
Albania	5	2	3	8	3	5	6	7	12
Bosnia and Herzegovina	25	16	26	33	30	13	11	19	23
Montenegro	4	3	2	18	10	5	3	10	15
North Macedonia	20	22	12	15	13	3	18	29	14
Serbia	75	86	114	168	117	42	46	100	75

Source: UNCTAD (2025)

Table 3 presents the number of announced greenfield FDI projects in the Western Balkan countries from 2015 to 2023. Serbia consistently attracted the highest number of greenfield FDI projects, reaching a peak of 168 in 2018 and retaining a dominant position throughout the observed period. Bosnia and Herzegovina and North Macedonia showed fluctuating trends, with Bosnia reaching its highest number of projects (33) in 2018 and North Macedonia peaking at 29 in 2022. Albania and Montenegro reported relatively lower numbers of announced projects, with Albania showing a modest increase over time, reaching 12 in 2023, while Montenegro saw minor fluctuations, reaching a peak at 18 in 2018. From this table, it can be observed that in 2020, due to the impact of the COVID-19 pandemic, a noticeable decline in greenfield FDI projects was recorded across all countries.

Figure 4. Share of greenfield investments in Western Balkan countries (2015-2023), in %



Source: UNCTAD (2025)

Figure 4 illustrates the distribution of greenfield investments among Western Balkan countries from 2015 to 2023. Serbia attracted the largest share of greenfield investments, with 64% of the total projects, demonstrating its position as the primary investment hub in the region. Bosnia and Herzegovina followed with 15%, with a significant share of investment activity. Montenegro secured 6% of the investments, while Albania had the lowest share, with only 4% of the total greenfield FDI projects. North Macedonia with 11%, indicating a moderate share of greenfield projects. Montenegro secured 6% of the investments, while Albania had the lowest share, with only 4% of the total greenfield FDI projects. This distribution highlights Serbia's dominant role in attracting greenfield investments, while other Western Balkan countries receive a relatively smaller proportion of such projects.

Table 4. Value of announced greenfield FDI projects in Western Balkan countries, 2015-2023 (Millions of US dollars)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023
Albania	137	34	13	219	57	343	249	170	1049
Bosnia and Herzegovina	3089	822	639	737	532	465	356	693	1905
Montenegro	43	614	49	2009	572	581	103	140	1702
North Macedonia	354	339	135	917	287	137	1025	623	592
Serbia	4529	2132	4128	7004	4391	2108	3226	4438	11190

Source: UNCTAD (2025)

Table 4 presents the value of announced greenfield FDI projects in the Western Balkan countries from 2015 to 2023. The data indicates significant fluctuations in investment values across the years and countries. Serbia consistently attracted the highest greenfield FDI values, reaching a peak in 2023 with \$11,190 million, further reinforcing its status as the leading investment destination in the region. Bosnia and Herzegovina showed a fluctuating but moderate investment trend, reaching its highest value of \$1,905 million in 2023. Montenegro had a significant increase in 2018, reaching \$20,009 million, making it an outlier compared to other years. North Macedonia showed fluctuating investment values, with a notable increase in 2021 with \$1,025 million. Albania exhibited a more modest investment volume, but in 2023 recorded a sharp rise to \$1,049 million, compared to previous years. The data highlights Serbia's dominance in attracting greenfield FDI, while other Western Balkan countries display varied investment trends.

5. CONCLUSION

The Western Balkans have been recognized as an attractive investment destination, driven by economic reforms and simplified procedures for attracting foreign capital. A well-designed tax policy, particularly in the form of tax incentives, plays a crucial role in shaping the investment decisions of foreign investors. Also, FDI is an important factor for economic growth in all Western Balkan countries. Foreign investors are increasingly attracted to the region due to its favorable location, highly skilled workforce and affordable labor prices. By investing money in key sectors such as manufacturing, infrastructure, energy and ICT, FDI promotes economic growth. During the period under review, the Western Balkan countries recorded a significant increase in FDI inflows, which can be attributed to the economic reforms implemented and various investment incentives. However, despite these positive trends, the region still lags behind EU countries in attracting foreign capital. Serbia has been recognized as the leading investment destination in the region, attracting the largest share of FDI and greenfield investments, indicating a more competitive business environment compared to neighboring countries. Other Western Balkan countries have shown different levels of investment activity. Some of the factors that may cause these differences are economic policies, political stability, and market attractiveness.

The limitations of this research relate to the fact that Western Balkan countries were not compared with countries outside the region, as well as to the period covered by this research. To further improve the investment climate and ensure sustainable economic growth, it is necessary to continue reforms focused on strengthening the institutional framework, improving legal security, and creating a more favorable business environment for foreign investors.

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SUBSTITUTION OF TRADE POLICY INSTRUMENTS: THE CASE OF SERBIA

Abstract: In this study, I examine the potential substitutive relationship between tariffs and non-tariff measures, considering the conditions under which such substitution is expected to occur. I develop a deterministic model based on the protection for sale framework, analyzing weighted welfare maximization in a small importing economy. The model derives theoretical conditions for substitution of tariffs with non-tariff measures, highlighting the roles of relative marginal compliance costs between domestic and foreign producers, product price elasticity, consumers' sensitivity to quality, policymakers' prioritization of lobbying, and the existence of binding minimal production standards. Notably, the model predicts the lack of substitution effects when minimum standards are binding and compliance costs are comparable, as often expected in sectors with established and well-justified international standards. These predictions are tested empirically using the sample of non-tariff measure usage in Serbia from 2010 to 2021 across HS-2 sectors. The empirical testing was based on estimating a static model using a within regression estimator and a dynamic model of non-tariff measure usage employing the system-generalized method of moments. The empirical results provide significant and robust evidence of substitution between tariffs and technical measures. The identified substitution effects are also found to be scaled by the institutionalization of lobbying, further supporting the underlying theoretical framework. Conversely, only tentative and non-robust evidence of complementarity between tariffs and sanitary and phytosanitary measures was identified. This divergence likely reflects sectoral differences related to standards heterogeneity and domestic competitiveness.

Keywords: trade policy, non-tariff measures (NTM), tariffs, international trade, lobbying, policy mix, substitution, Serbia

1. INTRODUCTION

The importance of trade policy is multifold as it defines the framework of economic relations of a country with the rest of the world. Therefore, it comes as no surprise the great interest for the trade policy effects and their potential effects of growth, social welfare and distributional equality (Beverelli, Boffa, & Keck, 2019; Niu, Milner, Gunessee, & Liu, 2020). However, economic efficiency is not always the only or even leading factor when determining the optimal trade policy mix. Namely, the process could be influenced by various political factors, such as interest groups' lobbying (Grossman & Helpman, 1994; Yu, 2000). The issue has become particularly important lately, with high level of interconnectedness of the world economy, and instability in trade policy of key world economies, that have long reaching effects in the majority of countries that are participating in global value chains (Ghodsí & Stehrer, 2022).

In this study, I examine one peculiar aspect of this optimal policy mix choice, focusing on interaction between tariffs and non-tariff measures. I seek to answer in what cases is substitution between the two more likely. In order to do this, I develop a deterministic model based on the protection for sale framework of weighted welfare maximizations. From this model I derive the conditions for the initial hypothesis – that tariffs and non-tariff measures are substitutes. I test this prediction empirically, by considering the case of Serbia. The country underwent significant trade liberalization process since the 2000s, resulting in considerable overall tariff reductions. This presents an interesting opportunity to investigate empirically if this process resulted in the rise of neo-protectionism.

The initial hypothesis was tested using the sample of tariffs and non-tariff measure usage across HS-2 sectors in the period between 2010 and 2021. The testing is based on estimating a static and dynamic model of non-tariff measure frequency of use, using the within regression estimator and system-generalized method of moments (Blundell & Bond, 1998). The results support the initial hypothesis, particularly in the case of technical measures.

The remainder of this paper is organized as follows. The following section presents the review of the related theoretical and empirical literature. Section 3 presents the deterministic model of weighted social welfare maximization resulting in comparative statics describing the relationship between non-tariff measure level of usage and tariffs. In Section 4, identification strategy is described, followed by empirical methodology and sample characteristics and data sources. Section 5 presents the results of empirical investigation of the effects of tariffs on non-tariff measure usage in the case of Serbia. Final section concludes.

2. LITERATURE REVIEW

Substitution of tariffs with non-tariff measures has been a topic in international trade theories, particularly in the context of trade liberalization and the constraints imposed by multilateral agreements. The theoretical frameworks revolve around political economy considerations, strategic policymaking, and the role of regulatory gaps in trade agreements. Baldwin (1984) was among the first to highlight the trend of policy instruments substitution, noting that as countries agreed to lower tariff rates, they increasingly turned to alternative trade barriers. This perspective is reinforced by Copeland (1990), who argued that trade agreements primarily focused on tariff reductions, leaving regulatory gaps that policymakers exploited by implementing NTMs.

Further, more formal theoretical developments extend this idea, incorporating political economy models that explain why policymakers opt for non-tariff measures when tariffs are constrained. Beverelli et al. (2019) built on the work of Grossman and Helpman (1994), demonstrating that when tariff reductions are externally imposed, policymakers, influenced by domestic producer lobbying, compensate for lost protection by introducing non-tariff measures. Similarly, Essaji (2010) analyzed how the introduction of standards, a common form of NTMs, affects production costs asymmetrically, typically disadvantaging foreign producers relative to domestic firms.

The substitution of tariffs with non-tariff measures is also explained through strategic policymaking and the incentives of governments to maximize domestic welfare while responding to lobbying pressures. For instance, Yu (2000) applied the approach based on game theory to show that policymakers choose between tariffs and non-tariff measures based on the strength of lobbying from producers and consumers. When tariffs are transparent and politically costly due to their impact on consumers, governments may opt for non-tariff measures, particularly voluntary export restraints, as a more politically viable alternative.

The theoretical literature on trade policy substitution highlights multiple dimensions of this phenomenon, ranging from trade liberalization-induced shifts to political economy considerations and strategic policymaking. The relationship has been tested in numerous empirical studies. Empirical literature testing the theories previously discussed presents mixed evidence, with no clear consensus.

Several studies support the substitution hypothesis. For instance, Beverelli et al. (2019) empirically test their own theoretical model, demonstrating a positive impact of tariff reductions on the likelihood of trade disputes related to technical barriers, particularly in OECD countries. Niu, Milner, Gunessee, and Liu (2020) convert non-tariff measures into ad valorem equivalents and find significant substitution effects across 60 countries from 2003 to 2015, except in OECD agricultural sectors. Kee, Nicita, and Olarreaga (2008) similarly establish sectoral heterogeneity, with substitution effects in industrial sectors but a complementary relationship in agriculture. Grüber and Reiter (2021) provide descriptive evidence of non-tariff measures during the period of intense trade liberalization, providing further support for substitution hypothesis. Additional empirical studies further corroborate the substitution effect (Bown & Tovar, 2011; Feinberg & Reynolds, 2007; Herghelegiu, 2018; Kuenzel, 2023). Some empirical studies imply particularly strong substitution effects in developing economies (Limão & Tovar, 2011; Moore & Zanardi, 2011; Ronen, 2017).

Other empirical studies report evidence of complementary relationship between non-tariff measures and tariffs. For instance, Beghin, Disdier, and Marette (2015) suggest that nearly 40% of analyzed non-tariff measures enhance trade rather than restrict it. Descriptive evidence of complementary relationship was also found in the case of Colombia (Goldberg & Pavcnik, 2005). More comprehensive and robust empirical tests in multi-country settings are in line with these findings (Dean, Signoret, Feinberg, Ludema, & Ferrantino, 2009; Lee & Swagel, 1997).

3. THEORETICAL FRAMEWORK

To motivate the empirical analysis of substitution between tariffs and non-tariff measures I develop a simple deterministic model. The model is based on the general framework of protection for sale proposed by Grossman and Helpman.(1994). In this regard, the model builds upon the model of Beverelli, Boffa and Keck (2019), who use the same framework to explore the substitution effects of standards and tariffs by considering differences in marginal costs of compliance of domestic and foreign producers. I adopt a similar partial equilibrium framework, where I analyze the case of small, open economy importing a good. Also in line with aforementioned theory, I assume perfect competition and linear supply and demand curves. I depart from the existing framework in considering the effects of non-tariff measures (conceptualized as standards) on demand side, which has previously been abstracted. Namely, I consider the possibility that the introduction of standards (σ) positively affects the quality of products if they are set above some objective threshold of quality standard (σ_m). The demand for product is then defined as following linear function:

$$D(\sigma, \sigma_m, \tau) = b - cp + \gamma(\sigma - \sigma_m) \quad (1)$$

Where b , c , and γ are positive parameters and p is price of the good. If the standards are set above the minimal threshold, this contributes to the quality of good resulting in higher demanded quantity of good, all other things being equal. However, if the standards are below this threshold, it negatively affects the demand due to substandard quality of good. In line with the existing theories, in order to simplify the analysis I assume all the producers adopt only legally required standards. The supply is defined as:

$$y(\sigma, p) = p - \phi\sigma \quad (2)$$

where the supply quantity is dependent on market price and the level of standards, as well as the marginal cost of implementing the said standards (ϕ), which is assumed to be positive.

The country is assumed to be importer and not to export the good. Imports are defined as difference between demanded and supplied quantity:

$$M(\sigma, \sigma_m, \tau) = D(\sigma, \sigma_m, \tau) - y(\sigma, p) \quad (3)$$

The implication of the assumption of perfect competition and that the country is strictly importer that we made previously is that the effective domestic price of this small country will be determined by the world price, increased by tariffs (τ) and costs of conforming to standards the importing country sets for foreign producers ($\phi_s\sigma$). To simplify the analysis, I standardize the world price to 1, obtaining the expression for effective equilibrium price in the small importing country:

$$p^* = 1 + \tau + \phi_s\sigma \quad (4)$$

By selling at equilibrium price, domestic producers get surplus:

$$\pi = \int_{\phi\sigma}^{p^*} y(\sigma, p) dp \quad (5)$$

The effective equilibrium price is relevant not only for producers, but also for consumers. At that price, consumers get consumers' surplus defined as:

$$s = \int_{p^*}^{\frac{b+\gamma(\sigma-\sigma_m)}{c}} D(\sigma, \sigma_m, \tau) dp \quad (6)$$

where the lower limit of integration is the equilibrium price, and the upper limit is the choke price obtained from Equation (1) by setting condition $D(\sigma, \sigma_m, \tau) = 0$.

I embed this set-up into the protection for sale framework. The focal point of the framework is that the policy makers choose optimal trade policy mix of instruments simultaneously maximizing total welfare in the country and being affected by domestic producers' lobbying. This is encapsulated by the following modified welfare function that policymakers optimize:

$$V(\sigma, \tau) = \pi + a(\pi + s + \tau M) \quad (7)$$

where a denotes a non-negative parameter that describes the importance policy makers place on domestic producers' interests. The higher the level of this parameter is, the lower importance is placed on domestic producers' interests and the closer this framework gets to standard social welfare maximization problem.

Policy makers are not entirely independent when setting tariffs, as they are constrained by the international regulations, primarily the regulations related to multilateral trading systems and international trade agreements in which the country participates. We have a related example of this in the European Union integration process of Serbia (Matkovski, Zekic, Savic, & Radovanov, 2018). I, thus, consider tariffs in the model to be bound to the value τ , which is set by international obligations of the country. I formalize the decision process of the policy makers in small importing economy as the optimization problem, defined as:

$$\max_{\tau} V(\sigma, \tau) \text{ s.t.} \quad \tau = \tilde{\tau} \quad (8)$$

From the optimization problem defined in Equation 8, I derive first order condition for optimal tariff rate, as:

$$\frac{\partial V(\sigma)}{\partial \sigma} = 0 \quad (9)$$

From here, I can derive optimal level of standards (non-tariff measures) (σ_u) introduced by policymakers, which results in maximized modified welfare function value. This optimal level of standards has infinitely many solutions as long as a condition for b parameter is satisfied. Such result is of limited usefulness, and it is difficult to interpret. However, we are primarily interested in substitution effect – i.e. under which conditions will decrease in tariffs result in increase in non-tariff measures. I can formalize this substitution effect as:

$$\frac{\partial \sigma_u}{\partial \tilde{\tau}} < 0 \quad (10)$$

Despite our complex solution of first-order condition, by invoking implicit function theorem, we can determine the condition in Equation 10 as closed-form inequality:

$$\frac{\partial \sigma_u}{\partial \tilde{\tau}} = \frac{a((1-c)\phi + (c-1)\phi_s - \gamma) + 2(\phi - \phi_s)}{a((c+2)\phi^2 - 4\phi\phi_s + 2\phi_s^2) + 2(\phi - \phi_s)^2} < 0 \quad (11)$$

By solving this inequality, I derive conditions under which substitution between tariffs and non-tariff measures will occur. Since the denominator is always positive, the condition under which the substitution of trade policy instruments will occur comes from the nominator. Here, a crucial condition for policy instruments substitution is marginal costs of compliance advantage domestic producers have over foreign producers ($\phi < \phi_s$). In such circumstances, domestic producers will lobby for non-tariff measures introduction if tariffs are exogenously reduced, as such change increases or maintains their advantage over foreign producers on domestic market. The substitution will occur as long as the condition $(c-1)(\phi_s - \phi) - \gamma < 0$ is met. From this condition, we can clearly conclude that if domestic producers have compliance costs advantage, the substitution will occur as the demand for good traded is relatively inelastic ($c \leq 1$). In the case of such an inelastic good, that is, when consumers are not price sensitive, introduction of standards protects domestic producers while improving quality at the expense of raising prices of good. However, due to price insensitivity, such a change does not strongly affect the weighted welfare value. The substitution effect thereby grows with increase in compliance cost advantage of domestic producers and quality elasticity of demand.

On the other hand, in the case of elastic good, demand will react strongly to increases in prices caused by introduced standards, which cannot be as easily offset by increases in quality and protection of domestic producers. Our substitution condition also implies that substitution between tariffs and non-tariff measures will occur as consumers' sensitivity to quality grows, as introduction of non-tariff measures improves the quality of good, increasing the consumers' surplus, but only as long as the quality elasticity is larger than compliance cost advantage adjusted by price elasticity. It is also worth noting that these effects are proportionally scaled by the weight policymakers place on protection (the importance of lobbying).

The substitution can occur even if foreign producers have marginal compliance cost advantage, if the demand for good is more elastic and the condition $1 + \frac{2}{a} - \frac{\gamma}{\phi - \phi_s} < c$ is satisfied. This implies that for substitution to occur if domestic producers are at compliance disadvantage, policymakers need to prioritize social welfare in general compared to welfare of producers. In this case, policy instrument substitution is driven not by lobbying, but by general public

interest. Additionally, the substitution is more likely to occur in this case, as consumers are more sensitive to quality and as cost disadvantage of domestic producers is lower. Such result is a notable difference from the related model of Beverelli et al. (2019), where domestic producers' cost advantage is a necessary condition for trade policy substitution.

I further consider what happens if non-tariff measures are set at least at objective level that ensures sufficient quality demanded by consumers. I operationalize this as standard level denoted by σ_m . If such level of minimally and objectively required standard is possible to operationalize for policymakers, their decision regarding optimal non-tariff measures level becomes the optimal result of the following maximization problem:

$$\begin{aligned} \max V(\sigma, \tau) \text{ s.t.} \\ \tau = \tilde{\tau} \\ \sigma \geq \sigma_m \end{aligned} \quad (12)$$

If the constraint set by minimal objective criterion for non-tariff measure is not binding, the maximization problem reduces to Equation 8, and the solutions previously discussed. However, if the constraint is binding, then according to Kuhn-Tucker conditions, the shadow price of minimally required standard for non-tariff measure (λ) needs to be strictly positive. Thereby, the shadow price is determined from first order condition of problem posited by Equation 12 as $\lambda = -\frac{\partial V(\sigma, \tau)}{\partial \sigma} \Big|_{\sigma = \sigma_m, \tau = \tilde{\tau}}$. The condition $\lambda > 0$ is met (and, thus, $\sigma_u = \sigma_m$) if $(2 + a(c + 2))\phi^2 - 4(a + 1)\phi\phi_s + 2(a + 1)\phi_s^2 = 0$, and $((1 - c)\tau + b - c + \gamma + 2 - \phi_s) + a((c + 1)\phi_s + (c - 1)\tau - 2)\phi_s + 2(\tau + 1)(\phi - \phi_s) > 0$. These conditions are only met in the specific case of perfectly inelastic demand ($c=0$) and equal marginal compliance costs of domestic and foreign producers ($\phi=\phi_s$). Under those circumstances, policymakers will always set minimal standards required by consumers, and in such circumstances change in tariffs has no effects on optimal choice of non-tariff measures. Any standards higher than the minimum have no positive effect of social welfare, because they neither provide protection for domestic producers, nor affect consumption patterns.

The difference between optimal solution when minimal standard is binding or not binding depending on the relationship between marginal compliance costs of domestic and foreign producers is illustrated in Figure 1.

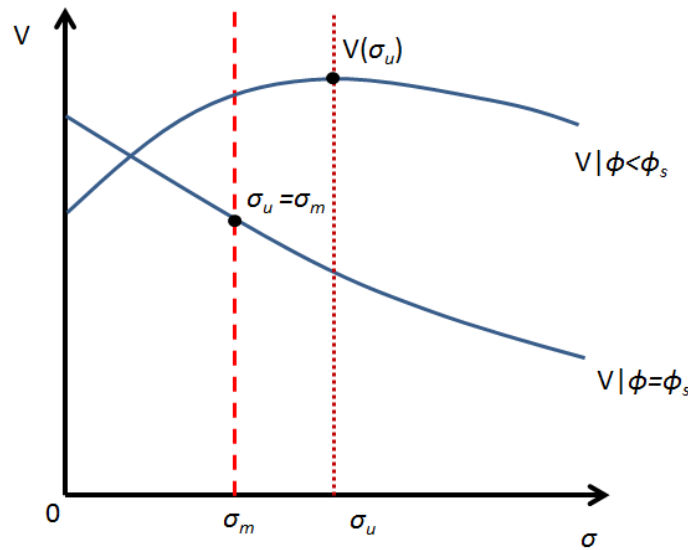


Figure 1: Illustration of policymakers' optimal choice of non-tariff measures
Source: Author.

Figure 1 depicts the relationship between social welfare (V) on the vertical axis and the level of the non-tariff measure (σ) on the horizontal axis. Two distinct social welfare curves are shown, both representing the relationship between V and σ for a fixed level of the tariff (τ). The first V -curve, denoted by $V | \phi < \phi_s$ represents the more likely scenario where domestic producers face lower marginal compliance costs than foreign producers ($\phi < \phi_s$). This curve reaches a higher maximum level of social welfare, as the increase in standards set by non-tariff measures positively affects both producers (who enjoy greater protection) and consumers (who enjoy higher quality of good). However, this increase is detrimental to trade, and under conditions previously explored at certain point further increase in non-tariff measures can start exhibiting negative effects of weighted welfare function. Larger marginal cost advantage of domestic producers increases the slope in value function, resulting in optimum at higher level of non-tariff measures and higher weighted welfare value. The other welfare V -curve, denoted by $V | \phi = \phi_s$ represent the special case I discussed previously, where domestic and foreign producers have equal marginal compliance costs ($\phi = \phi_s$).

A vertical dashed red line denoted by σ_m represents a minimum acceptable level for the non-tariff measure ensuring sufficient quality for consumers. This constraint could reflect necessary safety regulations or product quality standards that are objective and possible to quantify and are introduced into regulatory framework. A horizontal dotted red line indicates the unconstrained optimal level of the non-tariff measures, denoted as σ_u . This is the level of non-tariff measures that would be chosen if the minimum standard constraint were not binding, which is the case when domestic producers enjoy increase in protection from increasing standards.

As depicted, generally, numerical simulation of the model indicated that unconstrained choice of optimal non-tariff measures level results in higher weighted welfare than the result of the constrained choice. For the other perspective, we can also say that the model implies higher weighed welfare in the case where domestic producers have lower marginal compliance costs than foreign producers. This would usually be the case if the compliance requires specific knowledge of importing country's institutional and regulatory framework or if the standards set technological requirements and importing country has superior technology.

In the scenario depicting binding constraints faced by policymakers, the minimum standard will also be optimal standard level of non-tariff measures. However, this would lead to a decrease in welfare compared to unconstrained case. It is also worth noting that while tariff rates are held at fixed rate for the purpose of illustration, their exogenous changes tend to shift the welfare curves upwards and downwards. This reflects our main result stating that decrease in tariffs is compensated by increase in non-tariff measures by weighted welfare maximizing policymakers, in the case of lower marginal compliance costs of domestic producers. In the special case of equal marginal costs, changes in tariff do not affect the optimal choice of non-tariff measures.

Figure 1 shows that when domestic producers have a cost advantage in compliance, the overall social welfare achievable is higher for any given level of σ . This suggests that policies that lower domestic compliance costs, or situations where domestic firms are inherently more efficient at meeting standards, can lead to welfare gains. The fact that the constraint at σ_m is binding only in very special case implies that, in the absence of the constraint, policymakers would optimally choose the lowest non-tariff measures level possible. Only an objective criterion protecting interests of consumers is then holding the level of the non-tariff measures chosen. However, in most other cases, policymakers will choose the level of non-tariff measures that is higher than the minimum required by consumers.

It is worth noting that the domestic producers will lobby for higher standards when they have marginal cost advantage compared to foreign producers. However, in the special case of constrained optimum, they have an incentive to lobby for non-tariff measures reduction and it reduces their costs.

If the constraint is not binding, then maximum weighed welfare is achieved at point $V(\sigma_u)$. The results also imply weighted welfare loss from imposing minimal objective standard, even if marginal compliance costs of foreign and domestic producers are identical.

The illustration, as well as the deterministic model, highlights the importance of considering both compliance costs and the potential objective binding constraints in designing optimal trade policy. The analysis underscores that even when tariffs improve welfare, a binding minimum standard setting the level of non-tariff measures can limit the achievable level of social welfare, leading policymakers to choose a constrained optimum, decoupling non-tariff measure choice from exogenous changes in tariff rates. The results, though simplified, emphasize the significance of considering objective standards and regulations, as well as their effect of quality (and thus demand) in conjunction with traditional tariff policies.

We can also consider the main results of our model within broader historical context and concrete product groups. Namely, in general, due to liberalization of trade policies, tariffs have been continuously reduced over time for many products. The results of the model show why it is expected that such reductions are expected to result in increased use of non-tariff measures. In essence, the model presents a simple mechanism explaining why neo-protectionism occurs, particularly in small open economies. However, in specific cases of products with inelastic demand where production technology is largely standardized, and where there are scientifically-backed standards of production ensuring minimal quality and safety of products, we expect to see no effects in tariffs changes, whether the changes are positive or negative. A promising scenario for such an outcome is trade policy mix regulating international trade in agricultural commodities, where we could expect tariff hikes to result in maintained levels of non-tariff measures, severely restricting international trade.

4. METHODOLOGY

From the preceding theoretical model I derive the general hypothesis to be tested empirically in the remainder of this paper:

H1: The decrease in tariff rates causes the increase in the level of non-tariff measures use in the same country.

The hypothesis is conditional of marginal compliance cost advantage of domestic producers and either inelasticity of imported good's demand or high sensitivity of demand to quality with lobbying moderating the intensity of trade policy substitution. Moreover, if domestic producers are at marginal compliance cost disadvantage, the substitution could still occur for sufficiently low lobbying pressure or high quality sensitivity relative to demand elasticity of imported good. However, if the marginal compliance costs of foreign and domestic producers are the same, and there is an objective criterion codified in the importing country's legislature that ensures minimal quality standard of a good, and if such good's demand is inelastic, changes in tariffs for such goods will not affect non-tariff measures related to the same good. I rudimentarily operationalize this condition by separately observing the interaction between non-tariff measures use characteristic mostly for agricultural sector (the group of sanitary and phytosanitary measures) and for technical measures to trade. Considering that in the case of agriculture and sanitary and phytosanitary measures we have systematically more inelastic goods, convergence of production techniques across countries with production experience accumulation, leading to convergence in marginal compliance costs, and scientifically-backed and internationally recognized standards such as Codex Alimentarius (Beghin, Maertens, & Swinnen, 2015; Kastratović, 2023; Kastratović & Vasiljević, 2018), we expect that in this case it is more likely to observe insignificant effects of tariffs on non-tariff measures usage. I, thus, formulate the following sub-hypothesis accordingly, as:

H1a: The decrease in tariff rates does not affect the non-tariff measure usage in the case of agriculture in the same country.

Given the unobservability of marginal compliance costs and demand elasticities, I employ the following panel fixed-effects model:

$$NTM_{it} = \beta_{0i} + \beta_1 AT_{it-1} + \beta_2 IMP_{it} + \varepsilon_{it} \quad (13)$$

where i denotes HS-2 level sectors, t denotes years, NTM_{it} is the frequency index of NTMs at the HS-2 level measuring the proportion of HS-6 level products within a sector subject to at least one non-tariff measure of type A or B, AT_{it-1} represents the average tariff rates applied to sector in year, lagged by one year to mitigate reverse causality, IMP_{it} is the import value (in thousands of constant USD) for HS-2 sector, controlling for competitive pressure from foreign producers, and ε_{it} is the error term. To account for lobbying effects, I extend the model with a lobbying dummy () interacting with tariffs::

$$NTM_{it} = \beta_{0i} + \beta_1 AT_{it-1} + \beta_2 AT_{it-1} \times L_t + \beta_3 L_t + \beta_4 IMP_{it} + \varepsilon_{it} \quad (14)$$

where all terms represent the same variables and indices as equation 13, and L_t is a dummy variable indicating the introduction of Serbia's Law on Lobbying in 2018, which institutionalized lobbying and increased transparency in this activity. If lobbying moderates trade policy substitution, we expect the slope coefficient for L_t to be significantly negative.

To address endogeneity concerns, I follow Beverelli et al. (2019) and Niu et al. (2020) by lagging tariffs variable. Additionally, I test strict exogeneity (Wooldridge, 2002, p. 285), by estimating:

$$NTM_{it} = \beta_{0i} + \beta_1 AT_{it+1} + \beta_2 IMP_{it} + \varepsilon_{it} \quad (15)$$

which represents the baseline model adjusted by considering the effects of leads of tariffs (rather than lags) on non-tariff measure usage. If such effects are statistically insignificant, it would support the assumption that tariffs are exogenous. Given the potential persistence of non-tariff frequency over time, and the suitability of the sample with relatively short time frame, I additionally estimate a dynamic panel model, which is particularly suitable in such case (Kastratović, 2019):

$$NTM_{it} = \beta_{0i} + \beta_1 NTM_{it-1} + \beta_2 AT_{it+1} + \beta_3 IMP_{it} + \varepsilon_{it} \quad (16)$$

The dynamic model is estimated using the Blundell-Bond system generalized methods of moment approach. Thereby I use Windmeijer's correction to ensure robustness of standard errors (Windmeijer, 2005). To address Nickel's bias, we consider the lagged non-tariff measures variable as endogenous (Nickell, 1981). For previously discussed reason, the same was done for tariffs and imports variable. In this way, I directly address the endogeneity problem, while accounting for potential persistence of non-tariff measure's coverage of products over time.

The sample includes data on frequency indices by HS-2 level, calculated by the author for Serbia in the period between 2010 and 2024. The descriptive statistics for the sample is presented in Table 1.

Table 1: Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
NTM-A _{it}	1440	51.70	48.72	0	100
NTM-B _{it}	1440	77.55	35.40	0.50	100
AT _{it}	768	12.11	9.80	1.05	49.34
IMP _{it}	768	402,559	889,719	429	7,422,724
L _t	1440	0.46	0.50	0	1

Source: Author's calculation.

The basis for this calculation was extensive database of all non-tariff measures in Serbia, obtained by performing content analysis across the entire regulatory framework of the Republic of Serbia, resulting in information at HS-6 level about the types of non-tariff measures introduces, their date of introduction, and affected countries. By aggregating this data on HS-2 level, I am able to retrieve the number of HS-6 codes within HS-2 sectors that have at least one matching non-tariff measure active in the given year. This sum is then divided for every HS-2 sector with total number of HS-6 codes within each HS-2 sector (Disdier & Fugazza, 2019), which was obtained from comprehensive Harmonized System Classification. This provides a large dataset of 1440 observations describing non-tariff measure usage in Serbia in the considered period. This dataset was matched by HS-2 code with tariff and import value data provided by the World Bank, via World Integrated Trade System. This data was not as comprehensive, which limits the sample size to 768 observations and the timeframe of the analysis to 2010-2021.

5. RESULTS AND DISCUSSION

In this section, I present the results of empirical model estimations indicating the existence and the extent of substitution between tariffs and non-tariff measures in the case of Serbia. Table 2 presents the baseline static model estimation result. Columns NTM-A and NTM-B refer to the estimations of Equation 13, for two operationalizations of the dependent variable – sanitary and phytosanitary measures (type A) and technical measures (type B). In classifying the measures for constructing the dependent variable I followed the classification of the United Nations Conference on Trade and Development. The next two columns refer to the extended model denoted by Equation 14. Finally, the last two columns show the results of strict ergogeneity testing.

The baseline specification indicates possible complementary relationship between tariffs and sanitary and phytosanitary measures. In contrast, there is strong evidence of substitution between tariffs and technical measures. The coefficient indicating the effects of tariffs on sanitary and phytosanitary measure is statistically significant at 10% level. It indicates that liberalization of trade by reducing tariffs by one per cent point leads to the reduction of coverage of sanitary and phytosanitary measures by 0.67 per cent points within HS-2 sectors on average. Coefficient reflecting the effect on tariffs on technical measures is significant at 1% level, indicating that a reduction of tariffs by one per cent point leads to the increase of non-tariff measure coverage within HS-2 sectors by approximately 4.18 per cent points on average. Such results indicate possible liberalization processes specific to agriculture, whereas in the manufacturing sector we can observe tendency of maintaining the protection of domestic producers with tariff liberalization.

The extended model does not fit well the specific case of sanitary and phytosanitary measures, as evidenced by the lack of statistical significance of that specification as a whole. However, the fit is considerably improved for technical measures model, indicated by significant increase in both F-statistics and coefficient of determination. We observe the effects that are consistent with theoretical expectations. Namely, the institutionalization of lobbying in the Republic of Serbia was found to significantly scale substitution effects. In the absence of lobbying, there is statistically significant effect of tariff reduction on non-tariff measures increased use, which is significant at 1% level, similarly to the baseline model. However, we can see that when lobbying is present in institutionalized form, the economic effects of tariffs on non-tariff measures' usage grow by additional 0.53 per cent points. Lobbying institutionalization in itself also has a significant effect on non-tariff measure usage, as evidenced by the corresponding coefficient which is statistically significant at 1% level.

Table 2: Baseline Static Model Estimation Results

Variable	NTM-A	NTM-B	NTM-A	NTM-B	SET: NTM-A	SET: NTM-B
AT _{it-1}	0.673* (0.361)	-4.148*** (0.956)	0.607 (0.377)	-2.865*** (0.862)		
AT _{it+1}					-0.038 (0.072)	-5.048*** (0.069)
IMP _{it}	-7.84×10 ⁻⁷ (9.78×10 ⁻⁷)	8.99×10 ⁻⁶ (1.43×10 ⁻⁵)	-7.65×10 ⁻⁷ (9.24×10 ⁻⁷)	-3.37×10 ⁻⁶ (7.73×10 ⁻⁷)	-3.36×10 ⁻⁷ (3.25×10 ⁻⁷)	16.2×10 ⁻⁶ (7.48×10 ⁻⁶)
L _t × AT _{it-1}			-0.120 (0.094)	-0.535* (0.312)		

L_t			1.027 (0.744)	35.360*** (5.037)		
Intercept	45.976*** (4.290)	118.233*** (12.864)	46.802 (4.547)	100.800*** (10.500)	52.260 (0.922)	120.851 (9.165)
Observations	384	384	384	384	672	672
F-statistics	2.43*	9.89***	1.57	31.49***	0.55	31.26***
Within group R^2	0.04	0.06	0.05	0.26	0.00	0.15

Note: *** and * denote significance at 1% and 10% significance levels, respectively. All specifications include fixed effects. Robust standard errors clustered at HS-2 level are presented in parentheses.

Source: Author's calculation.

While strict exogeneity testing indicates we can rely in conclusions on our static model of sanitary and phytosanitary use, it indicates that endogeneity was not completely eliminated by the use of lags in the case of technical measures' specification. For this reason, I address the endogeneity problem more directly by instrumentalizing tariffs and imports with their lagged variables.

Considering the specific nature of our dependent variable and the panel structure of the sample, I base this approach in estimating the effects of tariffs on non-tariff measures use on dynamic panel estimation to check the robustness of our initial conclusions. The results of this estimation are presented in Table 3. The diagnostics indicate that this is not a valid approach for the specification describing the use of sanitary and phytosanitary measures (column NTM-A), as the level of persistence is unrealistically high, no autocorrelation of first order was found in the residual of differences equation and the Hansen test indicates that the instruments used in the estimation are not valid. However, the same diagnostic tests indicate the validity of specification and the chosen instrument in the case of technical measures model (denoted as NTM-B in Table 3).

Table 3: Dynamic Model Estimation Results

Variable	NTM-A	NTM-B
NTM_{it-1}	0.982*** (0.117)	0.697*** (0.031)
AT_{it}	0.079 (0.053)	-0.897** (0.433)
IMP_{it}	-1.57×10^{-7} (1.79×10^{-7})	-3.78×10^{-7} (5.41×10^{-7})
Intercept	0.844 (1.114)	39.230*** (6.440)
Observations	672	672
Number of groups	96	96
Number of instruments	64	80
F-statistics	3733.50***	270.18***
AR(1)	0.317	0.063
AR(2)	0.312	0.836
Hansen test	0.015	0.083

Note: ***, **, and * denote significance at 1%, 5% and 10% significance levels, respectively. Robust standard errors are presented in parentheses. AR(1) and AR(2) refer to p-values of Arellano-Bond test for autocorrelation of first and second order in first differences. Hansen test refers to p-value of Hansen test of overidentifying restrictions.

Source: Author's calculation.

The estimates confirm the initial finding of significant substitution effect of tariff reductions. Namely, the results suggest that the reduction in tariffs by one per cent point, causes the average increase in non-tariff measure usage within HS-2 sectors by the nearly same extent in the short run. The corresponding coefficient is statistically significant at 5% level. When we account for persistence, this effect nearly triples in the long run. The estimation results also show significant persistence in the use of non-tariff measures. This could potentially indicate a ratchet effects in the use of non-tariff measures, meaning that once introduced for some products, the non-tariff measures remain in the long run. This emphasized the perils of the use of neo-protectionism, which could be difficult to counter in the future, particularly if the multilateral trading system does not continue with the liberalization processes and greater regulation of their use.

6. CONCLUSION

In this study, I examined possible substitutive relationship between tariffs and non-tariff measures. Using a simplified theoretical framework based on perfect competition and weighted welfare maximization describing small open economy, I show that substitution occurs if domestic producers have marginal compliance cost advantages if the products are relatively inelastic or consumers' sensitivity to quality is significantly stronger than their price sensitivity.

Moreover, substitution could also occur in the case of marginal compliance cost disadvantage of domestic producers if lobbying is less prioritized by the policymakers, the consumers are more sensitive to product quality, and price elasticity is relatively large. Finally, I show that if minimal standards of quality are binding by the regulation of importing country and if the marginal compliance costs are comparable (which is expected in more traditional production sectors with more scientific and internationally recognized production standards) the substitution effects are insignificant.

I empirically test this prediction by using a detailed dataset of non-tariff measures combined with data on average tariff rates observed in Serbia in the period between 2010 and 2021 at HS-2 level. The testing was based on static and dynamic panel data models estimations which employed within regression estimator and system-generalized method of moments, respectively. I find tentative evidence of possible complementary relationship between tariffs and the use of sanitary and phytosanitary measures, which was not robust to changes in specification. However, substitution effects are significant and robust in the case of technical measures, supporting the main initial hypothesis. This could reflect characteristics of the products to which the measures generally refer. Namely, in the case of industrial products there is greater heterogeneity of standards across countries, as well as greater potential pressures for protection due to lower competitive advantage of domestic producers compared to the foreign ones. To the contrary, in the case of sanitary and phytosanitary measures, we mainly observe effects in products related to agriculture, where Serbia possesses much stronger competitive advantage and where there are more internationally binding and scientifically-backed production standards mandating similar requirements (and causing similar compliance costs) for both domestic and foreign producers. We can, thus conclude that the empirical analysis supports initial hypothesis, particularly in the case of substitution between tariffs and technical measures. In addition, these substitution effects are scaled by institutionalization of lobbying in the Republic of Serbia, which is also in line with theoretical predictions.

There are a few limitations to this study that need to be taken into account when interpreting these results. First, there could be some measurement error in the dependent variable, as it measures frequency of measures within the sectors, but not the extent of their restrictiveness. Moreover, the simplifying assumption of this index means that instances of single or multiple non-tariff measures of a particular type are treated equally. The operationalization of dependent variable also cannot account for possible measures that could be trade facilitating, such as changes in procedures implementing the use of information and communication technologies (Kastratović & Bjelić, 2022). Furthermore, the results could be affected by aggregation bias, as the substitution dynamics are analyzed at the sector rather than product level, which would be more consistent with the theoretical framework. For this reason, future studies of substitution effects should be based on lower level of aggregation, both in terms of Harmonized Classification level observed and the types of non-tariff measures.

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4



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DIGITALIZATION IN TOURISM - CHALLENGE AND OPPORTUNITY

Abstract: Knowledge and modern technologies play a crucial role in enhancing a country's competitiveness in the global market. As information and communications technology (ICT) has become a global phenomenon, tourism was among the earliest sectors to embrace new technologies and platforms. It was one of the first industries to digitalize its business operations worldwide. This paper focuses on digitalization in the tourism sector and analyzes the development and use of ICT infrastructure and digital services that could boost tourism and strengthen Serbia's position in the international tourism market. While digitalization offers numerous benefits, the paper also highlights key challenges—particularly the lack of digital skills, which hinders the effective use of technological advancements in tourism. Improving ICT readiness is essential, as it encourages further digitalization of travel and tourism services. According to the *Travel & Tourism Development Index Report*, Serbia continues to make strides in ICT readiness, ranking 47th out of 119 countries in 2024, with a score of 5.56.

Keywords: Digitalization, Information and Communication Technology (ICT), tourism, development, Serbia.

1. INTRODUCTION

With the transition of the economy to a new development phase—the post-industrial society—traditional factors of production, such as physical assets and manual work, increasingly cede their primacy to intangible assets that manifest in the form of knowledge and information, namely, intellectual capital. This position of knowledge is determined by its indisputable role as a carrier of technical and technological progress. For this reason, the accumulation of knowledge and investment in human capital are some of the key determinants of quality economic growth, sustainable development, and an increase in social and personal well-being (Leković, 2018, p. 40). Structural changes in the economies of highly developed countries are characterized by increased participation of technical progress as a basic development factor. Knowledge and modern technologies are key generators of growth in the competitiveness of the national economy in the international market (Đorđević, 2018, p. 15). Numerous countries are focusing on the digital economy and nurturing it as a driver of economic development (Nakatani, 2021).

As the digital economy relies on the ever-changing Internet technology, with characteristics such as industrial model innovation and inclusive growth, it will become the field with the greatest potential and fastest development in the future and will play a significant role in achieving rapid economic development (Tang, 2022). The digitalization of all areas of society is becoming an inevitability, and whether Serbia will use the digital economy as an opportunity to develop tourism and improve competitiveness in the international tourism market will depend on the speed and adequacy of its response to this challenge.

Information and communication technologies (ICT) offer significant benefits in the tourism sector, especially in tourist destinations, by influencing tourist satisfaction (Pahrudin, Hsieh, & Liu, 2023). As information and communication technology has become a global phenomenon, tourism has been a consistent early adopter of new technologies and platforms. Tourism was one of the first sectors to pioneer the shift to digital business processes globally, including online flight and hotel bookings. The digitalized tourism sector must continue to innovate and generate new business opportunities in order to ensure continued competitiveness, growth, and sustainable development of the sector (UNWTO, n.d.).

Further growth of tourism will depend on its ability to adapt to new trends in the tourism market. Technological advances and digitalization present challenges that need to be addressed, but they also offer valuable opportunities that should be seized. Digital adaptation in tourism is not an option but a necessary condition for achieving and maintaining competitiveness in the international tourism market. Sophisticated, technologically and digitally aware tourists impose new standards for the tourism industry, and the agility of companies and their readiness for change are the main prerequisites for long-term sustainable business (Tomić, Komazec, Stoiljković, & Delić, 2018).

The introduction of new technologies often raises concerns about unforeseen and unintended consequences. The latest advancements, particularly in AI, are viewed as significant risk factors that could impact the world in the coming decade. Although these technological developments must be carefully implemented to prevent negative outcomes such as job loss, privacy breaches, data security issues, or declines in service quality, they also have the potential to revolutionize the tourism industry, transforming how travelers explore destinations and interact with service providers (World Economic Forum [WEF], 2024a, p. 50).

2. THEORETICAL BACKGROUND

Business digitalization involves using digital tools, technologies, and data to enhance the efficiency and effectiveness of business processes (Miceli, Hagen, Riccardi, Sotti, & Settembre-Blundo, 2021, p. 8). The term *digitization* refers to “the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form” (Parviainen, Tihinen, Kääriäinen, & Teppola, 2017, p. 64). Digitalization enhances work efficiency by improving business operations through the use of digitized data and information (Kumar & Shekhar, 2020, p. 93). Some argue that *digital transformation* is a broader concept than digitization and digitalization. Digital transformation (DT) consists of three key components: technological, organizational, and social (Bikse, Lusena-Ezera, Rivza, P., & Rivza, 2021, p. 14). Digital transformation is not only about the introduction of new technology, but also about the development of people, processes, and organizations, along with the changes that arise from technology (Marx, Flynn, & Kylänen, 2021). To achieve digital transformation, it is essential to adopt a holistic approach that integrates all the previously mentioned elements—digital technologies, organizational solutions, and the human factor (Bikse et al., 2021).

Digitalization is the process through which technology and data-driven management are transforming our social and economic systems and lives (OECD, 2021, p. 11). It goes beyond converting existing processes into digital versions; it involves reimagining current operations from new perspectives enabled by digital technology (Parviainen et al., 2017). Digitalization and technological advancements are transforming people's lives, habits, work, behaviors, perceptions, and decision-making, while also creating new opportunities for travel businesses to remain competitive in the global market (Kindzule-Millere & Zeverte-Rivza, 2022). It has also transformed the traditional roles of tourism producers and consumers, introducing new roles, relationships, business models, and competencies (Dredge, Phi, Mahadevan, Meehan, & Popescu, 2018). Digitalization is affecting all businesses, and its impact will continue to grow in the future. As a result, companies need to take a proactive stance rather than waiting to see what happens or assuming that their market position will remain unchanged. Neglecting digitalization could put them at risk of falling behind in a highly competitive market (Parviainen et al., 2017).

The introduction of new technologies has also transformed systems and processes within the tourism industry (Happ & Ivancsó-Horváth, 2018). The rise of digital platforms has expanded the scope and diversity of tourism products, services, and experiences, offering on-demand features that increase transaction speed, improve market awareness, and enable faster feedback. These changes have opened up both opportunities and challenges for small and medium-sized enterprises (SMEs) in tourism as they strive to meet consumer demands and reach new markets (Dredge et al., 2018). Technological advances are creating new opportunities for SMEs to compete in markets they may not have previously accessed (Fraccastoro, Gabrielsson, & Pullins, 2021). Digital technologies and platforms offer SMEs effective and relatively low-cost ways to market, sell, and promote their products and services to global audiences, encouraging entrepreneurship in local communities (WEF, 2024a, p. 51). New IT and market trends dictate new ways of communication between businesses and target audiences, with digital marketing enabling more direct and active interaction between tourists, tourism products, and destinations (Gajić, Brdar, Stanković, & Živković, 2018, p. 207). The shift from traditional to digital media has had a significant impact, making it easier and faster for users to access

and process information (Akhtar et al., 2021). The widening reach of digital tools and systems has transformed digitalization from a driver of marginal efficiency to an enabler of far-reaching innovation and change (OECD, 2021, p. 11).

Digitalization has impacted all stakeholders in the industry. On the one hand, it has transformed the tourism experience, providing tourists with advantages such as the ability to reserve flights and trains, check in online, and book hotels through various apps, saving significant time. Tourists can also access personalized offers, take virtual tours of destinations, and easily find information on hotels, attractions, guides, and other service providers—including reviews—which helps them make informed decisions. On the other hand, digitalization has altered the operations of industry stakeholders. For example, it has led to the diversification of travel agency businesses. Digital tools have enabled more effective and efficient communication, boosting competitiveness. Additionally, digitalization has lowered information exchange costs, accelerated data transfer and retrieval, increased customer participation in decision-making, and reshaped the industry's marketing strategies. As a result, digitalization has significantly extended the reach of travel agencies (Kumar & Shekhar, 2020, p. 103).

While the importance of digitalization is widely recognized, companies often face challenges in understanding its potential impact and benefits (Parviainen et al., 2017). They may also struggle with limited technical knowledge and digital skills, inadequate ICT and digital infrastructure, and insufficient financial resources, as digitization often involves significant costs. Consequently, it is crucial for companies to understand the real opportunities and advantages that digitalization can offer, as this awareness is key to its full implementation (Kindzule-Millere & Zeverte-Rivza, 2022).

According to Parviainen et al. (2017, p. 66), the impact of digitalization and its goals for an organization can be identified from three different viewpoints:

1. **Internal efficiency** – an improved way of working via digital means and re-planning internal processes. Digitalization offers several advantages for internal efficiency, such as enhancing process efficiency, quality, and consistency by removing manual tasks and improving accuracy. It can also provide better real-time visibility into operations and results by integrating structured and unstructured data, enhancing data insight, and consolidating data from multiple sources. Additionally, it can improve employee job satisfaction by automating routine work and freeing time for skill development.
2. **External opportunities** – new business opportunities in existing business domain (e.g., new services, new customers). These opportunities include faster response times, enhanced customer service, along with the potential for innovative ways of doing business. New digital technologies can create opportunities for new services or advanced customer offerings.
3. **Disruptive change** – digitalization is completely changing business roles. Disruptive changes involve shifts in a company's operating environment caused by digitalization. For example, a company's existing business model may become obsolete in the new context (e.g., manual scanning of invoices being replaced by electronic invoicing). On the other hand, digitalization can also create entirely new business opportunities, such as the inclusion of an e-invoice operator.

It is widely believed that people are vital to the successful delivery of tourism services. Consequently, those working in tourism are considered a critical component in the effective operation of businesses in the sector (Gruescu, Nanu, & Pirvu, 2008, p. 169). Unlike other industries, the tourism and hospitality (T&H) industry relies significantly on the skills, competencies, and abilities of its human capital (Lazić, Bradić-Martinović, & Banović, 2023, p. 27). To effectively utilize digital technologies, employees must acquire new knowledge and skills (Bikse et al., 2021). The lack of digital skills has been identified as a major obstacle to leveraging the full potential of digital technologies in tourism (Dredge et al., 2018).

Lazić et al., (2023) examined the digital skill levels of employees in the T&H sector in Serbia and identified key influencing factors. The study found that, on average, T&H employees possess basic digital skills that enable them to complete simple and moderately complex tasks in a digital environment. However, the findings also indicate that the overall level of digital proficiency in the sector is insufficient to ensure long-term growth and resilience. While employees may have adequate skills for basic operations, they often lack the advanced skills necessary to implement more sophisticated digital solutions. The analysis revealed that education and job position are the most significant determinants of digital skills, emphasizing the critical role of education in workforce development.

The development of new technologies is progressing rapidly. The integration of ICT and tourism management has made acquiring appropriate digital skills essential for success in the tourism business (Lazić et al., 2023, p. 28). Ultimately, reaping the full benefits of digitalization and technological innovations will depend on each country's ability to implement policies that help workers adapt to change and acquire the necessary skills for success in the digital era (OECD, 2022, p. 5).

3. RESEARCH METHODOLOGY

More than ever, it is necessary to implement new technologies to attract tourists, so that a high-quality tourism offer can provide more than traditional ones, as modern tourists in the digital age make their travel decisions based on multiple parameters (Gajić et al., 2018, p. 208). Given that improving ICT readiness is necessary to advance the further digitalization of travel and tourism services, this paper focuses on analyzing the development and use of ICT infrastructure and digital services in Serbia.

ICT readiness is one of the pillars of the Travel and Tourism Development Index (TTDI), which is an evolution of the Travel and Tourism Competitiveness Index (TTCI) improving the index's ability to reflect the growing role of sustainability and resilience in T&T's growth, as well as the sector's role in broader economic and social development (WEF, 2021, p. 4). This paper will present and analyze Serbia's ICT readiness pillar score, along with the country's relative position (rank) compared to other economies, using data from both the TTDI and TTCI reports.

To monitor Serbia's progress in the area of ICT readiness, data will be presented for the period from 2008—when Serbia was first included in the report as an independent state—up to the most recent report from 2024. After analyzing the ICT readiness pillar over time, Serbia's scores and rank for 2024 will be presented according to the individual variables that comprise the pillar, with particular attention given to those related to the use of digital services.

4. RESEARCH RESULTS

The progress and development of the global information society have influenced every part of the economy to the extent that it is difficult to imagine any business process that does not rely on the use of information technologies (Đorđević, Vukašinović, & Veinović, 2014, p. 11). Information technologies are key drivers of the development of the tourism industry (Suyunchaliyeva, Shedenova, Kazbekov, & Akhmetkaliyeva, 2020, p. 4). Modern information and communication technologies are influencing the digitalization of the entire tourism industry. In recent years, more and more companies providing tourism services have begun to incorporate digital assets into their strategies, recognizing that change is essential for maintaining and improving competitiveness in today's market (Happ & Ivancsó-Horváth, 2018, p. 11).

The adoption of technologies such as the Internet of Things, location-based services, artificial intelligence, augmented and virtual reality, and blockchain has led to a tourism offering that is more attractive, efficient, inclusive, and economically, socially, and environmentally sustainable than its predecessor. It has also encouraged innovation and a reassessment of processes to address issues such as seasonality and overcrowding, and to develop smarter destinations (UNWTO, n.d.).

The significance of information technology in tourism—particularly in the web-based environment—has increased notably in recent years, and this trend is expected to persist. IT services have enabled business transactions within the industry by engaging with trading partners, distributing products, and providing information to customers globally (Suyunchaliyeva et al., 2020, p. 5). From AI algorithm-driven personalized trip planning to engaging virtual reality experiences, technology provides travelers with unmatched convenience and customization. At the same time, digital technology and online platforms support destinations and tourism and travel (T&T) businesses by enabling online bookings, sharing-economy utilization, digital payments, and mobile accessibility—facilitating entry into new markets, optimizing operations, improving visitor interaction, and collecting consumer insights and preferences (WEF, 2024a, p. 50).

The structure of the Travel and Tourism Development Index highlights the importance of ICT for the tourism sector, where ICT represents one of the pillars influencing the global assessment of the competitiveness and positioning of national economies as tourist destinations in the international market. The use of ICT enhances the competitiveness of a tourism destination and its stakeholders, as it helps meet the diverse and complex needs of modern tourists (Petrović, Milićević, & Djeri, 2017).

Information and Communication Technologies (ICT)—specifically, ICT Readiness (formerly known as ICT infrastructure)—is one of the pillars of the Travel and Tourism Development Index (TTDI), which evolved from the Travel and Tourism Competitiveness Index (TTCI). This pillar measures the development and use of ICT infrastructure and digital services (WEF, 2021, p. 9). Table 1 shows the score and rank of the ICT Readiness pillar for Serbia.

Table 1: Score and Rank of the ICT Pillar for Serbia

Year	Pillar	Score (1-7)	Rank
2008	ICT infrastructure	2.8	57 (out of 130)
2009	ICT infrastructure	2.9	63 (out of 133)
2011	ICT infrastructure	3.3	62 (out of 139)
2013	ICT infrastructure	3.6	49 (out of 140)
2015	ICT Readiness	4.4	56 (out of 141)
2017	ICT Readiness	4.8	57 (out of 136)
2019	ICT Readiness	5.0	56 (out of 140)
2021	ICT Readiness	5.1	53 (out of 117)
2024	ICT Readiness	5.56	47 (out of 119)

Source: Authors' presentation based on TICI and TTDI reports.

Based on the data shown in Table 1, a positive trend in the ICT pillar score for Serbia can be observed. In the initial year of the analyzed period, 2008, Serbia's score for this pillar was the lowest compared to all other years in the observed period, amounting to 2.8. In the following years, the score improved year by year, reaching a value of 5.56 out of a possible 7 in 2024, the final year of the observed period.

When it comes to Serbia's relative position on the list for the ICT pillar, after 2011 the country consistently ranked around 50th place. According to the most recent TTDI report from 2024, Serbia ranks 47th out of a total of 119 countries—a significant achievement, as a rank below 50 indicates global competitiveness.

Table 2 shows the score and rank for each individual variable that comprises the ICT readiness pillar for Serbia. Serbia's overall score for this pillar is 5.56, which is higher than the average score of 5.0. Furthermore, most of the individual variable scores are also above the average, with the exception of the variable **Power losses**, where Serbia scores slightly below average.

Table 2: Scores and Ranks of ICT Readiness Pillar Variables for Serbia, 2024

ICT READINESS	Score	Rank
Individuals using internet	6.01	54
Broadband internet subscribers	4.14	46
Mobile broadband subscribers	6.18	45
3G mobile network coverage	6.95	54
Use of digital payments	6.25	36
Use of digital platforms for providing transportation and shipping	4.93	42
Use of digital platform for providing hotels, restaurants and leisure activity services	5.38	36
Power losses	4.65	81

Source: Authors' presentation based on the Economy Profiles in the TTDI 2024 Edition.

Based on the data presented in Table 2, it is evident that Serbia has high scores in many of the variables comprising the ICT readiness pillar. The variable **3G mobile network coverage rate** has the highest score—6.95 out of a possible 7. The variable **Broadband internet subscribers** has the lowest score, 4.14. However, despite being the lowest among the ICT readiness variables, Serbia's relative position in this category is still strong, ranking 46th.

Overall, Serbia achieves a relatively high score in the ICT readiness pillar. With a score of 5.56, it exceeds the average. Serbia's position on the TTDI list is also notable, ranking 47th. Achieving above-average scores in seven out of the eight variables and demonstrating continuous growth from 2.8 in 2008 to 5.56 in 2024 reflects significant progress in the field of information and communication technologies.

Although various methodological changes occurred during the observed period—especially in the variables that make up the ICT pillar—and the data are not fully comparable over time, Serbia's progress in this area remains evident. It is particularly noteworthy that the most significant improvement since the 2021 report was in the **use of digital services**. For example, in the variable **Use of digital platforms for providing transportation and shipping**, Serbia improved by an impressive 46 places, moving from 88th in 2021 to 42nd in 2024. In addition, the scores for the variables **Use of digital payments** and **Use of digital platforms for providing hotels, restaurants, and leisure activity services** have improved significantly. These two variables now represent Serbia's highest rankings in 2024, both placing the country 36th out of 119.

5. CONCLUSION

The travel and tourism sector is one of the largest and fastest-growing economic sectors in the world. Although the trend of high growth rates in travel and tourism activities in previous years was abruptly interrupted by the COVID-19 pandemic, companies operating in this field are now faced with numerous other challenges in the global business environment. One of these challenges is technological change, which affects both individual behavior when planning and making travel decisions, and the operations of companies in the sector.

In order for these technological challenges to become opportunities for gaining and maintaining competitive advantage—rather than threats to survival in a highly competitive environment—it is necessary to recognize, understand, and address the needs of today's consumers, who are becoming increasingly sophisticated due to technological progress. Digitalization is necessary to meet the growing expectations of consumers (Happ & Ivancsó-Horváth, 2018).

Digitalization has impacted all stakeholders in the industry (Kumar & Shekhar, 2020, p. 103). With online bookings, sharing economy platforms, digital payments, and mobile access increasingly shaping travel and tourism services, digital technology and online platforms are enabling destinations and tourism businesses—including small and medium-sized enterprises—to access new markets, optimize operations, improve visitor engagement, and gather consumer insights and preferences (WEF, 2024a, p. 20). Digitalization improves organizational efficiency and creates new business opportunities (Parviainen et al., 2017). It also provides tourists with advantages such as booking flights and trains, reserving hotels through various applications, and easily accessing information about accommodations, attractions, guides, and service providers—ultimately saving time and helping them make informed decisions (Kumar & Shekhar, 2020). Digital technologies also benefit older adults who are unable to travel due to age-related limitations. Technologies such as virtual reality can engage them more effectively (Akhtar et al., 2021). Moreover, technology enables remote work while traveling and offers the possibility of new experiences through virtual tourism. This allows people to explore destinations and participate in tourism activities without the need for physical travel—especially useful for individuals with mobility challenges, financial constraints, or health issues (WEF, 2024a, p. 51).

In addition to the positive aspects and opportunities, digital transformation also presents several challenges, such as a lack of funding (as digitalization can be costly), insufficient technical knowledge and digital skills, and limited ICT and digital infrastructure (Kindzule-Millere & Zeverte-Rivza, 2022). Research findings indicate that a key issue related to digital transformation is human capital and the need for employees to acquire relevant competencies and digital skills (Bikse et al., 2021). Tourism job roles are also evolving. New positions requiring new skill sets are being created, while existing roles are transforming. Consequently, continuous improvement in employees' digital skills is essential (Hsu, 2018).

According to the TTDI Report (2024), since 2019 there have been advancements in areas such as ICT readiness—especially in developing countries—and in the business environment, contributing to the growth of digitalization and operational efficiency in the T&T industry. Analysis of the TTDI and TTCI—where ICT is one of the pillars that influence the global competitiveness and positioning of national economies as tourist destinations—reveals that Serbia is making notable progress in this area. Compared to the initial year of the analysis (2008), when the ICT infrastructure pillar score was 2.8 out of 7, Serbia received a score of 5.56 in 2024, ranking 47th out of 119 countries. It is particularly noteworthy that Serbia showed the most significant improvement in digital service usage compared to the 2021 report. The variables *Use of digital platforms for providing hotels, restaurants, and leisure activity services* and *Use of digital payments* are Serbia's highest-ranking categories, placing the country 36th among 119 countries in 2024. Serbia has demonstrated notable advancement in ICT, as evidenced by a consistent year-on-year increase in its ICT pillar score—from 2.8 in 2008 to 5.56 in 2024.

The OECD emphasizes that unlocking the full potential of the digital revolution requires not only investment in digital infrastructure but also the development of human capital through skills enhancement and innovation in business models and operations (OECD, 2019). Similarly, the WEF highlights the need for travel and tourism stakeholders in developing countries to prioritize ICT infrastructure, improve accessibility, and invest in skill-building (WEF, 2024a).

Considering the above and the findings from Lazić et al. (2023), which show that T&H employees in Serbia possess adequate digital skills for basic tasks but generally lack advanced skills—limiting the adoption of more complex digital solutions—concluding remarks can be made.

To capitalize on Serbia's progress in developing and using ICT infrastructure and digital services, and to fully benefit from digitalization, it is essential to address the critical challenge of limited advanced digital skills among employees in the tourism and hospitality sector. Moving forward, the focus should be on building the competencies and digital skills needed to fully leverage technological innovations in tourism—ultimately enhancing Serbia's competitiveness in the global tourism market.

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THE MAIN TRENDS OF MANAGEMENT CONSULTING IN SERBIA BASED ON RESEARCH RESULTS FROM 2024

Abstract: Management consulting provides knowledge-based inputs to guide and strengthen the business processes of organizations. Specially trained professionals provide consulting to various organizations, thereby assisting the client organization in identifying and analysing management problems. Management consulting plays a significant role in the development of businesses in the developed market economies. Today, there is hardly any business area that cannot be linked to consulting activities. The business environment brings radical challenges to business life the companies have to face with and often they can effectively answer to these challenges only by engaging specialized consulting companies. These changes have shaped the areas of management consulting, too. The leading consulting firms today organize their business around subdivisions (e.g., strategy, HRM, Big Data, etc.), specializing in one or more of them.

Before the 2020 management consulting in Serbia was in the beginning phase of development due to various effects of the historical traditions, elements of the organizational culture and economic situation. After the political and economic changes in 2000 there was a return of Serbia into international economic flows, which, in turn, caused a significant increase in demand for new knowledge, experience and expertise, including those in the form of consultancy services. The COVID-19 pandemic resulted in radical changes of the work conditions, communication and leadership style in almost each organization. Today the geopolitical crisis and the implementation of artificial intelligence in the business processes represent the main challenges why organizations need the help of a competent management consultant.

The aim of this paper is to analyse the main trends of management consulting in Serbia in the current business context based on a research project conducted by online surveys at the end of year 2024.

Keywords: consulting, management consulting, HRM, Serbia

1. INTRODUCTION

Management consulting plays a significant role in the evolution of businesses in the developed market economies. Management consulting is provided to organizations and their leaders by external consultants in order to help organizations achieve their goals, determine and solve problems, identify new opportunities, acquire the necessary skills, and implement change (Kubr, 1996). The business environment brings radical challenges to business life the companies have to face with and often they can effectively answer to these challenges only by engaging specialized consulting companies. These changes have shaped the areas of management consulting, too.

Poór and Milovecz (2011) analysed management consulting in the Central and Eastern European region and recognized deep changes in the client-consultant relationship. The working process and relations of HR clients and consultants showed serious modifications resulting from the increased HR knowledge of clients and from the implications of new interventions of the HR practice. Consultants also did recognize that general solution picked up from the shelf of global HR consultancies had not been successfully applicable for the long run. The other study from Central and Eastern Europe shows that the economic crisis has had a major impact on companies' HR activities and on the use of external HR services providers. The most significant change came after the economic crisis in each country group reduced the number of companies with HR departments, but Eastern Europe and the peripheral countries experienced the largest cut-back (Poór et al, 2019).

Before 2020 management consulting in Serbia was in the beginning phase of development due to various effects of the historical traditions, elements of the organizational culture and economic situation. The COVID-19 pandemic resulted in radical changes of the work conditions, communication and leadership style in almost each organization and presented a challenge for the majority of organizations. Nowadays the most important issues affecting the business context are the geopolitical crisis and the usage of artificial intelligence. In this situation the role of management consultant's is even more important.

The aim of this paper is to analyse the main trends of management consulting in Serbia based on a research project conducted by online surveys at the end of year 2024.

2. THEORETICAL BACKGROUND

2.1. The development of management consulting in Serbia

In their work, Mihajlović and Cvijanović (2013) underline that management consultancy practice in Serbia is less developed than in market economies in the Central and Eastern European (CEE) region, but it still has a longer tradition than in the majority of the countries of the CEE region. Certain forms of consultative services were present in former Yugoslavia in the 1950s. Self-management introduced a formal delegation of power to workers establishing work councils in all enterprises – management activities were assumed to be shared between the state (represented by managers) and the workers' collective. As the private sector and entrepreneurship were furthermore negligible, the self-managing society as an economic ambience triggered the beginnings of consultative services development. There was a specific business climate for development of consultative services in management, technology and other fields, certainly significantly less favourable than in developed market economies.

The dominant model of consulting in Serbia was the "Doctor-patient" model, while Process consulting was still unknown in the national consulting practice. Powerful domestic leaders and managers used to order studies on the organizational development strategy and organizational design on which whole teams of consultants would work (Janićijević, 1992). Mihailović (2007) noted that in a situation as described above, the business consultant had to be competent, informed, objective, and in many cases, a good psychologist, in order to have a dialogue with the employees in the company and understand the problem. There was a tendency to standardize the activities of consultants, to have a tried and tested recipe for all situations.

After the political and economic changes in 2000 there was a return of Serbia into international economic flows, which, in turn, caused a significant increase in demand for new knowledge, experience and expertise, including those in the form of consultancy services. The programs of rehabilitation and restructuring of enterprises were of particular interest, but also the formulation and implementation of development strategies and networking with economic actors on the international market, the introduction to information technology, improving the performance of the basic functions of management companies, joint ventures, technological cooperation and others (Mihajlović, Simonović & Sarić, 2016).

In the first decade of the 21st century, consulting became highly important in Serbia. The demand for consulting services has increased along with real needs, as dictated by: privatization, value evaluation of the enterprise, foundation of new small and medium enterprises, as a supposition of faster development of market economy, new products, seeking out new markets etc. (Mihajlović - Cvijanović, 2013).

Ratković, Njegovan and Stamenković (2016) state that during the decade of privatization in Serbia (2000–2010), consulting companies and financial advisers have earned the most. They assessed the property and value of Serbian companies, proposed the methods for selling them and charged a service fee. Consultant services were well paid, but for many companies these services were useless. Privatization in Serbia will be remembered by the vast number of cancelled sales. Nearly a third of customers failed to fulfil their promise in that process.

The period of the world financial and economic crisis was challenging for all economic subjects in Serbia, as the economy was in depression, there was a high decline in production and investments, especially in manufacturing, a significant decrease in the GDP growth, fall of exports, along with a high level of unemployment (Antevski, 2010). Mihajlović, Subić & Cvijanović (2009) underline that enterprises in Serbia found themselves in a paradox situation during the financial crisis: finding a way out of the crisis “required” consulting services, which were very expensive, and the main reason for needing enterprise restructuring in the first place was financial crisis. The majority of enterprises had no assets to buy consulting services and find a way to break this “vicious circle”. Dealing with the characteristics of the Serbian management practice in that period, Vukotić, Milivojević and Zakić (2013) stress that there was not only a “value vacuum”, but also a “leadership vacuum” - a lack of competent leaders and managers.

Concerning the supply side of the consultancy market in Serbia, it is important to note that the professional organization of business consultants, the Association on Management Consultants of Serbia (UPKS) was established in 2009. In 2010 they conducted a study on the consultancy practice. According to their results, in 2010 in Serbia there were 11 360 consultants. Based on the answers of their members, it can be concluded that the majority of consultants worked as entrepreneurs or in small businesses (98%), and were in domestic ownership (61%). In the opinion of interviewed consultants, consulting was a vital part of the Serbian economy, even if the consulting market was not developed, the consultants had all the important professional competences. A proof of the unstable consultancy market is the fact that only half of the consultants believed that they would be present at the consulting market in 3-5 years. In their opinion their success was threatened by external facts, financial factors and corruption (Kratak pregled poslovnog konsaltinga u Srbiji, 2010). It is important to underline that although for many years the Association on Management Consultants of Serbia was not active, in August 2019 it became a full member of the international management consulting organization, ICMCI.

Another research on the consultancy practice was conducted by Mihailović, Tepavac and Kovačević (2012). The obtained data underline that the consultative services market in Serbia in that period was immature, highly atypical, with a massive number of small consultative organizations and extremely small number of large companies. Their research results show that the highest supply was in the field of corporative strategy (50%) and operative management (28%). It can be interpreted by the mutual will of consultants and clients to obtain the eligible results, as soon as possible.

Obradović (2016) notes that based on an EBRD project, in the period of 2013-2016 almost 240 SMEs in Serbia were given the opportunity to use consulting services. The most popular consulting fields were in management of quality, followed by marketing, strategy and IT. In almost half of the SMEs which had used consulting services there was an increase in income, productivity, the number of employees and in export. These results may be a good example of the positive effects of the usage of consulting services in SMEs.

Krivokapić and Čudanov (2016) presented research results on the attitudes of managers towards consultancy in Serbia. Based on the answers obtained from 84 managers they concluded that in 2015 organizations that operate in Serbia often did not have financial resources that would create conditions to hire such experts. However, it was encouraging that a large number of managers who had participated in this survey recognized the importance and they believed that organizations should use this kind of assistance, if such need arose. It is also important to emphasize that 70% of the interviewed managers believed that consultants had adequate professional competences. There was an overall view that the benefits which can be expected justify such investments, and that local organizations can expect certain improvements if they opt for hiring consultants.

Poór, Slavić and Berber (2016) have been analysing the human resources (HR) practice and HR outsourcing in Serbia. The research results on the usage of external providers in HR show that the majority of the analysed companies use external providers, but to different extents. Consultants are engaged mostly in the field of training and development and selection. The analysis of the international Cranet data from 2015 shows that the usage of HR consultants in the field of compensation is significantly less than in the developed European countries (Berber & Slavić, 2016). The long term

data show that in the last decade there was an increase in the usage of consultants in different HR fields, while the first part of this decade experienced a kind of stagnation.

The COVID-19 pandemic had a significant impact on business processes globally. The consulting industry has already been significantly affected in many ways by the global pandemic, too. The research of Szeiner et al (2023) pointed that in CEE region some of the respondents reported rather negative effects, but the survey finds that a significant proportion of respondents consider the emerging crisis as an opportunity and not only as a threat.

The research results of Resimić, Stojiljković and Raičević (2023) showed that the consulting sector in the Republic of Serbia records constant growth, but its potential is still underutilized compared to other, especially Western countries. Consultants are aware that today knowledge is the main capital and knowledge management is one of the primary conditions for achieving a competitive advantage. Consulting companies should strive to increase trust between consultants and clients, as this will increase the success of the services provided.

3. RESEARCH METHODOLOGY

In order to analyse the current practice of management consulting in Serbia, a questionnaire-based field research was conducted. The research is a part of international study; therefore, a standardized online questionnaire was used. It was filled out by 53 organizations which used management consulting in December 2024. In this paper we present the main descriptive results of the survey.

Concerning the sample overview the majority of respondents (49%) belongs to service sector, 45% of them are operating in industrial production, while about 6% of them come from agriculture.

Relating to the year of the establishment of the organization, 28% of the respondents were founded before 1990, 18% between 1990 and 2000, 26% between 2001 and 2010, 17% between 2011 and 2020 and 16% after 2020. Based on it we can conclude that almost half of the responding organizations (46%) has more than 25 years of business experience.

Regarding the ownership of the analysed organizations we may state that the majority of them are domestic private companies (49%), while the share of foreign owned private companies is about 40%, and there are domestic state organizations, too. Their share is 11%.

Concerning the size of the organizations, 45% of them are small organizations, with less than 50 employees, 25% of them are medium-sized companies with 51-249 employees, while 30% of the respondents are large organizations with more than 250 employees.

The last presented data about the analysed organisations is their annual budget. The obtained data show that 22% of responding organizations have an annual budget less than 300 000 EUR, 22% a budget between 300 000 and 1.500,000 EUR, 24% between 1,5 and 7 million EUR, 12% between 7 and 70 million EUR, while 20% of respondents have a more than 71 million EUR annual budget.

4. RESULTS AND DISCUSSION

The first question presented in this paper point to the frequency of using management consulting services by the observed organizations. The obtained results are presented in figure 1.

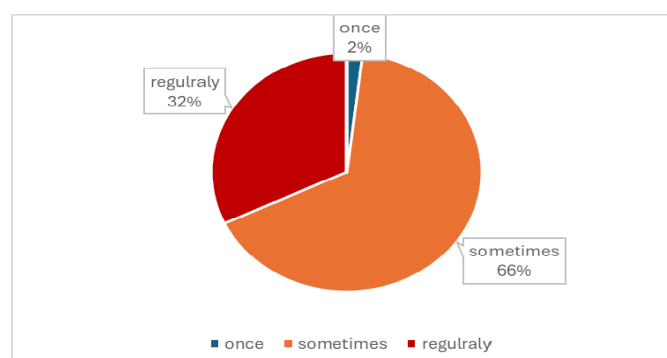


Figure 1. The frequency of the usage of management consulting services
Source: Own research

One company (2%) claimed to use this service only once, while the majority of respondents (66%) use consulting services occasionally. Almost one-third of the respondents (32%) ask for consulting services regularly.

The second topic analysed in this paper is the cooperation between responding organizations and consulting firms. The organizations may choose among the following possibilities: they regularly cooperate with a consultant in some fields, they regularly cooperate with a consultant in some specific management fields and they regularly cooperate with a consultant in each management field. The attained answers are presented in figure 2.

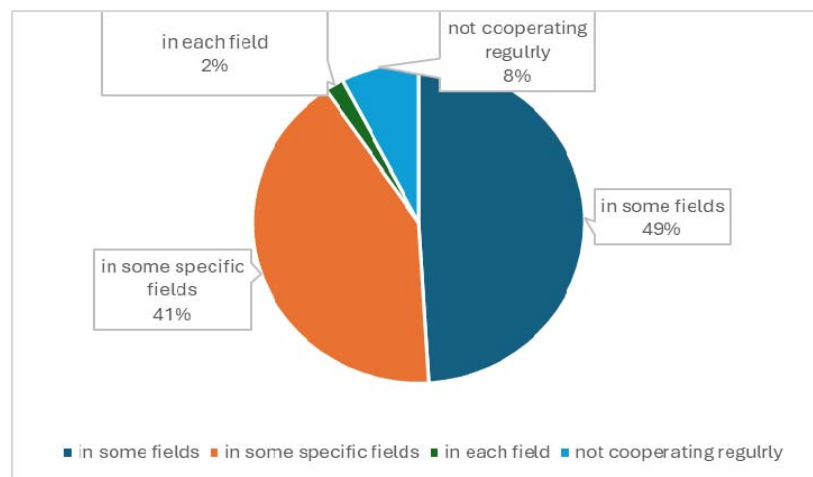


Figure 2. The way of cooperation with consulting firms
Source: Own research

The majority (49%) of respondents cooperate with consultants regularly concerning some specific management fields, but there is a large share of organizations (41%) who cooperate with consultants concerning some specific management fields. Only 2% of organizations hire consultants for each management field.

The third figure presents the management fields concerning which responding organizations have used consulting services in the period between 2020 and 2023.

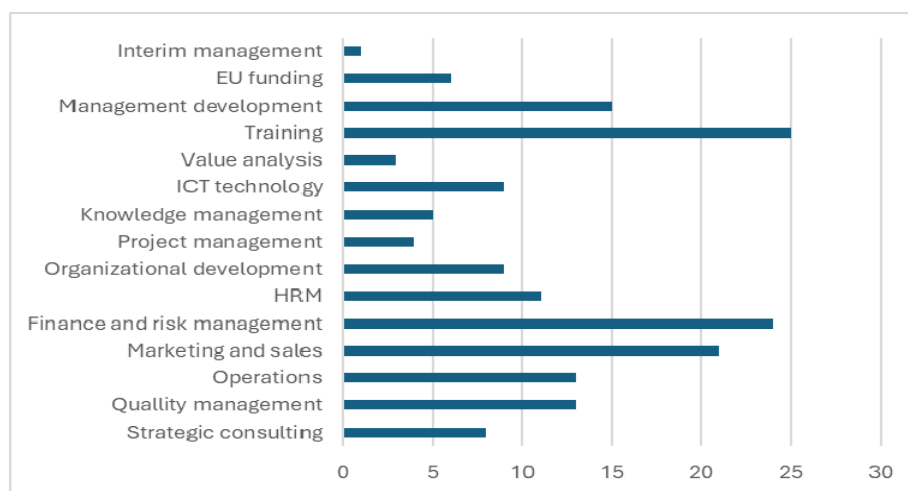


Figure 3. The used management consulting fields
Source: Own research

In the period between 2020 and 2023 the majority of respondents asked for consultants' help in the field of Training (25), Finance and risk management (24) and Marketing and Sales (21). Interim management (1), Value analysis (3) and Project management (4) were the least common fields for hiring a management consultant.

The last presented question points to the criteria organizations use when choosing management consultants. The obtained results are presented on a scale from 1 to 5. (Figure 4)



Figure 4. The criteria for choosing a management consultant (1-5)

Source: Own research

The most important criteria for choosing a management consultant in Serbia are: earlier experience with the consultant (4.43), the specific proposal of the solution for the problem (4.23) and recognition/good reputation (4.15). It is interesting that the consultant's presence at social media platforms showing competence and credibility is the least important (2.08) criterium. The service price and a friend's proposal are criteria of medium importance.

5. CONCLUSION

Management consulting provides knowledge-based inputs to guide and strengthen the business processes of organizations. Today, there is hardly any business area that cannot be linked to consulting activities. Mihailović, Radosavljević and Popović (2021) stress that the role of the consultant is to introduce the manager to a new perspective of looking at the problem, which the manager, due to his full involvement in it, could not notice and objectively look at. The consultant, however, observes the problem from a desirable distance, which leads to objectivity in the diagnosis. In process consulting, the objectivity of the consultant overrides the subjectivity of the manager, who, after several cycles of diagnosis and meetings, will become objective himself.

The review of development of management consulting in Serbia shows that it begins in the 1950s in the period of self-management. After the change of the regime there were new challenges for consulting sector, they helped organizations to survive and develop in the period of privatization, restructuring and internationalization. The management consultants had an important role in the period of global economic and financial crisis and global pandemic, too. Nowadays management consultants had to use their expertise to help organizations in the period of geopolitical crisis and implementation of artificial intelligence at the workplace and other radical changes in the business environment.

The aim of this paper was to analyse the main trends of management consulting in Serbia based on the current business context. The research results obtained from 53 companies in December 2024 on the experience of Serbian organizations on the cooperation with management consulting service providers show that the majority of organizations use consultants occasionally, and there are service providers with whom they cooperate with regularly on finding solutions for some management fields. Most often the organizations need the consultants' help concerning Training, Finance and risk management and Marketing and Sales. When making a decision on choosing an appropriate management consultant for Serbian organizations the most important criteria are: Earlier experience with the consultant, The specific proposal of the solution for the problem and Recognition / good reputation.

Based on the above it may be concluded that the management consulting and the cooperation between organizations and consultants are moderately developed in Serbia. The limitation of the research is the sample size and structure. Future research has to focus on more representative sample and to analyse the reasons of only moderate level of cooperation between business organizations and management consulting service providers.

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DOMINANT WORK PATTERNS IN THE IT SECTOR OF THE REPUBLIC OF SERBIA

Abstract: The conducted research focuses on work patterns in the IT sector, analyzing office-based work, the hybrid work model, and remote work. Previous studies have highlighted the choice of work pattern as a significant factor in organizational efficiency and employee well-being within the IT sector. The primary objective of this research is to determine the most dominant work pattern in organizations operating within the IT sector of the Republic of Serbia. The study was conducted on a sample of 190 employees from organizations in the Serbian IT sector. Data collection took place from September to December 2024 using an electronic questionnaire via Google Forms. The most dominant work pattern was identified through descriptive statistics using the statistical software SPSS IBM. The main findings indicate that the hybrid work model (a combination of office-based and remote work) is the most prevalent work pattern. Organizations that implement the hybrid work model can retain and attract highly qualified talent while providing greater flexibility to employees.

Keywords: Work patterns, employees, IT sector, Republic of Serbia

INTRODUCTION

Digitization and technological development have transformed the work environment and ways of working in the IT sector, encouraging the wider application of flexible work arrangements (Paulišić et al., 2024; Tang, 2024). The COVID-19 pandemic has further accelerated transformation, forcing organizations to redefine traditional ways of working (Savic & Dobrijević, 2022; Moon et al., 2022).

Global trends in the IT sector indicate an increased application of flexible work arrangements, with a special emphasis on remote work and the hybrid work model (Saygılı & Öztürk, 2024). Each of them brings certain advantages and challenges, both for organizations and for employees. The hybrid work model stood out as a compromise solution that creates a balance between productivity and flexibility (Balamurugan & Priyanka, 2023). The goal of this research is to analyze and determine the dominant work pattern in the IT sector of the Republic of Serbia, considering the preferences of employees and the needs of organizations.

This paper is structured as follows. Chapter 2 presents a theoretical overview that includes an analysis of office work, the hybrid model and remote work, examining their characteristics, advantages and challenges. Chapter 3 describes the research methodology, including sampling, the method of data collection and the methods of analysis used. Chapter 4 presents the research results and their discussion, through which the implications of the findings are analyzed. In the last chapter, the concluding part of the work, the main findings of the research are synthesized and their wider consequences for the IT sector of the Republic of Serbia are considered, while highlighting possible directions for future research.

1. THEORETICAL BACKGROUND

1.1. Office work, hybrid work model and remote work

Technological development and the COVID-19 pandemic have led to a rethinking of the traditional office work model, pointing to its limited adaptability to modern business requirements, efficiency and innovation that the market demands today (Chang & Chiu, 2022; Lamovšek et al., 2025). According to Gangisetty et al. (2024) in addition to traditional office work, the hybrid model and remote work stand out as the main approaches currently present in the IT sector.

Working from the office, as a traditional form of work, implies the physical presence of employees in the organization's workspace. This work pattern has a significant impact on various aspects of the work environment and employee performance, enables direct interaction between employees, facilitates team cooperation and contributes to strengthening the organizational culture. The advantages of working from the office include easier communication, better monitoring of work processes and greater connectivity among colleagues. However, this model can also have disadvantages, such as high costs of maintaining office space, limited flexibility, and potential reduction in productivity due to distractions in the work environment (Davis et al., 2011). Working from the office has a complex impact on the performance and well-being of employees, depending on the design and organization of the space. The employee's physical environment, i.e. the office, can significantly influence the motivation, job satisfaction and productivity of employees. Traditional offices, which are often private and closed, can improve concentration and reduce distractions, while open offices can improve communication and teamwork, but often cause problems such as noise and lack of privacy (Lee & Brand, 2005; Haapakangas et al., 2018). According to Zoghbi-Manrique-de-Lara & Sharifiatashgah (2019) the perception of crowding and lack of personal space in offices can lead to deviant behavior of employees, especially when they feel threatened in terms of privacy. Integrating the workspace with organizational goals and opportunities for social interactions can positively impact employee well-being. The symbolism of the workspace and opportunities for interaction play a key role in the social sustainability of the work environment (Vilnai-Yavetz & Rafaeli, 2021). These factors can affect employee productivity and motivation, suggesting a need for a balance between working from the office and more flexible options such as working from home.

Flexible work arrangements, such as flexible working hours and telecommuting, help employees balance professional and personal commitments (Pulido & López, 2005). Full-time telecommuting has some disadvantages such as lack of communication, employee mental health, well-being and stress. In order to overcome this, organizations are adopting a new concept, i.e. a hybrid work model (Selvi & Madhavkumar, 2023). The hybrid work model, which combines office work and remote work, is becoming increasingly popular due to its flexibility and ability to adapt to the needs of employees. It allows employees to work wherever and whenever they are most productive (Ramachandaran, 2024). This work pattern allows employees to choose where they work, which can improve work-life balance and increase job satisfaction. A hybrid work model offers significant advantages in terms of flexibility, but also brings challenges in terms of communication and mental health (Dale et al., 2024). According to Hopkins & Bardoel (2023), there are four types of hybrid work models, namely the office-centered hybrid model, the fully flexible hybrid model, the split-week model, and the week-sharing model. In an office-centric hybrid model, employees mostly work from the office although they are allowed to work at any location for a day or two (Ateeq, 2022). According to Selvi & Madhavkumar, (2023) in this model, employees coordinate effectively and have a strong sense of belonging. In a fully flexible hybrid model, employees are allowed to choose how many days they want to work from home or in the office. But this model creates problems in the cooperation of employees, so the organizational structure is developed according to this model. In the split week model, employees telecommute some days and work in the office a few days a week. This model helps managers stay in touch with their teams, and employees often meet face-to-face with their colleagues and managers. In the week division model, the month is divided into weeks according to teamwork and based on the work, it is decided which department will work in which weeks in the office. It allows employees to work together for a week, which helps them complete the work on time. Organizations that successfully implement this model can expect improved productivity and employee satisfaction, but it is important to focus on strategies that will support employee well-being and effective communication (Sampat et al., 2022; Krajčák et al., 2023; Balamurugan & Priyanka, 2023). According to Santillan et al. (2023) and McConnell & Metz (2024) employees in a hybrid environment often achieve higher productivity and job satisfaction, because they can adapt the working conditions to their needs. Hybrid work conditions allow employees to satisfy basic human needs, such as safety, belonging, and self-confidence, which contribute to their overall satisfaction (McConnell & Metz, 2024).

Remote work, especially in the IT sector, has become a significant aspect of the modern work environment, especially after the COVID-19 pandemic. This shift has brought about various changes in organizational practices, employee expectations and work-life balance. The IT sector has used telecommuting as a competitive advantage, increasing adaptability, productivity and resilience in a digitized global economy (Pulido & López, 2005; Kautish et al., 2025). Telecommuting in the IT sector has been shown to positively affect employee well-being and job satisfaction (Kautish et al., 2025). The ability to work from home or remotely is associated with improved job satisfaction through better work-life balance and reduced commute stress (Pulido & López, 2005). However, challenges such as reduced communication with co-workers and the need for an appropriate work environment at home can affect work-life

balance. Organizational support is crucial in establishing an environment that empowers workers to effectively manage work-life balance (Aundhkar et al., 2000; Nakrošienė et al., 2019; Lipták et al., 2023).

2. METODOLOGY

In this part of the paper, the sampling procedure, the way in which the participants answered the questions, the time frame of data collection, as well as the analysis and description of the sample will be presented. During the research of the most dominant work pattern in the IT sector in the Republic of Serbia, the electronic questionnaire "Google forms" was used. The questionnaire included control questions such as gender, age, level of education, position in the organization, size of the organization, market served by the organization, work experience and work patterns. The questionnaire link was distributed exclusively to employees in the IT sector in the Republic of Serbia.

Table 1: Sample characteristics

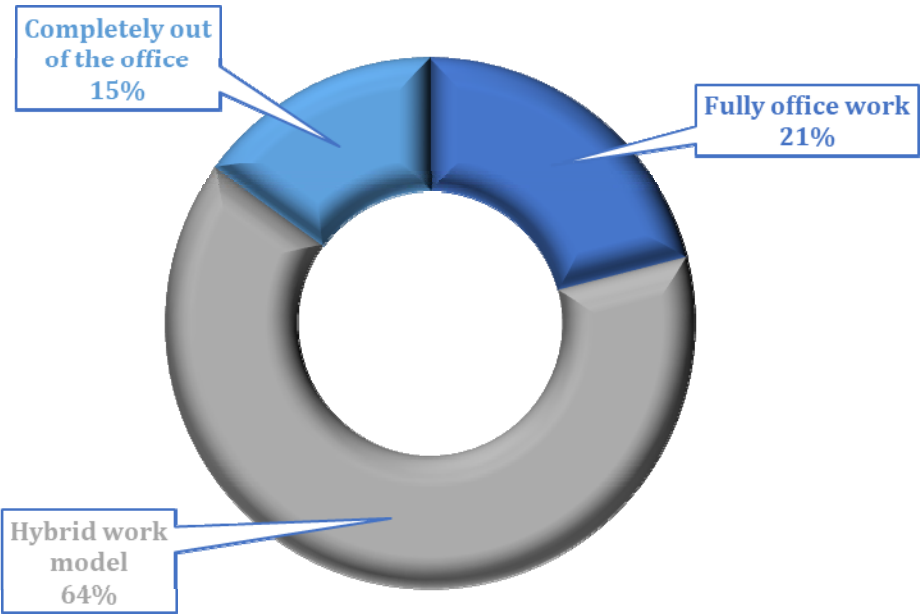
Sample characteristics	Number of respondents	Percentage (%)
Gender		
Male	111	58
Female	79	42
Age structure		
18 – 25	82	43
26 – 30	44	23
31 – 35	28	15
36 – 40	11	6
41 – 45	12	6
46 – 50	9	5
More than 50	4	2
Level of education		
High school	21	11
Three years of vocational studies	61	32
Beachelor's deree	65	34
Master's study	38	20
Ph.D.	5	3
Position in company		
Manager	54	28
Professional worker (software engineer)	136	72
Size of the organization		
Micro	8	4
Small	59	31
Medium	49	26
Big	74	39
Target market		
Locally	21	11
Regionally	19	10
Nationally	30	16
Internationally	55	29
Globally	65	34
Work experience		
Less than one year	24	13
1 – 5 years	97	51
6 – 10 years	35	18
11 – 15 years	11	6
16 – 20 years	10	5
More than 20 years	13	7
Work form		
Fully office work	39	21
Hybrid work model	122	64
Completely out of the office	29	15

Source: The authors' research

The questionnaire related to the determination of the most dominant work pattern was intended for managers and qualified workers (software engineers) in the IT sector in the Republic of Serbia. The created questionnaire was filled out by 190 employees in the IT sector on the territory of the Republic of Serbia. Sample collection lasted from September to December 2024. The most dominant work pattern was determined by applying descriptive statistics with the help of statistical software SPSS IBM. Table 1 shows the structure of the sample according to gender, age, level of education, position of the employee in the organization, size of the organization, market served by the organization, work experience and family history. The sample consisted of a higher representation of male respondents (58%), younger employees aged 18 to 25 (43%), with completed four-year academic studies (34%), in the position of software engineers (72%). The sample consisted mainly of employees in large organizations (39%) serving the global market (34%). In the structure of the sample, the work experience of the employees ranged from 1 to 5 years. The most dominant work pattern in the observed sample was the hybrid work model, which combines work from home and work in the office (64%).

3. RESULT AND DISCUSSION

The results of the conducted research showed that the hybrid work model is the most dominant in the IT sector of the Republic of Serbia. This model is applied in their organizations by 64% of respondents, while 21% of respondents work exclusively from the office, and 15% exclusively remotely. Figure 1 shows the structure of respondents according to work patterns. These results indicate that organizations have recognized the advantages of this model and are ready to implement it in their long-term business strategies. Analysis has shown that organizations that implement a hybrid work model are more successful in retaining employees and have a lower turnover rate (Sharma, 2024; Pulman & Fenge, 2024). Also, they can retain highly skilled talent and increase flexibility in performing work tasks (Selvi & Madhavkumar, 2023; Williams & Shaw, 2025). In addition, employees who can work from home feel less stress and report greater efficiency in performing work tasks (Kumari et al., 2025). It is assumed that organizations will increasingly experiment with customized work patterns to increase competitiveness and attract highly skilled professionals.



Picture 1: Sample structure based on working patterns
Source: The authors' research

CONCLUSION

Work patterns are evolving in line with global changes, including digital transformation and the consequences of pandemics. Digitization has enabled the wider adoption of remote work and flexible models, while pandemics such as COVID-19 have accelerated these changes and forced organizations to adopt new strategies (Paulišić et al., 2024). The future development of work patterns will depend on further technological innovations, the needs of employees and the business goals of companies, making flexible work models the standard in many industries, especially in the IT sector. The hybrid work model dominates the IT sector of the Republic of Serbia, enabling greater flexibility for employees

and better adaptability to organizations. This model proved to be the optimal solution for the balance between productivity and employee satisfaction. With the constant development of technology and changing market demands, it is expected that companies will continue to adapt work models to further improve efficiency and employee satisfaction. The research results indicate that the hybrid work model is the most dominant in the IT sector of the Republic of Serbia, with 64% of respondents applying it. These findings suggest that organizations have recognized the benefits of combining remote and office work, enabling greater flexibility, a better work-life balance, and increased employee productivity. Additionally, organizations that implement this model are more successful in retaining talent and reducing employee turnover rates.

The analysis has shown that while traditional office work provides better control and enhances teamwork, it also has certain drawbacks, such as limited flexibility and potentially lower productivity due to workplace distractions. On the other hand, remote work allows for greater autonomy and reduces stress associated with commuting, but it may negatively impact communication and the sense of belonging to the organization. The hybrid work model represents an optimal solution that allows employees to enjoy the benefits of both approaches while enabling organizations to maintain a high level of employee engagement and efficiency.

It is expected that organizations will continue experimenting with and adapting work models in the future to enhance their competitiveness and attract highly skilled professionals. Additionally, it is crucial for organizations to provide adequate support and strategies that will help employees adapt to new ways of working, with a focus on mental health, effective communication, and long-term business sustainability.

One of the main limitations of this research is the limited sample, which includes 190 employees in the IT sector of the Republic of Serbia. Although this sample provides insight into dominant work patterns, future research could include a larger number of respondents and expand the sample to different sectors within the IT sector to obtain a more comprehensive picture. The research relies on descriptive statistics, while additional analyzes would provide insight into the factors influencing the choice of working model. Further research could focus on examining the impact of work patterns on productivity, employee satisfaction and well-being. In addition, future research could analyze the impact of work patterns on different categories of employees, such as juniors, seniors and managers, in order to gain insight into the needs of different groups within the IT sector.

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DIGITALIZATION OF THE SUPPLY CHAIN IN SUPPORT OF THE CIRCULAR ECONOMY

Abstract: The aim of this paper is to investigate the role of digitization of business processes in supply chain management and its contribution to the implementation of circular economy principles. Special focus is placed on the possibility of unifying data from various specialized software solutions to enable more efficient analysis of supply chain performance and making informed decisions that support sustainable development.

The methodology of the work is based on the analysis of existing research and examples from practice, whereby the connection of digital technologies with the improvement of energy efficiency and the use of renewable energy sources is examined. The circular economy, in part, is based on the principle of promoting and expanding opportunities for the use of renewable energy sources with the goal that all systems reach the level of constant use of renewable and sustainable energy sources and on the principle of encouraging human activity and utilization of resources in order to achieve new value. It is precisely in the supply chain management segment in the context of business digitalization that the principle of encouraging human activities to follow technological trends can be reflected. Also, innovative approaches in business that can contribute to the optimization of resources and the reduction of the ecological footprint are being considered.

The conclusion of the paper indicates that digitization is a key tool for the implementation of the circular economy, enabling more efficient management of data and resources in the supply chain. Through the integration of digital solutions, companies can redefine their strategies and harmonize economic, environmental and technological goals, which opens up space for sustainable economic development.

Keywords: Circular economy, digitization, supply chain, sustainable development

1. INTRODUCTION

Understanding the circular economy and its benefits for sustainable societal development requires an analysis of its fundamental principles and objectives. A key principle of the circular economic model is keeping products and materials in use for as long as possible. The advantages of this approach lie in preserving added value through more efficient use of material and energy resources, as well as human labor (Geissdoerfer et al., 2017). Therefore, it is essential that products, their components, and materials remain in circulation through designs that enable durability, reuse, repair, remanufacturing, and recycling (Ellen MacArthur Foundation, 2015).

The second key principle of the circular economy is the elimination of waste and pollution. The implementation of the circular economy aims to reduce the negative effects of production activities on the environment and human health. This model enables the reduction of natural resource consumption, greenhouse gas emissions, and other hazardous

substances generated as byproducts in production processes. It also contributes to reducing air, water, and land pollution by significantly decreasing waste volumes (Bogetić, Stojković & Dokić, 2021).

The third principle of the circular economy is reflected in the regeneration and restoration of natural systems. Implementing this model leads to reduced use of non-renewable resources and better conservation of renewable energy sources and raw materials. The circular economy is a regenerative economic model that positively impacts all forms of capital: natural, social, financial, and human (Ghisellini, Cialani & Ulgiati, 2016). Its goal is to restore degraded ecosystems, extend product lifecycles, and minimize waste through thoughtful design that prevents products from becoming waste after use (Bocken et al., 2016).

Innovation, digitalization, and the application of new technologies can significantly accelerate the transition to a circular and green economy, ensuring not only resource and environmental conservation but also enhancing economic competitiveness (Murray, Skene & Haynes, 2017). The circular economy redefines the concept of production and consumption through a new approach to design, resource utilization, and waste management. In this model, waste does not exist; instead, materials and resources are reused in the same or other production processes (Kirchherr, Reike & Hekkert, 2017).

The transition to a circular economy brings long-term benefits for the economy and businesses through innovation, improved brand image and consumer loyalty, increased productivity, and reduced operational costs (Ellen MacArthur Foundation, 2019). The European Union is currently undergoing two parallel transitions affecting economic and societal transformation: the shift from a linear to a circular economic model and digital transformation (European Commission, 2020). Digitalization enables more efficient information exchange and the application of modern technological solutions, while a successful transition to a circular economy requires continuous communication, strong collaboration among various stakeholders (government, industry, consumers, waste management sector), and the implementation of technical solutions such as product eco-design, recycling, and repair (Lieder & Rashid, 2016).

Recycling, as one of the key processes in the circular economy, involves collecting, sorting, processing, and reusing materials from waste for the same or similar purposes. This economic model can provide Serbia with development opportunities, ecological security, "green" jobs, improved water and air quality, healthy food, and an overall higher quality of life for its citizens (Aćimović & Mijušković, 2021). At the same time, the challenges of digitalization and innovation influence global economic processes, with information technology and electronics redefining traditional globalization drivers and fostering sustainable development (Stahel, 2016).

2. DIGITAL TECHNOLOGIES IN THE SUPPLY CHAIN

In contemporary business environments, constant change and adaptability have become prerequisites for market participants. As a result, existing business philosophies are continuously refined, while new concepts emerge to address the challenges posed by dynamic market conditions. One such philosophy, supply chain management, has garnered significant attention from both academia and industry over the past three decades. During this period, various business concepts and strategies have been developed to enhance and optimize supply chain operations. However, no single approach provides a universally optimal solution for all participants in every scenario. Therefore, understanding the appropriate application of these tools is crucial (Aćimović & Mijušković, 2020).

Over the past two decades, supply chains have increasingly adopted business models capable of meeting the demands of global markets. A common characteristic of these models is the integration of sustainability principles into operations. The circular business model in supply chain management is particularly comprehensive, as it considers environmental, economic, and social objectives equally. Circular supply chain management (CSCM) entails the incorporation of circular economy principles into supply chain operations and industrial and natural ecosystems. By pursuing a zero-waste vision, organizations systematically renew technical materials and regenerate biological resources through innovative business models and supply chain functions, spanning all phases from product design to end-of-life management (Farooque et al., 2019).

CSCM engages all stakeholders throughout a product's lifecycle, including manufacturers, suppliers, consumers, and end-users. The core principle of the circular economy is to maximize resource utilization and value extraction (Nasir et al., 2017). CSCM involves the strategic configuration and coordination of functions such as marketing, sales, research and development, production, logistics, information technology, finance, and customer service. This approach minimizes resource intake, waste leakage, and emissions while enhancing operational efficiency and fostering competitive advantage. Moreover, fostering collaboration among supply chain participants through digital innovations is vital for optimizing circular supply chain operations (Aleksić, Vujović, & Arsić, 2023).

To achieve a balance between economic, environmental, and social goals, businesses must leverage Industry 4.0 technologies, which play a crucial role in redesigning and implementing circular supply chain models. Digital technologies facilitate process acceleration, resource optimization, cost reduction, and profitability enhancement across supply chain operations. The rapid advancement of technological innovation and digitalization has compelled organizations to allocate resources in their development plans for the transformation of specific functions or entire business models. However, economic globalization and global policy decisions may also influence the pace of digital transformation (Aleksić et al., 2023).

Digital transformation integrates information, communication, and computing technologies within the supply chain, establishing a strategic imperative for businesses seeking competitive advantage. Key aspects of digital transformation include automation and the implementation of intelligent communication technologies to optimize procurement, warehouse logistics, and equipment management. Information technology specialists develop tailored IT solutions to enhance logistics efficiency. Digitalization enables comprehensive control and management of logistics processes, from procurement and production logistics to distribution (Aleksić et al., 2023).

A significant component of digital transformation is the digitization of procurement processes, which facilitates database management of potential, current, and past suppliers. This automation enhances the efficiency of e-procurement phases, such as supplier evaluation. Another key element of circular digital transformation is the adoption of smart production systems, which integrate advanced manufacturing techniques, operational technologies, and information and communication technologies. These systems replace traditional hierarchical structures with collaborative networks of specialized production components, thereby improving cost control and performance (Stock et al., 2018).

Automated production and recycling processes contribute to efficiency gains by reducing waste generation and energy consumption. Although digitalization and circular economy principles are inherently compatible, successful integration is not guaranteed. Public policies on the circular economy must consider digitalization to prevent misalignment between these two transformative processes. While circular economy policies may overlook digitalization opportunities, digital transformation initiatives may fail to address potential negative impacts on economic circularity. Therefore, a holistic approach is required to ensure the mutual reinforcement of digitalization and circular supply chain management (Bressanelli et al., 2018).

Table 1 will be presented, outlining the key loops in the circular supply chain, which focus on strategies for reusing materials, extending product lifecycles, and enhancing resource efficiency.

Table 1: Loops in the circular supply chain

Loops in the circular supply chain	
loop closure	It defines the practice of reusing materials through recycling, reuse production and similar processes (Bocken et al., 2016; Geissdoerfer et al., 2018).
slowing down loops	Extended use and reuse of products over time, through processes such as designing durable products and extending product life cycles (Leising et al., 2018).
Loop intensification	It suggests greater utilization of materials and finished products through sharing or consumption (Geissdoerfer et al., 2018).
decreasing loops	Using fewer resources per product (Bocken et al., 2016).
dematerialization of loops	It refers to the exchange of goods for services, in such a way as to increase utility and the lifetime of products and materials (Geissdoerfer et al., 2018).

Source: Adapted from Hazen, B. T., Russo, I., Confente, I., & Pellathy, D. (2021). Supply chain management for circular economy: conceptual framework and research agenda. *The International Journal of Logistics Management*, 32(2), 510–537.

Table 1 is important because it categorizes key strategies for implementing circular supply chain management. Each loop represents a different approach to resource efficiency, emphasizing reuse, extended product lifespan, and reduced material consumption. Loop closure focuses on recycling and reuse, while slowing down loops promotes durability and longevity. Loop intensification encourages sharing and higher utilization rates, whereas decreasing loops aims to minimize resource use per product. Finally, dematerialization highlights the shift from goods to services to enhance sustainability. Understanding these loops helps businesses optimize their supply chains, reduce waste, and align with circular economy principles.

3. THE BENEFITS OF DIGITIYATION FOR THE CIRCULAR ECONOMY

The integration of digitization into the circular economy plays a pivotal role in enhancing the efficiency, transparency, and sustainability of supply chains. As the world transitions towards more sustainable business practices, the role of digital technologies becomes increasingly crucial in supporting the principles of the circular economy. By leveraging technologies such as big data, the Internet of Things (IoT), artificial intelligence (AI), and blockchain, businesses can optimize their operations, reduce waste, and increase the reuse of resources, all of which are essential components of the circular model.

One of the main benefits of digitization in the circular economy is the ability to track and manage resources throughout their lifecycle. The use of IoT devices, for instance, enables real-time monitoring of products, materials, and waste, providing valuable insights into their condition, location, and potential for reuse. This data-driven approach allows for the identification of inefficiencies and waste points in the supply chain, facilitating corrective actions that align with circular economy objectives (Bocken et al., 2016; Geissdoerfer et al., 2018).

Additionally, blockchain technology enhances transparency and traceability in the circular supply chain. By providing a secure and immutable ledger for transactions, blockchain enables businesses to track the origin and journey of products and materials. This is particularly beneficial for ensuring the authenticity of recycled materials and ensuring that they meet quality standards. Furthermore, blockchain supports the implementation of closed-loop supply chains, where materials are returned to the production process after their use, thus minimizing waste and reducing the need for virgin resources (Hazen et al., 2021).

AI and machine learning also contribute significantly to the circular economy by improving decision-making processes. These technologies can analyze large volumes of data to predict demand, optimize production schedules, and reduce material waste. AI algorithms can suggest more efficient ways to use resources, thereby contributing to more sustainable manufacturing practices. Moreover, AI-driven systems can identify opportunities for product redesign, ensuring that products are built for longevity, repairability, and eventual recycling (Nasir et al., 2017).

The digitalization of logistics processes further accelerates the circular economy by improving the efficiency of transportation and warehousing. Digital platforms enable the real-time tracking of inventory, reducing the need for excess stock and minimizing the carbon footprint associated with transportation. Additionally, by automating logistics and using advanced analytics, businesses can reduce energy consumption, lower emissions, and enhance the overall sustainability of their operations (Aleksić et al., 2023).

In conclusion, the benefits of digitization for the circular economy are manifold, ranging from improved resource management and waste reduction to increased efficiency and enhanced transparency. As digital technologies continue to evolve, their integration into circular supply chains will be essential for driving the transition towards a more sustainable, resource-efficient future. Companies that embrace these digital solutions will not only contribute to environmental protection but will also gain a competitive advantage in the rapidly evolving global marketplace.

4. ANALYSIS OF SUCCESSFUL DIGITALIZATION IMPLEMENTATIONS IN THE CIRCULAR ECONOMY

Circular economy (CE) represents an economic model based on sustainability, resource reuse, and recycling. Digitalization plays a crucial role in its implementation, as it enables more efficient resource management, product life cycle tracking, and waste reduction. According to Zahariev, Manole, and Barbu (2024), digitalization facilitates the flow of information about products and resources, ensuring that all stakeholders are connected throughout the product's life cycle. This is important for reducing the need for new raw materials and ensuring sustainable operations in a circular economy.

Digitalization of the supply chain is one of the most vital aspects of the circular economy. As Zahariev et al. (2024) note, this process allows tracking and managing all stages of a product's life cycle—from production to recycling—thereby reducing resource consumption and promoting sustainability. The use of technologies such as blockchain, the Internet of Things (IoT), data analytics, and automation can significantly improve efficiency and traceability in this process (Van Buren et al., 2016). These technologies enable better monitoring and optimization of resource use, which is essential for creating closed-loop systems.

Examples of successful digitalization implementations in the circular economy can be found in various industries, such as the textile industry, IT sector, and electronics manufacturing. In the textile industry, companies like H&M and Adidas are using digital platforms for the collection and resale of recycled materials (Zahariev et al., 2024). This approach reduces waste and increases the use of recycled materials in production, contributing to a more sustainable business model. In the IT industry, companies such as Apple and Dell use digital technologies for recycling and reusing materials in the production of their devices, promoting a reduction in the demand for new raw materials (Corsten et al., 2013).

Additionally, the application of blockchain technology in resource tracking has become an important tool in the circular economy. Blockchain allows for greater transparency and traceability of product materials, making recycling and resource reuse more efficient. For example, Stevanović (2021) discusses how a blockchain-based platform in Serbia enables the collection and distribution of surplus fruits and vegetables, reducing food waste and improving resource management in the agriculture sector.

Table 2 Examples of Successful Digitalization Implementations in the Circular Economy

Industry	Company/Project	Implemented Technology	Goal/Outcome
Textile Industry	H&M, Adidas	Digital platforms for recycling	Increase in recycled materials and reduction of waste
Electronics Production	Apple, Dell	Automation, material recycling	Reduction of new raw materials and recycling old devices
Electronic Waste Recycling	Tech Industri Bulgaria	Digital collection network for waste	Regeneration of hazardous waste and reduction of environmental impact

Food Tech/Agriculture	Delhaize Serbia, Food Bank Belgrade	Blockchain platform for food distribution	Efficient distribution of surplus fruits and vegetables, waste reduction
Plastic Production	Big Bam Boo	Digitalized production process	Reduction of plastic material use and use of biodegradable alternatives

Source: Authors' own research

The implementation of digitalization in the circular economy not only helps reduce the ecological footprint but also fosters the creation of new business models based on sustainability. According to Van Buren et al. (2016), companies using digital technologies can track products throughout their life cycle, from production to recycling. This approach enables the identification of resource consumption in real-time, which helps reduce waste and encourages responsible consumption.

In addition to reducing waste, digitalization also facilitates the development of new business models that are more sustainable. As Zahariev et al. (2024) highlight, digital tools allow businesses to track and optimize their use of resources, reducing dependence on new raw materials and enabling the reuse of existing resources. These models, based on circular economy principles, foster long-term sustainability and reduce pressure on global resources.

5. CONCLUSION

Based on the results of this research, we can conclude that circular economy in Serbia has developed to a higher level than in earlier period, for example, in the last decade. The transition to a circular economy represents a fundamental shift in modern business practices, addressing both ecological and economic challenges associated with the traditional linear model. By prioritizing resource efficiency, waste minimization, and sustainable innovation, circular strategies contribute to long-term business competitiveness, economic resilience, and environmental preservation.

Despite its numerous advantages, the implementation of circular models faces significant challenges, including high initial costs, regulatory gaps, and consumer behavior inertia. Overcoming these barriers requires coordinated efforts from governments, industries, and consumers, supported by financial incentives, infrastructure development, and educational initiatives.

Ultimately, the circular economy represents a viable path toward a more sustainable and resilient global economy. By embracing circular principles, businesses and policymakers can not only mitigate environmental impact but also unlock new economic opportunities, ensuring long-term sustainability and prosperity.

Digital technologies ensure success for circular supply chains. With their help, the desired goals can be achieved much faster than would be possible without the application of digital technologies. Internet of things, big data, artificial intelligence, machine learning and blockchain technologies ensure adequate integration and increased cooperation between actors in the supply chain. In this way, they enable better monitoring and management of material flows, resources and information through circular supply chains.

Digital technologies support the automation and optimization of processes in circular supply chains, which leads to the achievement of better business results, such as the reduction of production costs, greater efficiency in control and risk reduction, predictive analysis and efficient exchange of information, efficient resolution of complaints, as well as efficient provision of after-sales services. The research determined that Industry 4.0 technologies such as 3D printing and robotics have no significant application in circular supply chains in Serbia.

Thanks to the digitalization of circular supply chains, both in Serbia and in the wider international context, it contributes to the development of theory and practice in the field of circular supply chains. Future directions of research can be aimed at a larger number of companies and industries both from the Republic of Serbia and from the region, in order to achieve representativeness of the results. Considering that the respondents were of the opinion that robotics do not have a significant application in circular supply chains, it is necessary to conduct research in order to determine the possibilities of these digital technologies in circular supply chains.

Digital transformation is a tool that provides companies with a competitive advantage and supply chain efficiency. Digital solutions and innovations must be constant, and companies use market research, forecasts and feedback to make decisions about strategies for implementing new technologies. Investing in technology requires large financial expenditures, and the decisions made about the implementation of technology must be supported by facts that correspond to the description and methods of doing business. It is precisely through the digitalization of supply chains that support for the circular economy can be given, because in this way the task of the supply chain will be realized in terms of a successful response to consumer demands and needs.

Future research will be oriented toward the investigation of the field in society which had a good experience by implementing the digital technology in circular economy. Namely, research and implementation of new technologies must not stagnate - increasing consumer satisfaction results in increased sales and redesign of existing digital solutions. When making strategic decisions about the design of supply chains, technology becomes a requirement without which companies cannot operate today. Acceptance of new laws related to socially responsible business would not be so

effective without digital solutions. That is, new challenges that appear on the market are more easily accepted and solved with digital technology in circular economy.

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DEVELOPMENT TENDENCIES OF PRODUCTION CAPACITIES IN THE CONTEXT OF DIGITALIZATION OF BUSINESS

Abstract: The paper discusses the importance and impact of digitization in terms of improving production capacities through the application of digital tools. Artificial intelligence and new digital infrastructures are significantly changing today's business at high speed. The applicability of digital tools can be seen in all branches, from agriculture using drones and smart technologies for better planning of orchards, to large production lines of the automotive industry, small and medium-sized enterprises of service activities and many others. Digital technologies, remote data storage and the development of artificial intelligence will increasingly replace the workforce and classic procedures and processes of organizational systems. The expectations are that artificial intelligence will lead to a high degree of determination in the design of organizational and generally existing systems, which confirms its persistence through the characteristic of universal diffusion. The goal of this work is to show, based on qualitative and quantitative analysis of the digital tools applied in practice, their importance and impact on the quality of input and the level of technical modernity of the means of work, which should result in the quality and level of usability of the output. Adequate response of each company is extremely important, because without constant adaptation and active feedback, there is no progress. There is no absolute progress without relative regression.

Keywords: digitalization, business, development, AI, efficiency

INTRODUCTION

The rapid advancement of digital technologies has significantly influenced the production capacity of businesses, reshaping traditional industrial structures and introducing new paradigms of efficiency, automation, and data-driven decision-making. Digitalization has evolved from a supplementary aspect of business operations to a core driver of competitive advantage, altering the mechanisms through which firms produce goods and services. In this context, the study of developmental tendencies in production capacity necessitates an examination of key digital transformation enablers, including the Internet of Things (IoT), artificial intelligence (AI), and big data analytics (Caruso, 2017). Todosijević (2019) emphasizes that the digital transformation of production capacity is not merely a technological shift but an evolutionary process within economic systems. In his theory of digital Darwinism, Todosijević (2019) argues that businesses must adapt to technological disruptions or face obsolescence. This perspective aligns with the concept that digitalization fosters survival mechanisms for enterprises through automation, process optimization, and real-time decision-making capabilities (Todosijević, 2019). Current trends reflect these changes: smart factories driven by cyber-

physical systems (Ritter & Pedersen, 2019), decentralized production enabled by digital tools (World Economic Forum, 2016), and data as a key strategic resource (Arntz et al., 2016). Todosijević (2020) underlines AI's importance in shaping production systems that are scalable and adaptable. At the same time, the shift brings challenges. Digitalization changes labor dynamics—some roles vanish, while others require new skills (OECD, 2016). Upskilling and flexibility are essential. Digital tools also help improve work-life balance (Caruso, 2017). Todosijević (2019) argues that workforce evolution must go hand-in-hand with technology adoption to ensure resilience. However, digital transformation requires investment and introduces risks, particularly for SMEs. Cybersecurity and data privacy are critical concerns. As Todosijević (2020) stresses, failing to build secure and adaptive digital infrastructure can hinder long-term progress. This paper examines how digitalization shapes production capacity, exploring both its transformative potential and its challenges. Through a review of literature and practical insights, the study aims to understand how businesses can respond strategically to this evolving landscape.

2. LITERATURE REVIEW

The evolving landscape of production capacity in the digital age has been the subject of extensive scholarly attention. Literature emphasizes the fundamental shift in how businesses conceptualize and implement production strategies, owing to rapid technological advancements. Caruso (2017) identifies key drivers such as automation, AI, and cloud-based systems that streamline production processes and create new value chains. These technologies contribute to increasing operational efficiency, reducing costs, and enhancing product customization. Ritter and Pedersen (2019) highlight that digital transformation has redefined business models, moving them toward more flexible, customer-centric, and innovation-driven configurations. Their research on the Industrial Marketing Management framework underscores how digitalization facilitates new forms of collaboration, especially in supply chain networks. Similarly, Fromhold-Eisebith (2021) elaborates on the spatial dimension of digital industry transformation, explaining how regional industrial ecosystems must adapt through digital infrastructure and workforce skill enhancement.

Todosijević (2019, 2020) provides a theoretical foundation for understanding digital transformation through the lens of “digital Darwinism.” He asserts that businesses must continually adapt their production models to survive the rapid pace of technological change. His analysis situates AI and data analytics as central to redesigning organizational systems, promoting universal diffusion and evolution of digital tools within production environments. Empirical studies from local and regional contexts confirm the widespread impact of digitalization across diverse sectors. Todosijević S. (2020) discusses case studies from the Western Balkans, where manufacturing enterprises implemented cloud-based inventory and workflow systems, resulting in measurable increases in output and reductions in downtime. Similarly, Milica (2023) documents digital platform integration in SMEs in North Kosovo, revealing that customer responsiveness and employee productivity improved by more than 30% after the adoption of automated service management tools. Bijeljina (2019) emphasizes how digitalization is particularly transformative in agriculture, where precision technologies such as drone-assisted surveying and smart irrigation systems optimize both yields and labor deployment. Data-driven resource planning reduces waste and enhances the sustainability of production processes. In a broader institutional context, the Zbornik SPIN2021 study outlines national and regional policies aimed at accelerating digital transformation. Their evaluation of EU co-funded innovation hubs shows that participation in digital training programs directly correlates with improved technological adoption rates among SMEs. The findings indicate a strong link between public-private collaboration and effective digital capacity building. Frank et al. (2019) and Arntz et al. (2016) emphasize the implications of Industry 4.0, where the integration of CPS and data analytics leads to real-time monitoring and adaptive control of production lines. These capabilities enhance transparency and allow for just-in-time manufacturing, which is especially valuable in volatile supply chain environments.

Todosijević's theoretical framing finds resonance in the work of Vrućica (2023), who argues that production adaptability depends on a business's ability to internalize digital competencies at every organizational level. Her case study of a metal-processing plant in Serbia illustrates how leadership support and continuous employee training enabled successful ERP system implementation and an output increase of over 25%. In summary, the literature collectively points to a consensus: digital transformation is not only reshaping production processes but also redefining strategic decision-making, organizational culture, and workforce requirements. The growing body of empirical research supports the view that proactive digital adoption leads to quantifiable gains in productivity and competitiveness. These insights form the analytical base for exploring the practical implications of digitalization on production capacity in the sections that follow.

3. METHODOLOGY

This study employs a comparative case study approach, integrating sectoral comparisons with in-depth case analyses. This methodological framing ensures consistency, treating comparative analysis and case studies as complementary parts of a single approach.

Qualitative data were sourced from an extensive literature review of academic articles, regional reports, and case studies focusing on digital tools in production. Sources include peer-reviewed journals, institutional publications, and industry analyses such as those by Caruso (2017), Ritter & Pedersen (2019), and Fromhold-Eisebith (2021). Additionally, local case studies from Todosijević R. (2020), Todosijević S. (2023), and Todosijević R. (2023) provide grounded context for the regional application of digital technologies.

Quantitative data were extracted from statistical reports and project documentation within selected case studies. Metrics analyzed include:

- An 18% average increase in production output from cloud system adoption in manufacturing firms (Todosijević R., 2020).
- A 30–35% rise in employee productivity after digital platform integration in service-oriented SMEs (Todosijević, 2023).
- A 20% increase in agricultural yields and 15% reduction in labor hours through smart technologies (Bijeljina, 2019).
- A 28% higher digital tool adoption rate among SMEs engaged in EU-supported innovation programs (SPIN2021).

These data offer a measurable view of how digital technologies enhance production capacity and enable organizational resilience.

To maintain alignment with Todosijević's analytical framework, the research categorizes findings into evolutionary stages of digital adoption, focusing on how organizations adapt structurally and functionally. Comparative analysis was used to identify patterns and variances across sectors such as manufacturing, agriculture, and service industries. Limitations of the study include variability in available data across regions and sectors, as well as challenges in generalizing findings from case-specific outcomes. Nonetheless, the triangulation of qualitative and quantitative insights strengthens the reliability of conclusions drawn. The methodology supports a multidimensional understanding of digitalization's role in reshaping production, providing a foundation for the analytical and discussion sections that follow.

4. DEVELOPMENTAL TENDENCIES IN PRODUCTION CAPACITY

The evolution of production capacity in the digital age is characterized by the integration of advanced technologies that enhance efficiency, responsiveness, and scalability. This transformation is not uniform across industries; it varies based on the nature of production, regional infrastructure, and organizational adaptability.

4.1 Digital Integration and Production Efficiency

Research from Zbornik SPIN2021 highlights that companies participating in digital innovation programs reported a 20–35% improvement in productivity due to automated quality control and real-time data integration. In the context of Southeast Europe, firms that adopted IoT-based predictive maintenance systems reduced downtime by 15–20%, showcasing the direct link between digital adoption and operational resilience.

In the manufacturing sector, Frank et al. (2019) describe the shift from linear production processes to adaptive, interconnected systems facilitated by CPS, enabling just-in-time strategies and cost efficiency. These technologies enable manufacturers to implement just-in-time production strategies, resulting in improved resource utilization and cost efficiency. Similarly, Caruso (2017) notes that automation and AI-driven workflow management have increased output by up to 30% in industrial settings.

4.2 Service Sector Adaptation

The service industry also exhibits significant developmental shifts driven by digital transformation. Todosijevic (2023) reports that North Kosovo SMEs integrating CRM and automated service platforms saw a 28% rise in customer engagement and a 31% improvement in service delivery times. This indicates that digital tools not only enhance productivity but also foster closer customer relationships.

In the hospitality sector, a study documented in the Digitalna Ekonomija (2020) paper demonstrated that implementing AI-driven customer service bots reduced wait times by 40% and increased client satisfaction by 25%. Such integration is crucial for maintaining competitiveness in service-oriented businesses.

4.3 Sectoral and Regional Variations

Regional studies, such as those documented by Todosijević R and Todosijević S. (2017), show that SMEs in urban areas are more likely to implement digital solutions compared to rural counterparts, largely due to better infrastructure and digital literacy. The Vrućica (2023) report highlights how public-private partnerships in urban centers, particularly those supported by EU initiatives, lead to a 30% higher digital tool adoption rate than in rural enterprises.

4.4 The Human Factor in Production Capacity

Human capital remains a critical factor in leveraging digital tools effectively. Todosijević (2020) stresses that continuous upskilling is necessary to match the pace of technological advancement, underscoring the human factor in digital adoption. This perspective is supported by findings from Bijeljina (2019), who notes that firms that invest in digital literacy training see a 25% faster adaptation rate when implementing new technologies.

Fromhold-Eisebith (2021) further argues that the successful adoption of digital tools in production systems hinges on aligning technological integration with workforce readiness. In practice, companies that offer continuous training on new digital interfaces report smoother transitions and higher employee engagement.

4.5 Public and Policy Support

Institutional support also plays a vital role. The SPIN2021 findings indicate that digital transformation projects co-funded by regional governments have significantly higher success rates. For instance, manufacturing companies receiving public subsidies for digital infrastructure improvements reported a 40% reduction in operational delays.

4.6 Concluding Remarks

The developmental tendencies in production capacity are increasingly shaped by digital innovation, organizational culture, and external support systems. Whether in manufacturing or service industries, success depends on the strategic alignment of technology adoption with human resource development and policy frameworks. As digital ecosystems evolve, the capacity to adapt flexibly and responsibly will define the competitive edge of modern enterprises.

5. CASE STUDIES AND INDUSTRY APPLICATIONS

Digital transformation is not only a theoretical concept but also a practical strategy that businesses across various industries are actively implementing. This section explores case studies and real-world applications where digital tools have significantly enhanced production capacity and operational efficiency.

5.1 Manufacturing Sector

- PPG Industries' Cloud and AI Integration: PPG, a global supplier of paints and coatings, has transitioned approximately 72% of its systems to the cloud, enhancing business agility and responsiveness. The adoption of AI technologies has improved consistency across manufacturing plants and accelerated quality control processes. [WSJ](#)
- Rockwell Automation's Continuous Improvement: Rockwell Automation has advanced beyond initial digital transformation stages to achieve continuous process improvement. By integrating IoT and analytics, the

company has enhanced operational efficiency and maintained its position at the forefront of industrial innovation. [PTC](#)

5.2 Agriculture and Food Production

- **John Deere's Precision Agriculture:** John Deere has transformed its operations by developing smart machinery equipped with GPS-based guidance systems, real-time soil sensors, and AI-powered analytics. These innovations enable farmers to monitor soil conditions, track crop performance, and apply inputs with pinpoint accuracy, reducing waste and improving sustainability (Harvard Business Review, 2024). **AI Tools for Kenyan Farmers:** In Kenya, small-scale farmers are utilizing AI-powered tools like Virtual Agronomist and PlantVillage to receive tailored advice on fertilization and pest control. For instance, farmer Sammy Selim nearly tripled his coffee yield by following recommendations from Virtual Agronomist. [The Guardian](#)

5.3 Public Sector Initiatives

- **Queensland Parliamentary Service's Digital Upgrade:** The Queensland Parliamentary Service undertook a significant digital transformation by implementing TechnologyOne's SaaS+ model. This upgrade improved process efficiency, data-driven decision-making, and operational productivity, setting a precedent for other government agencies. [The Australian](#)
- **City of Seattle's Collaboration Service Modernization:** The City of Seattle focused on updating systems like intranets to enhance efficiency and effectiveness in government operations. This modernization effort improved internal collaboration and service delivery to residents. [Talent Management Reloaded USA](#)

5.4 Lessons Learned

Across these case studies, a few common success factors emerge: integrating technology with human resource development, fostering public-private collaboration, and continuously monitoring the impact of digital solutions. The most successful implementations combine technological investment with robust training programs and clear strategic goals. Failure to address workforce readiness and data management issues often leads to suboptimal outcomes.

In summary, case studies confirm that digital transformation has improved productivity (e.g., ERP adoption in Serbian manufacturing), enhanced customer engagement (e.g., Kosovo SMEs with CRM systems), and supported sustainability (e.g., John Deere's precision farming, PPG's cloud migration). These concrete results demonstrate the strategic value of digital transformation across sectors.

6. FUTURE OUTLOOK AND RECOMMENDATIONS

The digital transformation of production capacity is an ongoing process that will continue to evolve as new technologies emerge. The future landscape of production will be shaped by several key trends: increasing automation, the integration of AI-driven decision-making, and the growing importance of data as a strategic asset. Businesses must prepare for these changes by investing not only in technology but also in human capital and digital literacy.

6.1 Predicted Trends in Production Capacity

According to McKinsey (2024), by 2030, nearly 70% of manufacturing processes will be fully automated, driven by advancements in AI and robotics. The integration of digital twins—virtual replicas of physical assets—will become more common, allowing for real-time monitoring and optimization of production lines. This shift will enable manufacturers to reduce downtime by up to 40% and increase output by 20–30%.

In agriculture, precision farming will become increasingly data-driven, with AI algorithms optimizing planting schedules, pest control, and yield predictions. The adoption of blockchain for supply chain transparency will also grow, enabling traceability from farm to table and reducing food waste by 15–20% (Deloitte, 2024).

In the service sector, automation of customer interactions through AI chatbots and virtual assistants will increase efficiency and customer satisfaction. Gartner (2024) predicts that by 2028, more than 80% of customer interactions will be handled without human intervention, leading to faster service and reduced operational costs.

6.2 Strategic Recommendations

To navigate these changes, businesses should adopt a proactive approach by: (1) investing in robust digital infrastructure, (2) fostering workforce adaptability through continuous training, (3) strengthening data management and governance, (4) building collaborative ecosystems with public and private actors, and (5) prioritizing cybersecurity through regular audits and encryption practices.

6.3 Policy Implications

Governments and industry stakeholders should collaborate to establish regulatory frameworks that encourage innovation while protecting data privacy and security. Public investment in digital literacy initiatives will be essential to reduce job displacement risks and to foster inclusive economic growth in the digital era.

6.4 Concluding Thoughts

The future of production capacity is inherently linked to digital transformation. Businesses that proactively embrace technological changes while fostering human adaptability will be best positioned to thrive. As digital ecosystems become more complex, strategic foresight and continuous adaptation will be key to maintaining competitiveness and achieving sustainable growth.

7. CONCLUSION

This research confirms that digital transformation significantly enhances production capacity across sectors. Case studies from Serbia, Kosovo, and global leaders like John Deere and PPG demonstrate measurable gains in output, efficiency, and customer responsiveness. The analysis shows that digital tools like AI, IoT, and cloud computing enhance efficiency and responsiveness. Case studies from manufacturing, agriculture, and service sectors demonstrate substantial productivity gains and cost reductions through digital adoption. These findings validate Todosijević's (2019) concept of digital Darwinism: businesses that fail to adapt technologically risk obsolescence. The results show that companies aligning digital innovation with workforce training achieve the most sustainable outcomes. Policymakers play a key role by supporting digital literacy and innovation frameworks to ensure broad participation in digital transformation. In conclusion, production capacity in the digital age is measured not only in physical assets but also in digital readiness, adaptability, and strategic foresight. Businesses that integrate technology with human capital development will be best positioned to thrive in an evolving global economy.

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Session

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THE ECONOMICS OF SOIL: DOES HIGHER PRODUCTIVITY GUARANTEE GREATER FARM PROFITABILITY?

Abstract: Agriculture plays a crucial role in Serbia's economy, with small and medium-sized farms forming the backbone of rural livelihoods. This study examines the nexus between productivity and farm profitability in Serbia. The sample consists of, on average, around 500 crop farms per year that have been actively operating over a period between 2018 and 2022, resulting in a total of 2,696 observations. Using financial data from the Farm Accountancy Data Network (FADN) and employing panel data analysis, this study will examine the impact of ten key variables on farm profitability, measured by Return on Assets (ROA), with a particular focus on three core determinants: land productivity, labor productivity, and total factor productivity (TFP). Based on previous research, we hypothesize that total, land and labor productivity have a positive and statistically significant effect on the farm profitability in the Republic of Serbia. The results indicate that land productivity has a positive and statistically significant effect on profitability, as higher land efficiency leads to increased revenue and lower per-unit production costs. Contributing factors include modern farming techniques, government support, and economies of scale. However, TFP does not exhibit a significant impact on profitability, likely due to rising input costs and the fragmented nature of Serbian farms, which limits the benefits of efficiency gains. Similarly, labor productivity does not significantly affect profitability, as small farms rely predominantly on low-cost family labor with limited mechanization. The findings emphasize the importance of improving land productivity as a key driver of farm profitability, suggesting that government policies should focus on expanding access to modern agricultural technologies, financial resources, and sustainable farming practices. Additionally, effective financial management strategies, such as optimizing external capital use and subsidies, could further enhance profitability. Despite these insights, the study acknowledges limitations, including potential data inaccuracies, the exclusion of other external profitability factors, and the relatively short timeframe analyzed. These findings hold significant implications for These findings are important for policymakers, agricultural experts, and farmers because they highlight that improving land productivity can boost farm income. Our study highlights the need for adaptive strategies and robust risk management frameworks to navigate through such turbulent times. Policymakers and industry stakeholders must work together to bolster the resilience and sustainability of the food sector in the face of ongoing and future uncertainties.

Keywords: FADN, productivity, profitability, farms, Serbia

1. INTRODUCTION

Agricultural production represents one of the most important segments of the economy of the Republic of Serbia, which is confirmed by the fact that agriculture, forestry, hunting, and fishing (economic sector A) contributed 6.3% to the GVA (Gross Value Added) of the Republic of Serbia in 2023 (Ministry of Agriculture, Forestry and Water Management, 2024). In addition to its share in GVA, it is important to highlight the share of this sector in total employment, which amounted to 13.1% or 373,200 employees in 2023. The agri-food sector significantly contributes to the overall foreign trade of the Republic of Serbia and represents the only sector that achieves a positive foreign trade balance. The share of the agri-food sector in the total trade of the Republic of Serbia in 2023 was 12.2%, while the sector's share in total exports was 16.2% (Ministry of Agriculture, Forestry and Water Management, 2024). In addition to its direct impact, agriculture also has a significant indirect impact on the level of economic development through the development of other economic branches. Agricultural products are often used as raw materials in manufacturing and processing industries (Tomić & Tomić, 2011). In 2023, the Statistical Office of the Republic of Serbia (2024) conducted the agricultural census, which revealed the following facts in its preliminary results: according to the 2023 census, the total number of agricultural holdings was 506,323, of which 99.6% were family agricultural holdings, 1,623 were legal entities, and 419 referred to entrepreneurs. The average size of an agricultural holding was 11.8 ha, with a significant regional difference between Northern Serbia, where the average size was 19.1 ha, and Southern Serbia, where it was 8.3 ha. In terms of average utilized land, farms specialized in crop production stand out, using on average 17.9 ha, as land is their main production resource. The largest percentage of used available land is related to arable land and gardens, accounting for 77.32% or 2,518,369 ha, of which 67% is used for grain production, 19% for industrial crops, 9% for forage crops, and 4% for other uses (Ministry of Agriculture, Forestry and Water Management, 2024). The dominant entities in the Republic of Serbia, as well as in all of Europe, are small agricultural holdings, which represent the foundation for agricultural development. The economic sustainability of these farms can be assessed through the analysis of their productivity and profitability (Miljatović & Vukoje, 2022). Due to the size of agriculture's contribution to Serbia's GDP and the share of crop production in total agricultural production, this paper will focus on the analysis of productivity as determinants of profitability in agricultural holdings engaged in crop production. The sustainability, growth, and development of agricultural holdings, which form the backbone of Serbian agriculture, are only possible if these holdings operate profitably. Long-term operation is the main goal of every enterprise. In order to achieve this goal, enterprises must successfully carry out their business activities, and business success is most commonly measured by profitability. In addition to measuring profitability, enterprise management must identify the factors that significantly affect profitability (Dakić & Mijić, 2020). Various indicators can be used to assess profitability or the earning capacity of a company, with the most commonly used being return on assets (ROA) and net profit margin (Jakšić, 2019). Global food security largely depends on increasing agricultural productivity. Reducing the amount of land, labor, and other necessary resources while maintaining or increasing the same output level represents productivity growth. Higher agricultural productivity makes food cheaper and more accessible to a larger portion of the population, directly reducing poverty (Fuglie, 2018). Indeed, the improvement of agricultural productivity was the world's main defense against the Malthusian crisis—a theory that predicted that food demand, due to continuous population growth, would face the problem of limited natural resources, resulting in widespread famine (Fuglie et al., 2012).

1. LITERATURE REVIEW

There is a significant number of papers in which authors investigated the impact of various factors on profitability, and indirectly on the sustainability of agricultural holdings and enterprises. ROA (return on assets) and ROE (return on equity) as profitability indicators can, in a certain way, summarize the overall performance in all areas of an enterprise; if the production offer is poor or efficiency is low, it will be reflected in profitability (Apalia, 2017). Besides being an important indicator of profitability for internal stakeholders, ROA also has a statistically significant and positive impact on the market value of the company (Asiri, 2015). A key question for all stakeholders, apart from the level of profitability, are the factors leading to that level. Identifying the profitability factors and undertaking actions that will increase the impact of positive and reduce the influence of negative factors is what differentiates successful from unsuccessful business entities. Tekić et al. (2023) analyzed the determinants of profitability on a sample of 167 micro-agricultural enterprises operating in the period from 2010 to 2019. Using the panel regression analysis method, the influence of microeconomic (liquidity, financial leverage, indebtedness, asset structure, total asset turnover ratio, fixed asset turnover ratio, current asset turnover ratio, inventory turnover ratio, accounts receivable turnover ratio, sales growth rate) and macroeconomic determinants (GDP growth rate and inflation) on the return on assets was examined. The authors found that total asset turnover, current asset turnover, and GDP growth rate had a positive and statistically significant impact on profitability, while indebtedness, asset structure, and fixed asset turnover had a negative and statistically significant impact. Liu, Xu, and Shang (2020) explored the impact of internal and external factors on the profitability of 39 agricultural companies listed on the Chinese Stock Exchange during the period from 2013 to 2018. Profitability was measured using indicators: return on sales (ROS), return on assets (ROA), and return on equity (ROE), and independent variables included two groups of factors: internal (company size, current ratio, debt ratio, long-term liabilities ratio, sales growth rate, capital intensity, R&D intensity, export intensity, and ownership) and external factors

(GDP growth rate and CPI growth rate). The authors concluded that company size, long-term liabilities ratio, and sales growth rate positively impacted financial performance, while debt ratio, capital, and export intensity had a negative impact. External factors showed no statistically significant impact on observed performance. Milošev (2023) investigated the influence of firm-level factors (lagged profitability, indebtedness, labor costs, size, liquidity, sales growth) and industry-level factors (market share and capital intensity) on profitability (ROA) of 115 agricultural enterprises operating in the Republic of Serbia from 2017 to 2021. The results indicate that previous profitability positively affects current profitability, while indebtedness, labor costs, and industry capital intensity negatively influence ROA. The study also highlights that internal determinants play a key role in agricultural enterprise performance. Novaković et al. (2024) analyzed the profitability factors in 220 small and medium agricultural enterprises in the Republic of Serbia for the period from 2014 to 2021. Using panel regression analysis, they concluded that financial leverage, company size, fixed assets, and total asset turnover have a statistically significant effect on profitability measured by ROA.

Although there are numerous studies analyzing a wide range of determinants affecting the profitability of agro-sector business entities, there is a noticeable lack of research focusing on the impact of productivity on profitability in agricultural holdings and enterprises. Productivity represents the capacity of production factors to generate output and is expressed as a ratio between output and input. It can be presented as partial productivity (output to one input) or as total factor productivity (Latruffe et al., 2016). Total factor productivity allows a broader productivity analysis as it considers all inputs and technological progress, overcoming the limitations of partial productivity which doesn't account for factor substitution, such as labor being replaced by capital or changes in output structure (Latruffe, 2010). This paper aims to analyze the impact of productivity on farm profitability, specifically the impact of total factor productivity as well as land and labor productivity—being the primary inputs in agricultural production. It is necessary to assess the relationship between productivity and profitability since both are essential prerequisites for the survival, growth, and development of farms and agricultural enterprises, and the well-being of entire nations given that agriculture is the main food source for a growing population. Productivity focuses on the efficiency with which people combine resources to produce goods and services and is thus considered one of the key drivers of wealth creation and employment (Kalai & Helali, 2020). Total factor productivity uses a systemic approach to productivity, comparing total agricultural output to the combined quantity of land, labor, capital, and all other inputs used in production. With an increase in TFP, each unit of output is produced with fewer total inputs (Fuglie, 2018). Muger et al. (2016) explored the sources of profitability change at 256 farms in Kansas for the period from 1993 to 2010 and concluded that changes in profitability mainly arise from changes in TFP. Hadley and Irz (2008) examined profit changes over time on cereal farms in England and Wales from 1982 to 2000 by decomposing changes into price and quantity effects. The quantity effect was then further split into productivity and activity effects. The productivity effect was divided into technical efficiency and technical change effects, while the activity effect included scale, resource mix, and product mix effects. Their analysis showed a decline in profit, mainly due to a negative price effect, although this was partially offset by the positive impact of technical change (i.e., productivity). That an increase in production relative to farm capital plays a crucial role in profitability growth was also confirmed by authors who analyzed the impact of farm size on profitability (measured with ROA) on a sample of 477 EU farms for the period from 2007 to 2018 (Kryszak et al., 2021). A study conducted in the southwest of Australia on 47 large-scale farms for the period from 1998 to 2008 confirmed that productivity growth was the main source of profitability (Islam et al., 2014). Guided by the assumption that increased TFP leads to more output being sold in the market, thereby generating higher revenue while input costs remain constant, the following research hypothesis was defined:

H1: Total productivity has a positive and statistically significant effect on the farm profitability in the Republic of Serbia in the time period from 2018 to 2022.

In addition to total factor productivity, it is essential to assess the impact of the productivity of the two most dominant inputs in agriculture—land and labor—on farm profitability. Land productivity expresses the relationship between the amount of output and the amount of land used in production. It can be expressed as the ratio between the value of agricultural products and the amount of land on which they were produced, or between the physical quantity of agricultural products and the land area used (Food and Agriculture Organization of the United Nations, 2017). To quantify the relationship between land productivity and the success of a farm (measured by ROA), the following hypothesis was defined:

H2: Land productivity has a positive and statistically significant effect on the farm profitability in the Republic of Serbia in the time period from 2018 to 2022.

In addition to land, labor is also a key factor in agricultural production. Labor productivity is the ratio between output quantity and labor input used in production. Labor input can be expressed as the number of active workers on the farm, time units spent working (hours, days, months), or full-time equivalent units (Food and Agriculture Organization of the United Nations, 2017). A positive impact of labor productivity on profitability was also confirmed in a study on Polish farms for the period 2009–2015, which analyzed the effect of labor productivity on profitability using a balanced panel

of 5,865 farms, divided into two groups: one with dominant family labor and the other with dominant paid labor (Pawłowska & Jaroszewska, 2020). The third research hypothesis concerns the impact of labor productivity on farm profitability (measured by ROA), leading to the following hypothesis:

H3: Labour productivity has a positive and statistically significant effect on the farm profitability in the Republic of Serbia in the time period from 2018 to 2022.

By testing the defined hypotheses, the aim is to analyze the impact of productivity one of the most important economic principles on profitability, which is a necessary condition for the survival, growth, and development of crop-producing farms in the Republic of Serbia. This research aims to provide support to farm management and other stakeholders in identifying key determinants of farm success to inform which factors to focus on, thereby enabling farms to develop and operate successfully.

2. DATA & METHODOLOGY

The financial data utilized in this study are obtained from the Farm Accountancy Data Network (FADN). The sample comprises, on average, approximately 500 crop farms per year that were actively engaged in agricultural production during the period from 2018 to 2022, forming a total of 2,696 observations. The profitability, as a dependent variable, would be measured using return on assets (ROA). As independent variables, we use a set of 10 determinants. Our analysis focuses on three productivity measures – total factor productivity, land and labor productivity. The subsequent table summarizes the variables classified as dependent and independent in the analyzed model.

Table 1: Overview of Research Variables

Variable	Name	Computation	FADN code
Dependent	Profitability	Farm Net Income / Total assets closing valuation	SE420/SE436
Independent	Total factor productivity	Total Output / Total input	SE131/SE270
	Land productivity	Total Output / Utilized Agricultural Area	SE131/SE025
	Labor productivity	Total Output / Total Labor Hours	SE131/SE020
	Equity turnover	Total Output / Net worth	SE131/SE501
	Debt-to-asset ratio	Total liabilities / Total assets closing valuation	SE485/SE436
	Current-to-total-assets ratio	Total current assets / Total assets closing valuation	SE465/SE436
	Share of external costs	Total external factors / Total input	SE365/SE270
	Share of farming overheads	Total farming overheads / Total input	SE336/SE270
	Subsidy rate	Balance subsidies and taxes on investment / Total Output	SE405/SE131
	Share of rural development payments	Total support for rural development / Total subsidies - excluding on investments	SE624/SE605

Source: Authors' computations

In order to fulfill this objective, the research will utilize panel data techniques as its main analytical approach. This method, often referred to as longitudinal analysis, is a powerful statistical tool ideal for tracking variations over time among multiple subjects. Before applying panel regression analysis, it is necessary to test the basic assumptions—such as autocorrelation, heteroscedasticity, and dependence of panel data. Statistical tests were employed to ensure the robustness of our analysis, and the results indicate that all basic assumptions are violated. Accordingly, this paper employs panel regression analysis with corrected standard errors, specifically the panel-corrected standard error (PCSE) method, to evaluate the model.

3. RESULTS & DISCUSSION

A descriptive statistical examination is performed on all variables included in the model, and the results are presented in Table 2. In analyzing the central tendency of the data, the median is used as the primary statistical measure rather than the arithmetic mean. This decision is driven by the presence of extreme values and skewed distributions in several variables, which could distort the mean and lead to misleading interpretations. Standard deviations and large gaps between minimum and maximum values further confirm the variability and asymmetry present in the data. The dependent variable, profitability has a median of 13% and a mean of 25%. The difference between these two values, combined with a relatively high standard deviation and extreme values (ranging from -3.18 to 10.81), suggests that while most farms operate with satisfactory profitability, a small number report exceptionally high returns, skewing the mean. Among the independent variables, Total factor productivity shows a high level of dispersion. The median value is 1.92, which is slightly below the mean of 2.26, while the maximum reaches over 183. This suggests that most farms are moderately efficient, but some display extremely high productivity, potentially due to intensive, technology-driven

production systems. Land productivity and labor productivity both show significant differences between mean and median (e.g., median labor productivity is 2,665.07, while the mean is 4,266.04), along with large standard deviations. This implies high variation in land and labor efficiency across farms, possibly reflecting differences in scale, mechanization, and labor organization. Equity turnover has a median of 0.30, suggesting that for most farms, each euro of equity generates around 30 cents of output. Debt-to-asset ratio has a median of 0, indicating that many farms operate debt-free. This aligns with traditional agricultural practices in some regions that prioritize low financial risk. However, a maximum of 0.54 shows that some farms do rely more heavily on borrowed capital. Current-to-total-assets ratio has a low median of 0.055, meaning that current assets make up a small portion of total assets in most farms. This may indicate limited liquidity and potential vulnerability to short-term financial shocks. Finally, the share of external costs has a median of 0.14, suggesting that farms generally rely moderately on outsourced services or external production factors (e.g., hired labor, contract services, etc.), although the maximum value of 0.93 shows considerable variability. The Share of farming overheads has a median of 0.2515. This indicates that, for most farms, roughly a quarter of their input costs are allocated to overheads - expenses such as maintenance, utilities, administrative costs, and similar indirect production costs. The subsidy rate reflects the relative weight of public investment support in overall production. The median value is 0.0183, showing that for the majority of farms, the net effect of subsidies (after taxes) on investment contributes modestly to output. The share of rural development payments has a median of 0, indicating that most farms in the sample do not receive this type of support. However, the mean of 0.0297 and the maximum of 1.00 suggest that a minority of farms are highly dependent on rural development funds, receiving their entire subsidy support through this channel. This is further illustrated by the standard deviation of 0.1213, confirming that the distribution is heavily skewed.

Table 2: Descriptive statistical examination

Variable	Mean	Minimum	Maximum	Median	St. deviation
Profitability	0.2486	-3.1808	10.8089	0.1295	0.5679
Total factor productivity	2.2552	0.0951	183.1129	1.9154	3.8146
Land productivity	261,562.7000	36,000.000	10,800,000	162,863.7000	399,947.7000
Labor productivity	4,266.0410	30.0000	80,108.3300	2,665.0650	5,119.3510
Equity turnover	0.4712	0.0163	11.9697	0.2988	0.7123
Debt-to-asset ratio	0.0071	0.0000	0.5386	0.0000	0.0338
Current-to-total-assets ratio	0.0814	0.0000	1.0000	0.05467	0.0968
Share of external costs	0.1546	0.0000	0.9296	0.1412	0.1293
Share of farming overheads	0.2678	0.0171	0.8597	0.2515	0.1019
Subsidy rate	0.0330	0.0000	15.3673	0.0183	0.2970
Share of rural development payments	0.0297	0.0000	1.0000	0.0000	0.1213

Source: Authors' computations

Prior to beginning the panel data assessment, it is imperative to assess the underlying assumptions intended for the implementation of the selected methodology. Table 3 presents the results of diagnostic tests for the panel regression model. The Wooldridge test confirms the presence of autocorrelation ($p = 0.000$), while the Modified Wald test indicates heteroskedasticity across panels ($p = 0.000$). The Pesaran test reveals significant cross-sectional dependence ($p = 0.000$), suggesting that unobserved common factors may influence the units. Finally, the Hausman test strongly favors the fixed effects model over the random effects alternative ($p = 0.000$), implying correlation between individual effects and explanatory variables. Given these results, the fixed effects model with robust standard errors is the appropriate specification.

Table 3: Statistical Tests for Panel Model Validity and Specification

Test	Test Value	p value
Wooldridge test	19.49	0.000
Modified Wald test for groupwise heteroskedasticity	11.87	0.000
Pesaran cross-section independence test	35.28	0.000
Hausman test	130.88	0.000

Source: Authors' computations

Table 4 presents the results of the panel regression model estimating the impact of various farm-level characteristics on profitability. The coefficient estimates, along with robust standard errors and p-values, are reported for each explanatory variable. Among the statistically significant predictors, land Productivity shows a positive and significant relationship with profitability ($p = 0.001$), indicating that farms with higher land efficiency tend to achieve greater returns. Similarly, equity turnover has a strong positive effect (coefficient = 0.63, $p = 0.000$), suggesting that more efficient use of equity capital is associated with increased profitability. In contrast, debt-to-asset ratio and current-to-total-assets ratio exhibit significant negative effects on profitability ($p = 0.000$ and $p = 0.015$, respectively), implying that higher financial leverage and lower liquidity are detrimental to farm performance. The share of external costs is also negatively associated with profitability ($p = 0.000$), which may reflect inefficiencies or over-reliance on outsourced inputs and

services. The subsidy rate has a significant positive effect on profitability ($p = 0.000$), highlighting the role of public financial support in enhancing farm income. The share of farming overheads is marginally significant ($p = 0.075$), with a positive coefficient, suggesting a possible link between structured overhead investment and improved performance, though this requires cautious interpretation. On the other hand, total factor productivity and labor productivity are not statistically significant ($p = 0.841$ and $p = 0.902$, respectively), which may indicate that their effects on profitability are already captured by more direct financial or operational variables. Similarly, the share of rural development payments does not show a statistically significant impact ($p = 0.238$). Overall, the results point to the importance of capital efficiency, cost structure, financial stability, and subsidies in explaining variations in farm profitability.

Table 4: Coefficient Estimates from the Panel Regression Model

Variable	Coefficient value (Std. Error)	p value
Total factor productivity	0.0006755 (0.0033737)	0.841
Land productivity	1.45e-07 (4.39e-08)	0.001
Labor productivity	1.68e-07 (1.36e-06)	0.902
Equity turnover	0.6296179 (0.0488497)	0.000
Debt-to-asset ratio	-0.500938 (0.0806733)	0.000
Current-to-total-assets ratio	-0.5271919 (0.2161649)	0.015
Share of external costs	-0.295918 (0.0492009)	0.000
Share of farming overheads	0.0924738 (0.0519583)	0.075
Subsidy rate	0.3529639 (0.00354)	0.000
Share of rural development payments	0.0281613 (0.0238682)	0.238

Source: Authors' computations

In this respect, hypothesis 1 is rejected. Total factor productivity does not statistically influence profitability. There could be several reasons why. Firstly, rising costs of input such as seeds, fertilizers, and labor can offset the gains from productivity improvements. If input costs increase faster than productivity, profitability may not improve. Serbian agriculture is characterized by small and fragmented farms. These small-scale operations may not benefit from economies of scale, limiting the impact of TFP improvements on overall profitability. Regarding hypothesis 2, it is accepted. Higher land productivity significantly boosted farm profitability by increasing output and efficiently using resources, resulting in higher revenue and lower per-unit production costs. The adoption of modern farming techniques and government support also played crucial roles in enhancing productivity and profitability. This synergy allowed farmers to better manage risks, achieve economies of scale, and meet strong market demand, solidifying the positive impact of land productivity on their financial outcomes. Last, but not least, hypothesis 3 is rejected. It could be due to the small scale of farms which rely on family labor, limited mechanization, low wage costs, traditional agricultural practices, and the fact that external factors can negate the benefits of increased labor efficiency.

4. CONCLUSION

Agriculture is a vital sector in Serbia, with numerous small and medium-sized farms playing a significant role in the country's economy and rural livelihoods. It plays a fundamental role in ensuring food stability and economic growth. This study investigates the relationship between different measures of productivity and farm profitability in Serbia, focusing on crop farms between 2018 and 2022. The analysis employed panel regression techniques with panel-corrected standard errors to account for autocorrelation, heteroskedasticity, and cross-sectional dependence. The findings of our study led us to some conclusions. Firstly, our results suggest that there is a positive and statistically significant relationship between land productivity and farm profitability. The results confirm that land productivity is a key determinant of profitability. Efficient land use, supported by modern technologies and favorable policy instruments, significantly enhances farm income. This finding underlines the importance of supporting structural improvements and technological adoption in land management practices to improve financial performance. Conversely, total factor productivity and labor productivity do not demonstrate statistically significant effects on profitability. This may reflect the fragmented structure of Serbian agriculture, reliance on low-cost family labor, and rising input costs, which diminish the potential impact of productivity gains on profitability. Additional factors, such as equity turnover and subsidy rate, positively affect profitability, while debt-to-asset ratio, current-to-asset ratio, and external cost share have significant negative impacts. These findings highlight the importance of sound financial management and suggest that profitability is shaped not only by physical productivity but also by capital structure, liquidity, and support mechanisms. Our study highlights the need for adaptive strategies and robust risk management frameworks to navigate through such turbulent times. Policymakers and industry stakeholders must work together to bolster the resilience and sustainability of the food sector in the face of ongoing and future uncertainties. These results are crucial for policymakers, agricultural economists, and farmers, as they highlight the importance of enhancing land productivity to improve farm incomes and overall economic sustainability. However, the study's limitations include potential data inaccuracies, the exclusion of other factors influencing profitability, and the specific timeframe analyzed. Future research should address these

limitations by incorporating broader datasets, exploring additional macroeconomic determinants of profitability, and extending the analysis over longer periods to capture trends and fluctuations more comprehensively.

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ENHANCING AGRICULTURAL DECISION- MAKING: A TOPSIS- BASED FRAMEWORK FOR CROP SELECTION

Abstract: Multi-Criteria Decision-Making (*MCDM*) is a widely used approach for solving complex decision-making problems. With the help of advanced computational tools, these methods can now be applied efficiently across various fields, including medical sciences, marketing, engineering, and agriculture. *MCDM* methods enable quick problem-solving and detailed analysis to identify optimal solutions. This study focuses on one such method, the *TOPSIS* (Technique for Order Preference by Similarity to Ideal Solution), and explores its theoretical foundations and practical applications in agriculture. Specifically, the research demonstrates how *TOPSIS* can be used to select the most suitable field crop.

Five crops—wheat, corn, sunflower, soybean, and sugar beet—were evaluated and ranked using six key criteria: yield per hectare (in tons), purchase price per kilogram (in dinars), production costs (in dinars per hectare), total domestic consumption (in thousands of tons), exports (in thousands of tons), and adaptability to climatic conditions (drought, frost, floods). The selected crops are widely cultivated in Serbia, making them relevant to the local agricultural context. The criteria were chosen to cover a range of factors, including market dynamics, production efficiency, and economic viability. Using the *TOPSIS* method, the relative closeness of each crop to the ideal solution was calculated. The results showed that corn performed the best, being closest to the ideal solution, followed by sugar beet in second place and soybean in third. Wheat ranked fourth, while sunflower was identified as the least suitable crop under the given conditions.

The *TOPSIS* method provides a systematic way to identify efficient and cost-effective alternatives, making it a useful tool for decision-making in agriculture. This study highlights its potential benefits, such as saving time, reducing costs, and improving energy efficiency, which can be valuable for farmers, managers, agronomists, and other agricultural professionals.

Keywords: Multi-Criteria Decision-Making (*MCDM*), Agriculture, Crop selection.

1. INTRODUCTION

Decision-making is a process that involves a series of steps and initiatives through which individuals—whether scientists, business professionals, or employees—consciously and actively influence their environment. Decisions can range from choices that primarily impact an individual's personal sphere, such as selecting a vacation destination or

choosing a university, to strategic decisions that affect entire societies and systems, such as determining a target country for exports.

This complexity has led to the need for a systematic approach to decision-making and the development of theoretical frameworks that provide scientific support for this process. Multi-criteria decision-making (MCDM) is a structured method used to identify the most suitable option among a set of alternatives while considering relevant criteria. Due to its universal applicability, MCDM is widely used across various disciplines, making it a valuable tool in diverse research contexts.

2. THEORETICAL BACKGROUND

The terms decision-making and decision are used daily in all aspects of human life. Decision theory is a distinct scientific discipline that has been developing for approximately fifty years. It focuses on defining these concepts and providing support in making optimal decisions.

According to decision theory, decision-making is a process in which the most appropriate solution to a given problem is selected from a set of possible alternatives. The entirety of available alternatives is referred to as a strategy. A decision is defined as the final outcome of the decision-making process and is made to achieve specific objectives set within the given problem context (Čupić, 1987).

Decision theory can be divided into two main approaches. The first approach focuses on improving decision-making by assisting decision-makers in establishing rules and criteria within the decision-making process. This is known as normative decision theory, which emphasizes the question of how decisions should be made.

The second approach is referred to as descriptive decision theory, which examines the actual process of decision-making, analyzing how decisions are made in practice (Suhonen, 2007).

In the decision-making process, mathematical models and optimization methods play a crucial role. A mathematical model is a set of mathematical relationships that define the connections between various physical quantities within a given process (Milinković, 2014). Optimization methods are closely linked to mathematical models, as they facilitate the selection of the best solution from a set of possible alternatives in accordance with predefined objectives.

Formally speaking, optimization involves determining the extrema—either the minimum or maximum—of an objective function using various methods, depending on the types of relationships present within the mathematical model (Kovačić, 2004).

Multi-criteria decision-making (MCDM) has a relatively short history. The foundations of modern MCDM were established in the 1950s and 1960s (Zavadskas, Turskis, & Kildiene, 2014), with significant growth in the field observed since the 1980s (Dyer, Fishburn, Steuer, Wallenius, & Zionts, 1992). MCDM encompasses situations in which a decision-maker must choose one alternative from a set of options, each evaluated based on multiple criteria. It is particularly relevant in cases where multiple criteria—often conflicting—must be considered simultaneously.

This complexity highlights the necessity of various MCDM methods designed to address different types of decision-making problems. MCDM represents one of the most important areas of decision theory, widely applied in solving real-world problems (Bobar, 2014). On the other hand, multi-criteria analysis methods serve as mathematical tools that support decision-makers involved in complex problem-solving processes. These methods are based on scientific principles that enable an efficient selection of the optimal solution.

Since the 1960s, numerous MCDM methods have been developed (Kovačić, 2004). One such method, applied in this study, is the TOPSIS method.

3. METHODOLOGY

The TOPSIS method (*Technique for Order Preference by Similarity to Ideal Solution*) is based on defining an ideal and an anti-ideal solution. The core principle of this method is that the selected alternative should have the shortest distance from the ideal solution and the longest distance from the anti-ideal solution.

The optimal alternative is defined as the one that is geographically closest to the ideal solution while being farthest from the anti-ideal solution. The ranking of alternatives is determined based on their relative similarity to the ideal solution, which prevents situations where an alternative is simultaneously similar to both the ideal and anti-ideal solutions (Chang, Lin, Linc, & Chiang, 2010).

The **TOPSIS** method consists of six steps:

1. Normalization of the decision matrix $[x_{ij}]_{m \times n}$ to obtain the normalized matrix $R=[r_{ij}]_{m \times n}$

In the decision matrix, many values x_{ij} have different metrics; therefore, the first step is to normalize the elements to obtain normalized values r_{ij} based on the following relation: .

$$r_{ij} = x_{ij} / \sqrt{\sum_{i=1}^m x_{ij}^2}$$

$$i=1,2, \dots, m; j=1,2, \dots, n$$

The normalized matrix in this case contains only dimensionless values.

2. Multiplication of the normalized matrix by weight coefficients

The weighted normalized values v_{ij} are obtained using the following relation:

$$v_{ij} = w_j \cdot r_{ij}; i = 1, \dots, m, j = 1, \dots, n.$$

In this relation, w_j represents the weight of the j -th criterion, which must be normalized, meaning the following equality holds:

$$\sum_{j=1}^n w_j = 1.$$

The weight of a criterion represents a positive number that is independent of the unit of measurement for a given criterion. A higher weight value indicates that the decision-maker assigns greater importance to that particular criterion.

3. Determination of ideal solutions

The ideal solution and the anti-ideal solution are calculated using the following relations:

$$A^+ = \{(\max v_{ij} | j \in J^{max}), (\min v_{ij} | j \in J^{min})\} = \{v_1^+, v_2^+, \dots, v_n^+\}$$

$$A^- = \{(\min v_{ij} | j \in J^{max}), (\max v_{ij} | j \in J^{min})\} = \{v_1^-, v_2^-, \dots, v_n^-\}$$

$$i=1,2, \dots, m.$$

J^{max} is associated with revenue-related criteria that are maximized, while J^{min} corresponds to cost-related criteria that are minimized.

The best alternatives are those with the highest v_{ij} values for criteria that are maximized and the lowest v_{ij} values for criteria that are minimized.

4. Determining the distance of alternatives from ideal solutions

The next step involves calculating the distance of all alternatives from both the ideal and anti-ideal solutions. The distances S_i^+ from the ideal solution and S_i^- from the anti-ideal solution are determined using the following relations:

$$S_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^+)^2};$$

$$S_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_j^-)^2}$$

$$i=1,2, \dots, m.$$

5. Determining the relative closeness of alternatives to the ideal solution

For each alternative, the relative distance to the ideal solution is calculated:

$$RC_1 = \frac{S_i^-}{S_i^+ + S_i^-}, 0 \leq RC_1 \leq 1, i = 1,2, \dots, m.$$

An alternative is considered closer to the ideal solution RC_1 if its value is closer to 1, or farther if it is S_i^+ closer to 0.

6. Ranking alternatives in descending order (Srđević B., Srđević Z., & Zoranović, 2002).

4. RESULTS AND DISCUSSION

The selection of crops for planting is a complex and challenging task. Analyzing factors that affect quality, growth rate, and market price fluctuations is of crucial importance. In this section of the paper, we will study the selected criteria from the groups of market, production, and socio-economic indicators for arable crops (wheat, corn, sunflower, soybean, sugar beet) using the TOPSIS method. The aim is to identify the most suitable crop based on multi-criteria analysis. The TOPSIS method allows for ranking alternatives based on their proximity to the ideal solution and distance from the anti-ideal solution, which is particularly useful in complex decision-making processes.

The following section presents an initial table with the selected crops and criteria for selection. The table includes both quantitative and qualitative data, which will serve as the foundation for applying the given method.

Table 1: Initial data for applying the TOPSIS method

Crop Type	Yield per Hectare (tons)	Purchase Price per Kilogram (in dinars)	Production Costs (in dinars per hectare)	Total Domestic Consumption (in thousands of tons)	Exports (in thousands of tons)	Adaptability to Climatic Conditions (drought, frost, floods)
Wheat	5.1	20.74	105.725	1822	1020	Satisfactory
Corn	7.2	17.47	576	4 130	544	Poor
Sunflower	2.9	35.37	101.855	586	80	Satisfactory
Soybean	2.8	49.84	125.141	550	5	Poor
Sugar beet	49.0	6.07	194.954	250	52	Satisfactory

Source: Statistical office of the Republic of Serbia, 2023;
Ministry of Agriculture, Forestry, and Water Management, 2022/23;
Jeločnik, M., Subić, J., & Nastić L. (2021)

The first step is to define the criteria for selecting the crop to plant. Table 2 shows the criteria and their description:

Table 2: Defining the criteria

Criteria (Labels)	Description
C1	Yield per Hectare (tons)
C2	Purchase Price per Kilogram (in dinars)
C3	Production Costs (in dinars per hectare)
C4	Total Domestic Consumption (in thousands of tons)
C5	Exports (in thousands of tons)

Source: Author's Own Calculation

The next step is to transform the initial data into quantitative indicators on a scale from 1 to 5. The decision matrix is formed based on the initial data presented in Table 3:

Table 3: Filled decision matrix in the TOPSIS method

Crop Type	Yield per Hectare (tons)	Purchase Price per Kilogram (in dinars)	Production Costs (in dinars per hectare)	Total Domestic Consumption (in thousands of tons)	Exports (in thousands of tons)	Adaptability to Climatic Conditions (drought, frost, floods)
Wheat	3	4	2	4	5	3
Corn	4	3	5	5	5	2
Sunflower	2	5	2	2	2	3
Soybean	2	5	4	2	1	2
Sugar beet	5	1	5	1	2	3

Source: Author's Own Calculation

Next, the weights (averages) for each criterion are determined (see Table 4).

Table 4: Presentation of criterion weights

Criteria	Weight
C1	0.2
C2	0.2
C3	0.3
C4	0.05
C5	0.1
C6	0.15

Source: Author's Own Calculation

1. Normalization of the decision matrix $[x_{ij}]_{m \times n}$ to obtain the normalized matrix $R=[r_{ij}]_{m \times n}$

The first step is to normalize the elements to obtain the normalized values r_{ij} based on the following relation:

$$r_{ij} = x_{ij} / \sqrt{\sum_{i=1}^m x_{ij}^2}$$

Table 5: Normalized decision matrix

	C1	C2	C3	C4	C5	C6
A1	0.39	0.46	0.23	0.57	0.65	0.51
A2	0.52	0.34	0.58	0.71	0.65	0.34
A3	0.26	0.57	0.23	0.28	0.26	0.51
A4	0.26	0.57	0.47	0.28	0.13	0.34
A5	0.66	0.11	0.58	0.14	0.26	0.51

Source: Author's Own Calculation

2. Multiplication of the normalized matrix by weight coefficients

The weighted normalized values v_{ij} are obtained using the following relation:

$$v_{ij} = w_j \cdot r_{ij}; i = 1, \dots, m, j = 1, \dots, n.$$

Table 6: Weighted normalized decision matrix

	C1	C2	C3	C4	C5	C6
A1	0.078	0.092	0.069	0.0285	0.065	0.0765
A2	0.104	0.068	0.174	0.0355	0.065	0.051
A3	0.052	0.114	0.069	0.014	0.026	0.0765
A4	0.052	0.114	0.141	0.014	0.013	0.051
A5	0.132	0.022	0.174	0.007	0.026	0.0765

Source: Author's Own Calculation

3. Determination of ideal solutions A^+ and anti-ideal solution A^-

The ideal solutions are determined based on the following table:

Table 7: Ideal solutions

Ideal solution	Calculation
A^+	$\max(V_{11}, V_{21}, V_{31}, V_{41}, V_{51})$
A^+	$\max(V_{12}, V_{22}, V_{32}, V_{42}, V_{52})$
A^+	$\max(V_{13}, V_{23}, V_{33}, V_{43}, V_{53})$
A^+	$\max(V_{14}, V_{24}, V_{34}, V_{44}, V_{54})$
A^+	$\max(V_{15}, V_{25}, V_{35}, V_{45}, V_{55})$
A^+	$\max(V_{16}, V_{26}, V_{36}, V_{46}, V_{56})$

Source: Author's Own Calculation

Table 8: Values of the ideal solutions

Ideal solution	Values
A ⁺	$V_1^+=0.132$
A ⁺	$V_2^+=0.114$
A ⁺	$V_3^+=0.174$
A ⁺	$V_4^+=0.0355$
A ⁺	$V_5^+=0.065$
A ⁺	$V_6^+=0.0765$

Source: Author's Own Calculation

Table 9: Anti-ideal solutions

Ideal solution	Calculation
A ⁻	$\min(V_{11}, V_{21}, V_{31}, V_{41}, V_{51})$
A ⁻	$\min(V_{12}, V_{22}, V_{32}, V_{42}, V_{52})$
A ⁻	$\min(V_{13}, V_{23}, V_{33}, V_{43}, V_{53})$
A ⁻	$\min(V_{14}, V_{24}, V_{34}, V_{44}, V_{54})$
A ⁻	$\min(V_{15}, V_{25}, V_{35}, V_{45}, V_{55})$
A ⁻	$\min(V_{16}, V_{26}, V_{36}, V_{46}, V_{56})$

Source: Author's Own Calculation

Table 10: Values of the anti-ideal solutions

Ideal solution	Values
A ⁻	$V_1^-=0.052$
A ⁻	$V_2^-=0.022$
A ⁻	$V_3^-=0.069$
A ⁻	$V_4^-=0.007$
A ⁻	$V_5^-=0.013$
A ⁻	$V_6^-=0.051$

Source: Author's Own Calculation

4. Calculation of the distance of all alternatives from the ideal and anti-ideal solutions

The distance S_i^+ from the ideal solution is determined as follows:

$$S_i^+ = \sqrt{\sum_{j=1}^6 (v_{ij} - V_j^+)^2}, i=1, \dots, 5.$$

Table 11: Distances of the ideal solution

Alternative	S ⁺
Wheat	0.12
Corn	0.06
Sunflower	0.14
Soybean	0.11
Sugar beet	0.10

Source: Author's Own Calculation

The distance S_i^- from the anti-ideal solution is determined as follows:

$$S_i^- = \sqrt{\sum_{j=1}^6 (v_{ij} - V_j^-)^2}, i=1, \dots, 5.$$

Table 12: Distances of the anti-ideal solution

Alternative	S ⁻
Wheat	0.10
Corn	0.14
Sunflower	0.10
Soybean	0.12
Sugar beet	0.14

Source: Author's Own Calculation

5. Determining the relative closeness of alternatives to the ideal solution

For each alternative, the relative distance to the ideal solution is calculated:

$$RC_1 = \frac{S_i^-}{S_i^+ + S_i^-}, 0 \leq RC_1 \leq 1, i = 1, 2, \dots, m.$$

Table 13: Presentation of the relative closeness of each alternative to the ideal solution

Alternative	RC
Wheat	0.45
Corn	0.70
Sunflower	0.42
Soybean	0.52
Sugar beet	0.58

Source: Author's Own Calculation

6. Ranking of alternatives using the TOPSIS method

Based on the calculated values of the relative closeness of alternatives to the ideal solution, the best alternative can be determined. The alternatives are ranked in Table 14:

Table 14: Ranking of alternatives-cereal crops

Alternative	RC	Rank
Corn	0.70	1
Sugar beet	0.58	2
Soybean	0.52	3
Wheat	0.45	4
Sunflower	0.42	5

Source: Author's Own Calculation

Based on the presented table and the performed analysis, the best result was achieved by corn, which is closest to the ideal solution, followed by sugar beet in second place, and soybean in third. Wheat ranked fourth, while sunflower emerged as the least suitable crop to plant.

4. CONCLUSION

Multi-criteria decision-making (MCDM) is a complex process with diverse applications across all sectors of human activity. One of its most significant areas of application is the agricultural sector, as all stakeholders involved in agricultural production systems must make various complex decisions on a daily basis.

By utilizing the TOPSIS method within MCDM, it is possible to determine the most efficient and most profitable solution, that is, the most suitable alternative. This approach serves as a powerful tool that enables farmers, managers, agronomists, and other professionals in the agricultural sector to optimize their decision-making process, saving time, money, and energy.

The analysis revealed that corn ranked as the most efficient and profitable option. This finding further reinforces the importance of corn as a key agricultural commodity, both in terms of economic return and adaptability to market conditions.

Some of the future research directions could include additional criteria such as environmental sustainability, irrigation system efficiency, and the use of artificial fertilizers. This would enable a more comprehensive and suitable analysis. Furthermore, emphasis could be placed on examining the efficiency of corn cultivation relative to soil type. This would focus on the conditions in which corn thrives best, the feasibility of achieving those conditions in our country's territory, and the proposal of the most optimal solutions.

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TECHNICAL EFFICIENCY OF SERBIAN VEGETABLE OIL PROCESSING INDUSTRY

Abstract: The objective of this paper is to analyse the technical efficiency of the sunflower oil production sector in the Republic of Serbia using Data Envelopment Analysis – DEA methodology. The analysis is conducted on representative sample of 10 companies classified under code 1041- Production of vegetable oil and fats. The study utilized data for the year 2023. Results provide insight into how firm size affect the technical efficiency of oil producers. In addition the analysis identifies key sources of inefficiency, most commonly stemming from suboptimal utilization of inputs such as raw material, energy, labor and others.

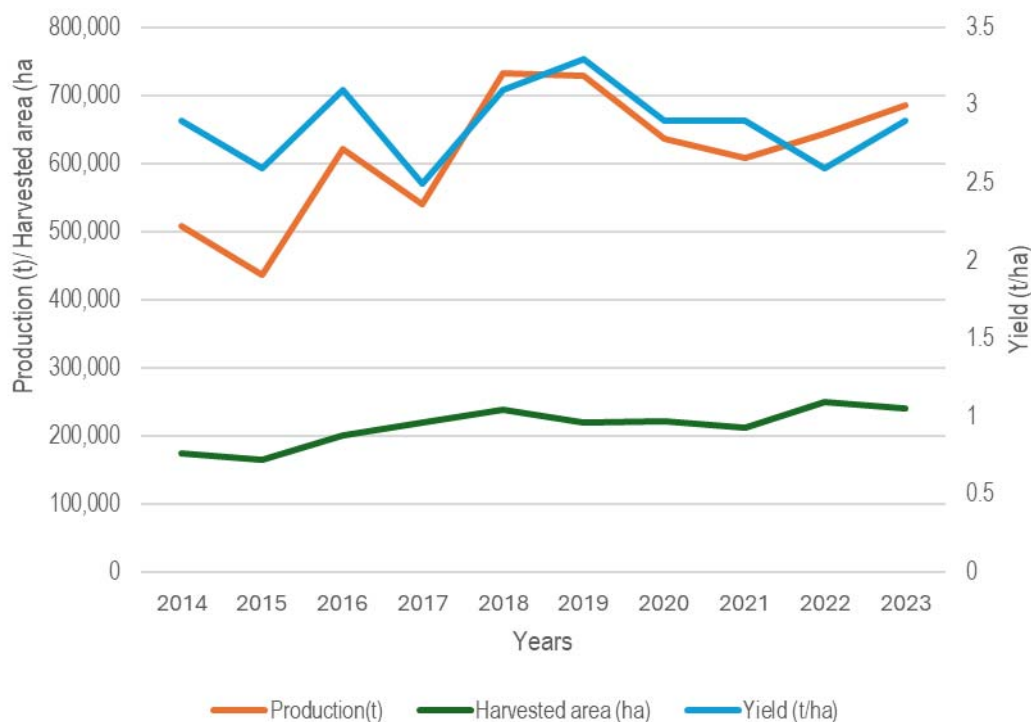
Keywords: technical efficiency, vegetable oil, DEA method, Serbia

1. INTRODUCTION

The production of the sunflower and sunflower oil represent a very significant part of the global oilseed market (Knežević & Popović, 2011). Sunflower and rapeseed, as well as sunflower and rapeseed oil produced from them, along with palm and soybean oil, belong to the group of the most important and widespread oilseeds and edible vegetable oils throughout Europe and the world. (Premović, Ilić, & Krmpot, 2024). On global scale, Russia and Ukraine dominate in sunflower seed production, and together account-51.3% of global supply. The European Union is also one of the major producer, with 9.83 million tons, followed by Argentina and Turkey (FAOSTAT, 2025). Considering that the Black Sea region presents production and trade center of sunflower and its derivatives, changes in these markets have a direct impact on global prices. The oilseed market in the Black Sea basin (which is also a reference point for the Republic of Serbia) is currently facing challenges due to a low oil price, which have dropped below USD 900 per ton. This is a significant drop compared to April 2022, when the price exceeded USD 2,000 per ton, as well as compared to October last year, when the price was USD 1,300 per ton. (Ministry of Agriculture, Forestry and Water Management, 2023b). According to Premović, Ilić, & Krmpot (2024) in Europe the maximum sunflower production was in Ukraine (14,000,000-14,160,000 t), and the minimum in Portugal (22,000-23,000 t). Serbia ranks as the 7th largest sunflower producer in Europe, with total output of 650,000 t.

According to SORS data in 2023 there was a growing trend in the sunflower harvested area, ranging from 166,192 hectares in 2015 to 251,155 hectares in 2022. Average yields have fluctuated significantly due to the impact of variable weather conditions. The highest yield was recorded in 2019 (3.3 t/ha), while the lowest was in 2017 (2.5t/ha). The overall increase in sunflower production in Serbia is primarily driven by expansion of sown areas.

Figure 1. Production, harvested area, and average yield of sunflower in Serbia in the period from 2014 to 2023



Source: SORS, 2025

In period between two agricultural censuses the area under sunflower and the number of farms increased by 26.6% and 69.8% respectively. At the same time, the average area under sunflower per farm decreased from 6.6 ha to 4.9 ha (Table 1). This indicate that significant number of small and medium-size farms decided to introduce sunflower into their crop rotation, which has resulted in a decline in the average area under this crop.

Table1. Number of farms and area under sunflower in Serbia

Year	Area [ha]	Number of farms [number]	Average area per farm [ha]
2012	186,361	28,307	6.6
2023	235,905	48,055	4.9

Source: Authors based on data from the Agricultural Censuses 2012 and 2023

According to the Ministry of Agriculture, Forestry and Water Management (2023a), the largest number of farms engaged in sunflower production cultivate between 10 and 20 hectares of utilized agricultural land (UAA), with a total area of 44,915 ha, representing 19% of the total sunflower cultivation area. They are followed by farms with 5 to 10 ha, which account for 25.3% of the total sunflower-producing farms, cultivating 23,753 ha in total, or 10.1% of the overall sunflower area. Farms which cultivate more than 10 ha represent only 1.9% of all sunflower producers yet manage the largest share of sunflower-planted land (25% of the total area). Structural changes in number and size of farms have occurred under the influence of specific agrometeorological conditions and market dynamics. In general, agrometeorological conditions during the 2023/2024 production season in the Republic of Serbia were mostly favorable for sunflower cultivation. Compared to the previous drought year, the season was notably more humid. However, storm winds, heavy rains, and hail in the northern regions during the grain-filling phase caused lodging and breakage of plants, albeit on limited area (Republic Hydrometeorological Institute of Serbia, 2024). The fact is that the domestic sunflower market reflect the situation on the global oilseed market, which is currently saturated with inexpensive Ukrainian supply and at the same time is experiencing downward price trend. During the sowing period, input prices were high. In the meantime, input and final product prices have fallen, which currently burdens producers the most. In the long term, these cost reductions are expected to benefit consumers as well. Following the introductory section, which provides a brief overview of developments in the global and Serbia's sunflower market, the study proceeds with the methodology section. The third section presents a literature review regarding the application of the DEA method for analyzing the efficiency of agricultural sector participants. This is followed by the discussion of research results, while the final section is devoted to concluding remarks.

2. METHODOLOGY

The efficiency of enterprises engaged in the production vegetables of oils and fats in the Republic of Serbia was analyzed based on data from the database Serbian Business Register Agencies, for the 2023 year, specifically using financial reports – balance sheets and income statements. In addition, information was gathered from company websites, business reports, and relevant research sources. Initially, the research encompassed 93 enterprises classified under the activity code 1041 – Production of oils and fats. However, the analysis revealed that only 58 companies held an “active” status. A significant number of these companies are not exclusively engaged in sunflower oil production, indicating a broad range of production activities within this industry. The analysis shows that only 21 companies are specifically involved in the production of sunflower oil. For the purpose of this research, data was processed for a representative sample of 10 oil-producing companies.

According to the legal status, the companies’ structure include: one join-stock company, 40 limited liability companies, 16 entrepreneurs, and one cooperative. In order to analyze the efficiency of the sunflower oil production sector in Republic of Serbia Data Envelopment Analysis (DEA) method was used. DEA is a non-parametric technique based on linear programming, which allows decision-makers to evaluate multiple inputs and outputs simultaneously. The efficiency of each Decision Making Unit (DMU) is assessed in relation to the most efficient unit (a production frontier), rather than to an average performance (Zhang, Huang, Lin, & Yu, 2009). The DEA method used in this study can be calculated under the assumption of Constant Returns to Scale (CRS), representing Technical Efficiency (TE), as well under Variable returns to scale (vrs), representing Pure Technical Efficiency (PTE). The efficiency scores for TE and PTE range from zero to one, where a score of one indicates full efficiency of the observed DMU, while values below one suggests the presence of inefficiency. Inefficient DMUs can improve their performance in two ways: by increasing their scale of operation (irs- Increasing Returns to Scale) or by reducing their scale (drs- Decreasing Returns to Scale) to an optimal level. The advantage of the DEA method over stochastic techniques lies in its ability to determinate the relative efficiency of each individual DMU in comparison with other within the selected sample, thus measuring efficiency internally (Popović & Đokić, 2019).

3. LITERATURE REVIEW

In order to analyze the efficiency of production several models have been developed. One of them is the Data Envelopment Analysis (DEA) method that can also be used to evaluate the efficiency of companies in agri-food sector. The literature review is organized into two sections. The first part considers the application of the DEA method in analysis of farm efficiency, while the second part addresses the efficiency analysis of companies in agri-food sector. Based on literature reviewed, it has been noticed that the DEA method is more frequently applied in the evolution of farms efficiency.

3.1. The application of the DEA method in evaluating farm efficiency

The next part of the paper examines numerous studies that consider the application of the DEA method in the analysis of the efficiency of agricultural holdings in different regions and sectors of agricultural production.

Günden, Miran & Unakitan (2006) applied the DEA methodology with a constant return to scale assumption to measure the technical efficiency of sunflower production in the Trakya region of Turkey. In their study, the inputs included land, labor, tractor use, nitrogen, seeds, and pesticides, while the output was total sunflower production. The results revealed inefficiencies in sunflower production across the region, with an average technical efficiency score of 0.672, indicating that the same output could be achieved with a 32.8% reduction in input use.

Bojnec & Latruffe (2007) analyzed the efficiency of Slovenian farms across different production sector over the period from 1994 to 2003. Their study included 130 observations, and the results showed that five sectors (crop production, dairy farming, integrated livestock production (with on-farm feed), fruit cultivation, and forestry) were fully efficient. The results also indicate that these specializations have the highest potential to compete in the European and global markets.

Niavis & et al. (2018) evaluated the efficiency of 100 Greek farms specialized in olive trees cultivation using an input-oriented DEA method. The inputs included land, chemical inputs, labor, and energy, while the output was the revenue of each farm. The results indicated significant variations in efficiency score. The results also indicated the possibility of restructuring the production process in order to reduce cost and enhance efficiency.

Popović et al. (2019) used the DEA method with variable returns to scale (vrs) to evaluate the technical efficiency of farms across different regions of Serbia, based on sample of 1,420 farms. The analysis was conducted based on two criteria: region and production type. The results reveal that farms in region Serbia North are in average more efficient than farms in Serbia South. According to production type, in the case of plant production the results indicated higher

average efficiency rate for the indoor and outdoor horticulture farms, and fruit producers. On the other hand, when it comes to livestock production type, results showed higher average efficiency in poultry and pig production. Popović & Đokić (2019) analyzed the technical efficiency of 520 farms in the region of Serbia North using input-oriented Data Envelopment Analysis (DEA) with variable return to scale (vrs). The output was the total value of agricultural production, while the inputs included intermediate consumption and depreciation, labor, and agricultural land. The results of the research indicated that above average levels of efficiency were achieved by farms engaged in poultry farming, indoor and outdoor horticulture, fruit growing and pig farming.

3.2. The application of the DEA method in evaluating efficiency of company in various food industries sectors

Ali (2007) analyzed the productivity and efficiency of the meat processing industry in India using the DEA method for the period from 1980-81 to 2002-03. To measure changes in total factor productivity (TFP), the author applied Malmquist TFP index. An output was the value of production, while input variables included cost of capital, labor, raw materials, and energy. The results indicated that the industry should modernize its production system in order to improve input utilization, particularly of raw materials, capital, and energy.

Jarzębowski & Bezat-Jarzębowska (2014), conducted an efficiency analysis of dairy processing companies in Poland, covering the period from 2006 to 2011. The sample ranged between 103 and 160 companies, depending on the year. The authors employed two approaches to evaluate efficiency: a parametric (on the example of the SFA method, Stochastic Frontier Analysis) and non-parametric (on the example of the DEA method, Data Envelopment Analysis). Authors used one output variable, sales revenue and two input variables, operating costs and assets value. The result showed an exponential relationship between technical efficiency scores obtained using SFA and DEA methods for the analyzed dairy processing sector during the observed period. The SFA method indicated that the efficiency of dairy processing companies was around 0.4 suggesting low level of technical efficiency.

Popović & Panić (2022) analyzed the technical efficiency of dairies in Serbia using DEA method for 77 dairy companies with 6 identified business strategies. In this analysis, operative revenue was selected as the output, while the inputs included material costs, average number of employees, fuel and energy costs, and another operating expenses. The results showed that dairy companies focused on long term coordination activities with dairy farmers, and those companies oriented on purchase and distribution of dairy product processed on farms, achieved above average levels of efficiency. The lowest level of efficiency performs dairy companies with business strategy focused on full vertical integration.

Pervan (2020) assessed the overall technical, pure technical and scale efficiency of large firms operating in the Croatian food industry using the DEA method. The sample included 64 companies (14 very large and 50 large companies). A total of five variables were used in the analysis (total assets, number of employees, material costs, business revenues, and profit). The results revealed a high level of overall technical, pure technical and scale efficiency among the analyzed firms.

A summary of reviewed DEA based efficiency studies is provided in Table 2.

Table 2: Overview of studies on the efficiency of the agri-food sector using DEA method

Author(s) and Year	Sector	Method	Sample	Output	Inputs	Conclusion
Ali (2007)	Meat Processing Industry, India	DEA	59 meat processing plants	Gross output	Capital cost, raw material costs, labor costs, energy costs	Modernization of the production system is needed to improve the utilization of raw materials, capital, and energy.
Jarzębowski & Bezat-Jarzębowska (2014)	Dairy Processing Industry, Poland	DEA, SFA	103–160 dairy processing companies	Sales revenue	Operating costs, asset value	Dairy processing companies show a low level of technical efficiency.
Pervan (2020)	Food Industry, Croatia	DEA	64 companies (14 very large, 50 large)	Operating revenue, profit	Total assets, number of employees, material costs	The results revealed a high level of overall technical efficiency, pure technical efficiency, and scale efficiency.

Popović & Panić (2022)	Dairy Processing Industry, Serbia	DEA	77 dairies	Operating revenue	Material costs, number of employees, fuel, other costs	Long-term coordination with agricultural producers and a focus on selling dairy products sourced from these producers lead to above-average efficiency.

Source: Authors based on the literature review, 2025

4. RESULTS

In this study, as the single output variable is selected the revenue from sale of products and services, adjusted for changes in the value of inventories of semifinished and finished products. The reason for choosing adjusted sales revenue as the output lies in the fact that in 2023, the most observed oil producers evidenced a decrease in the value of inventories of semifinished and finished products, due to specific market conditions. Sunflower is a commodity traded on the stock market, with prices determined by global supply and demand. A specific feature of oil producers' operations is that sunflowers are purchased in August of one year, while processing and sale of final products occur mostly in the following year. As a result, the inventory value in 2022 was relatively high, given that the average purchase price of sunflower was 57.86 RSD/kg in 2022, whereas in 2023, it dropped to 35.37 RSD/kg (Statistical Office of the Republic of Serbia, 2025). However, in 2023, the value of inventories was subject to a double effect. Additionally, to the lower procurement price of sunflower seed, the market also experienced a decline in final product prices in the second half of the year, which further reduced the value of inventories reported in the income statements. Until the end of March 2023, the Government passed Decision on the price limitation of basic foodstuffs was in effect, which reinstated prices to the level of November 15, 2021. This regulation was a response to the behavior of European countries that closed their markets, and the Republic of Serbia followed similar measures to protect the populations living standard by limiting the prices of oil and other essential food items.

On the input side, two variables were selected: first, the cost of materials, fuel and energy- which, according to financial statement, represent the dominant share of total across of all vegetable oil producers regardless of their size and second, other costs, which include labor cost, depreciation, service expenses, intangible cost, interest and miscellaneous. Three large companies – Dijamant doo, Victoria Oil, and Bimal record both revenues and cost above the sector average, while the remaining companies, classified as medium, small, and micro enterprises, report below-average values relative to the sector as a whole (Table 3).

The structure of companies registered under the activity code 1041 – Production of vegetable oil and fats, by size in 2023, is as follow:

- Large companies (5): Dijamant, Bimal Sunce, Vital Vrbas, Viktorija Oil, Banat
- Medium companies (1): Agrolek
- Small companies (2) Bach Oil, Dunavka
- Micro companies (2) Bački Dukat, Linum

Table 3. Descriptive statistics for variables of 10 DMU, used in DEA method (in thousands)

Variable	Average	Standard deviation	Minimum	Maximum
Revenue +/- inventory of semifinished and finished products change	43,304,760	52,549,754	162,093	136,456,099
Raw material, fuel and energy	37,615,056	45,283,152	109,913	122,166,586
Other costs (labor, depreciation, service, intangible cost, interest, and other costs)	7,635,904	10,700,436	42,276	30,589,002

Source: Serbian Business Register Agency database, 2025

The results of the correlation analysis (Table 4) confirm the existence of a strong correlation between the selected output and the defined inputs. It is expected, given that the oil and fat production sector is characterized by a relatively rigid relationship between the quantity of purchased sunflower seed and other inputs on one hand, and the output, which is expressed in terms of the value of produced products, on the other.

Table 4. Correlation analysis of input and output variables for 10 DMU

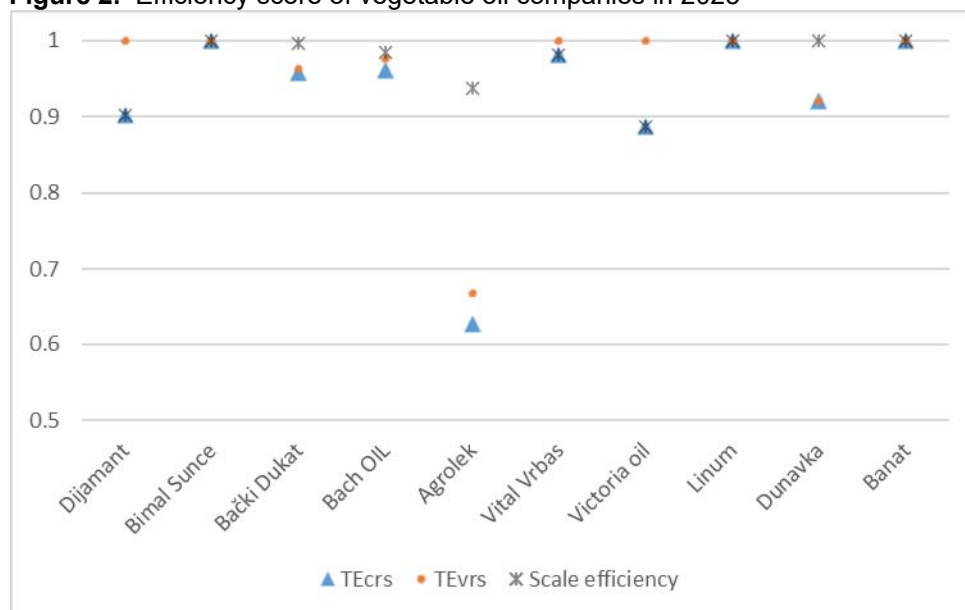
	Revenue +/- inventory of semifinished and finished products change	Raw material, fuel and energy	Other costs (labor, depreciation, service, intangible cost, interest, and other costs)
Revenue +/- inventory of semifinished and finished products change	1		
Raw material, fuel and energy	0.997371171	1	
Other costs (labor, depreciation, service, intangible cost, interest, and other costs)	0.967416192	0.950840324	1

Source: Serbian Business Register Agency database, 2025

For the evaluation of the DEA efficiency model of the vegetable oil and fat production sector in Serbia for 2023, the DEAP 2.1. software developed by Coelli in 1996 (Coelli, Rao, O'Donnell, & Battese, 2005) was used. The input-oriented model with variable returns to scale was selected for the analysis. Table 5 shows the efficiency coefficients by size, with the average technical efficiency for all oil producers in the sample being 0.924. The lowest value is found in the medium-sized vegetable oil producers (0.627), and the highest value is for the micro enterprises, 0.979. The maximum level of efficiency, represented by a TEcrs=1, was achieved by 3 oil producers in total (1 micro, 2 large). For TEcrs, decomposition was carried out into pure technical efficiency and scale efficiency, shown in the columns TEvrs and scale efficiency. Oil producers in the sample achieved lower levels of pure technical efficiency, with an average coefficient of 0.953. The oil producers that performed below average in terms of pure technical efficiency were medium-sized ones, while the micro and large performed above average. The efficiency level of 1 was achieved by 6 vegetable oil producers: 5 large and one micro. On average, the participation of oil producers with pure technical efficiency was highest among large, where the maximum level of pure technical efficiency TEvrc=1, was achieved, and lowest among medium oil producers (0.669).

Oil producers with a pure technical efficiency coefficient lower than 1 can improve their results by reducing their scale of operations (drs) to the optimal level. Out of the total number of 10 oil producers, 4 achieved the maximum level of technical efficiency in relation to their size (Figure 2): 1 micro (50% of all micro-oil producers), 1 small (50%), and 2 large (40%). A coefficient of less than 1 was achieved by 6 oil producers, and they can improve their operations by reducing the use of analyzed inputs (one or both) to the optimal level. A more detailed analysis obtained by the DEA method, using the example of the medium-sized enterprise Agrolek, which had the lowest values for TEcrs, TEvrs and scale efficiency, revealed that there is a room for improvement by reducing the second input, i.e., other costs, to achieve the optimal efficiency level. In general, for all oil producers with a scale efficiency coefficient lower than 1, their results can be improved by reducing the scale of operations (drs) to maximum average productivity.

Figure 2. Efficiency score of vegetable oil companies in 2023



Source: Results by using DEAP 2.1. software

Based on the analysis of average values (Table 5), it can be concluded that the biggest challenge lies with medium-sized oil producers due to the lowest values of TEcrs and TEvrs. On the other hand, large oil producers are technically fully efficient (TEcrs = 1) under optimal conditions, but their scale efficiency indicates room for improvement.

Table 5. Average technical efficiency of vegetable oil producers in Serbia according size

Size	TEvrs	TEcrs	Scale efficiency	Number of oil producer's
Micro	0.981	0.979	0.998	2
Small	0.949	0.941	0.992	2
Medium	0.669	0.627	0.937	1
Large	1	0.954	0.954	5
Average	0.953	0.924	0.969	10

Source: Results by using DEAP 2.1. software

5. CONCLUSIONS

The total production of sunflower in the Republic of Serbia is increasing due to the expansion of area in the sowing structure, i.e. oilseeds are becoming an increasingly common choice of farms, regardless of the size of the agricultural land used. Based on the efficiency analysis of the sunflower oil and fat production sector in Serbia in 2023, the average coefficient of technical efficiency was identified at level TEcrs = 0.924, which indicates high efficiency score in most of the companies in the analyzed sample. The pure technical efficiency (TEvrs) averages 0.953 and the coefficient of size efficiency averages 0.969. These results suggest that the sector in the observed period generally functions close to optimal conditions in terms of the combination of inputs necessary to achieve a given output. In terms of the size of the vegetable oil producers, micro oil producers, despite their smaller scale of operations, have achieved a very high coefficient (TEcrs=0.979). Large oil producers reached maximum pure technical efficiency (TEvrs=1), but the lower level of size efficiency coefficients indicates room for improvement, specifically by reducing the scale of operations (drs). Medium-sized oil producers are positioned the weakest with achieved coefficients of TEcrs=0.669 and TEcrs=0.627. The analysis has determined that these oil producers can improve their results by reducing input usage for the same level of produced output, particularly through a reduction in other costs. This paper contributes to the understanding of technical efficiency in the oil and fat production sector in Serbia. Considering that raw material prices, government regulations, and economic factors have a significant impact on enterprise efficiency in this industry, it opens the possibility for further research in this important but under-researched area. Therefore, future analyses in this sector will need to consider market specificities, as well as longer time intervals, to better understand trends and opportunities for further progress in the sector.

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THE GENERATORS OF GENERATION Z'S POSITIVE WOM IN THE ORGANIC FOOD MARKET

Abstract: The global purchase of organic food products has risen significantly over the past two decades, reflecting a shift in consumer behavior towards more sustainable practices. Marketing researchers have consistently examined the factors influencing these purchasing decisions, including the role of consumer recommendations. However, a review of both domestic and international literature reveals a significant research gap, particularly regarding Generation Z, a demographic poised to become a crucial segment in the food market. This paper aims to address this gap by examining the positive word-of-mouth (WOM) of Generation Z specifically in the context of the organic food market. While existing studies predominantly focus on the impact of WOM on purchasing decisions, there remains a lack of exploration into the generators behind such WOM. Accordingly, this research aims to identify the variables correlated with Generation Z's positive WOM in the organic food market. The empirical research was conducted in the Republic of Serbia, utilizing a sample size of 810 respondents. Research hypotheses were tested using the statistical software platform IBM SPSS Statistics, applying Pearson's correlation test. The findings indicate that all hypothesized variables (Health Consciousness, Ethical and Environmental Dimensions, Personal Attitude, and Subjective Norms) are statistically significant and positively correlated with Generation Z's positive WOM in the organic food market. Notably, the strongest correlation was found with the Ethical and Environmental Dimension, highlighting consumers' sense of obligation to choose organic food products. These results suggest that Generation Z's motivations for promoting organic food are deeply rooted in their values and awareness of ethical and environmental issues.

Keywords: Generation Z, recommendations, word-of-mouth, consumer behavior, organic food.

1. INTRODUCTION

In the past two decades, there has been a notable increase in the purchasing of organic food products, reflecting a shift in consumer behavior toward more sustainable practices. During this time, marketing researchers have focused on identifying the factors that influence environmentally conscious behavior (Albayrak et al., 2013). As consumers increasingly seek sustainable options, they often turn to their social circles for information and recommendations before

making a purchase (Al-Gasawneh & Al-Adamat, 2020). Consequently, word-of-mouth (WOM) communication has emerged as a crucial element in the organic food market.

Despite the growing interest in positive WOM, a review of both domestic and international literature reveals a significant research gap, particularly regarding Generation Z. This cohort, born between the mid-1990s and early 2010s, is on the brink of becoming influential household decision-makers, shaping the future of consumer behavior and family dynamics. Understanding their preferences is essential for organizations operating in a competitive market (Sjahrudin & Adif, 2024). Therefore, the subject of this study is positive word-of-mouth within Generation Z, with a specific emphasis on the organic food sector.

While existing studies predominantly focus on the impact of WOM on purchasing decisions, there remains a lack of exploration into the generators behind such WOM. Accordingly, this research aims to identify the variables correlated with Generation Z's positive WOM in the organic food market. Among the proposed variables are Health Consciousness, Ethical and Environmental Dimensions, Personal Attitude, and Subjective Norms. To sustain the growing demand for organic food, it is essential to understand the factors that may contribute to it (Hugar & Shivappa, 2021).

The paper contributes to a better understanding of young consumers' behaviors and addresses the identified research gap in marketing literature. It offers valuable insights into the positive WOM system, identifying the variables that motivate consumers to recommend organic food products to their peers. Marketing professionals can leverage these findings to develop their promotional strategies, drawing in new customers while empowering existing ones to act as "agents" of the company (Boyer et al., 2015).

The introduction section of this paper outlines the subject, objective, and its contribution. Following the introduction, a systematic review of both domestic and international literature is presented. This review provides a theoretical framework for the empirical research that follows. It consists of two parts: the first part focuses on organic food products and the WOM communication system, while the second part focuses on the characteristics of Generation Z. The methodology, results, and discussions on the author's empirical research are then presented, culminating in a concluding section that outlines the study's limitations as well as recommendations for future research.

2. LITERATURE REVIEW

According to Almli et al. (2019), the European organic sector is among the fastest-growing food markets currently. Hugar and Shivappa (2021) attribute this rising demand to a sustainable consumption trend, which is influenced by increasing environmental issues such as global warming and natural disasters (Rengalakshmi et al., 2024).

The term "organic" refers to the cultivation and processing methods of agricultural products (Sharma & Singla, 2019). These methods avoid harmful inputs and promote economic, social, and ecological benefits (Smoluk-Sikorska et al., 2023). Hence, organic farming is positioned as a way to protect the environment, as these products are free from harmful substances (Hossain et al., 2019).

Although it has many advantages, this production method is often associated with higher costs, leading to elevated prices compared to conventional products (Konuk, 2019). Consequently, willingness-to-pay for organic food (WTP) has become an increasingly popular research topic. Smoluk-Sikorska et al. (2023) describe WTP as the maximum price consumers are ready to pay for a specific product.

Nonetheless, WTP does not guarantee that consumers will purchase organic food. Research by Li and Jaharuddin (2021) highlights the gap between intention and actual purchase behavior. Their study revealed that the relationship between consumers' purchase intention and purchase decision on organic food could be enhanced by the moderating effect of word-of-mouth (WOM).

WOM represents a significant form of communication (Amin, 2019), occurring between consumers and others outside an organization, such as friends and family (Ghassani et al., 2022). This type of communication is perceived as highly credible (Konuk, 2019), as consumers tend to trust informal recommendations more than paid advertising sources (Pandey & Khare, 2017).

According to Al-Gasawneh and Al-Adamat (2020), WOM is a powerful factor in the decision-making process for organic food purchases. Moreover, Ghassani et al. (2022) affirm that consumers are more likely to buy sustainable products when relying on recommendations from their social circles. As such, recommendations play a vital role in shaping consumer behavior (Mouloudj & Bouarar, 2021).

Understanding the factors influencing consumer behavior in the organic food market is essential for maintaining stable demand (Wang et al., 2023), particularly in developing countries (Iqbal et al., 2021). One of the initial challenges in this consumer behavior analysis is the identification of green consumers (Mouloudj & Bouarar, 2021). A literature review shows a research gap, predominantly focusing on Generation Y (Millennials), while there is a limited exploration of Generation Z in the organic food sphere (Vehapi & Mitić, 2021). This cohort, born between the mid-1990s and early 2010s, is becoming increasingly significant in the market (Sjahrudin & Adif, 2024). As this generation matures into a substantial demographic force, understanding their unique values and motivations related to organic food becomes critical.

In comparison to older generations, Jakubowska et al. (2024) note that younger consumers tend to demonstrate higher impulsivity in decision-making. However, Kymäläinen et al. (2021) observe that younger consumers frequently rely on technology. Additionally, Aydemir et al. (2023) highlight that Generation Z members prefer visually appealing foods, especially those trending on social media. Accordingly, the authors suggest that future research should also investigate Generation Z's positive electronic word-of-mouth (eWOM) within the organic food market. Traditional WOM evolved into its electronic version as the internet opened new opportunities for consumers (Amin, 2019). eWOM has increasingly become a vital component of marketing strategies (Sharma & Singla, 2019), enabling consumers to share their experiences without the limitations of social, temporal, or spatial constraints (Al-Gasawneh & Al-Adamat, 2020). Thus, future research should explore the positive electronic word-of-mouth (eWOM) generated by Generation Z concerning the organic food market.

3. METHODOLOGY

The online questionnaire was conducted with 810 members of Generation Z in the Republic of Serbia (Subotica, Novi Sad, Kragujevac, and Vranje) in October 2024. Among the respondents, 633 (78.1%) were female, while 177 (21.9%) were male. A significant portion, 555 (68.5%) reported living in a city, 162 (20%) in a village, and 93 (11.5%) in a suburban area. In terms of living arrangements, 139 (17.2%) of the participants lived in a student dormitory, 171 (21.1%) lived independently, 133 (16.4%) shared a space with a roommate, and 345 (42.6%) resided with their parents. The "other" category was selected by 22 respondents (2.7%). The most common age among these Generation Z members was 20, reflecting the predominance of university students within the sample. The sample was convenient, allowing straightforward access and effective application in the research process. The questionnaire was divided into two sections, each designed to gather specific information and insights. The first section gathered information about respondents' socio-demographic backgrounds and purchasing habits regarding organic food. The second section included 16 constructs in which respondents rated their level of agreement on a Likert scale across 98 statements (ranging from a score of 1, representing strong disagreement, to a score of 5, representing strong agreement). Following a thorough review of both domestic and international literature, five key constructs were determined to be significant for this research, which is presented in Table 1: Health Consciousness, Ethical and Environmental Dimensions, Personal Attitude, Subjective Norms, and WOM.

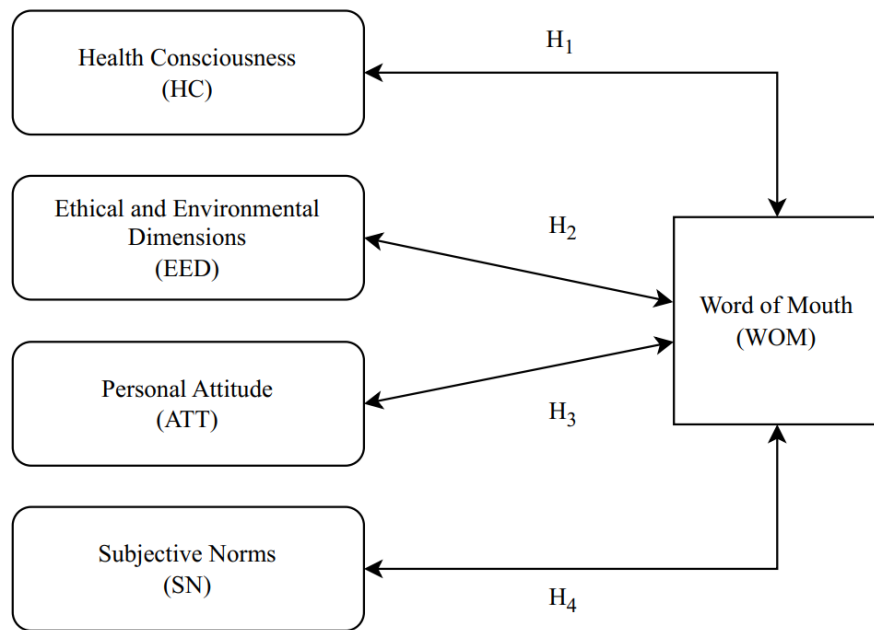
Table 1: Survey items significant for the paper

Survey items:		
HC3	Health Consciousness	Organic food is known for its health benefits.
HC10		I believe that it is safer to consume organic compared to conventional food products.
EED3	Ethical and Environmental Dimensions	Organic food products are environmentally friendly.
EED5		I feel ethically obligated to choose organic food products.
ATT7	Personal Attitude	Organic food is "trending".
SN10	Subjective Norms	I often buy food with my family.
WOM2	Word of Mouth	If someone is searching for healthy and tasty food, I will advise them to buy organic products.
WOM3		I have recommended organic food to my social circle.

Source: The authors' research

A research framework was created to identify the variables correlated with Generation Z's positive WOM in the organic food market.

Illustration 1: Research framework 1



Source: The authors' research

Based on the created research framework, the following hypotheses were set with the aim of testing them:

- H₁ – Health consciousness is positively and statistically significantly correlated with word-of-mouth.
- H₂ – Ethical and environmental dimensions are positively and statistically significantly correlated with word-of-mouth.
- H₃ – Personal attitude is positively and statistically significantly correlated with word-of-mouth.
- H₄ – Subjective norms are positively and statistically significantly correlated with word-of-mouth.

The hypotheses were tested using the IBM SPSS Statistics software platform, and the research results and discussion are presented in the following sections of the paper.

4. RESULTS

Given the nature of the research variables, the proposed hypotheses were tested using Pearson's correlation test to determine if there is a statistically significant correlation between them.

Table 2 shows the correlation between HC, EED, ATT, SN, and WOM2 (survey item: "If someone is searching for healthy and tasty food, I will advise them to buy organic products.").

Table 2: Pearson's Correlation test results

WOM2				
	<i>r</i>	<i>p</i>	N	Correlation
HC3	.243**	.000	810	Positive Significant correlation between variables
HC10	.254**			
EED3	.230**	.000	810	
EED5	.443**			
ATT7	.193**	.000	810	
SN10	.209**	.000	810	
** Correlation is significant at the 0.01 level (2-tailed).				

Source: The authors' research

Table 3 shows the correlation between HC, EED, ATT, SN, and WOM3 (survey item: "I have recommended organic food to my social circle.").

Table 3: Pearson's Correlation test results

WOM3				
	<i>r</i>	<i>p</i>	N	Correlation
HC3	.220**	.000	810	Positive Significant correlation between variables
HC10	.229**			
EED3	.242**	.000	810	
EED5	.479**			
ATT7	.163**	.000	810	
SN10	.227**	.000	810	
**. Correlation is significant at the 0.01 level (2-tailed).				

Source: The authors' research

All the variables analyzed in this study have statistically significant relationships, as indicated by a p-value of .000, which is well below the significance threshold of $p < 0.01$ (2-tailed).

The intensity of these relationships is generally low, within the range of 0.1 - 0.3 (coefficient *r*), with one notable exception: the relationship between Ethical and Environmental Dimensions (EED5) and WOM, which shows medium intensity, ranging from 0.3 - 0.5 (coefficient *r*). This suggests that the ethical obligation felt by consumers to select organic food products correlates most strongly with Generation Z's propensity for positive word-of-mouth in this market.

The positive correlation indicates that an increase in one variable correlates with an increase in another. For instance, heightened health consciousness among consumers is likely to result in a greater willingness to share recommendations. Based on the research findings, the previously established hypotheses *H*₁, *H*₂, *H*₃, and *H*₄ have been confirmed:

- *H*₁ – Health consciousness is positively and statistically significantly correlated with word-of-mouth.
- *H*₂ – Ethical and environmental dimensions are positively and statistically significantly correlated with word-of-mouth.
- *H*₃ – Personal attitude is positively and statistically significantly correlated with word-of-mouth.
- *H*₄ – Subjective norms are positively and statistically significantly correlated with word-of-mouth.

All identified variables correlate positively and statistically significantly with Generation Z's positive WOM regarding organic food products. The strongest correlation is linked to the EED5 dimension, suggesting that consumers with a strong ethical commitment are more likely to recommend organic food products. While the correlation for health-conscious consumers is lower, they also frequently share positive experiences. Additionally, subjective norms and personal attitudes emerge as important factors in facilitating positive word-of-mouth within this demographic.

5. DISCUSSION AND CONCLUSION

The concept of green marketing has become increasingly important due to various environmental challenges that modern society faces (Al-Gasawneh & Al-Adamat, 2020). One of the key objectives of this marketing approach is to promote the consumption of organic food products (Bryla, 2016). In line with that, Aydemir et al. (2023) highlights the importance of understanding consumer behavior in the food market, especially among Generation Z.

Research conducted by Vehapi and Dolicanin (2016) explored consumer behavior in the Republic of Serbia's organic food market. Their study examined consumer behavior through the lens of marketing mix instruments: product, price, marketing communication (promotion), and distribution channels (place). Findings from their research suggest that organic food producers and marketers should focus on the word-of-mouth (WOM) communication system as well as online communication channels. While existing studies predominantly focus on the impact of WOM on purchasing decisions, there remains a lack of exploration into the generators behind such WOM. The literature on consumer motivation is still lacking, and psychological elements' moderating influence has not received enough attention (Chen & Chen, 2021).

Therefore, this paper aims to fill the identified research gap in marketing literature and enhance the understanding of young consumers' behaviors. It identifies the variables that encourage consumers to recommend organic food products

within their circles, providing valuable insights into the positive WOM system. Marketing experts can leverage these findings to develop suitable promotional strategies that not only attract new customers but also empower existing ones to act as brand ambassadors (Boyer et al., 2015).

An online questionnaire was completed by 810 Generation Z members in the Republic of Serbia for this study. A review of both domestic and international literature identified five constructs as significant for the research: Health Consciousness, Ethical and Environmental Dimensions, Personal Attitude, Subjective Norms, and WOM. The aim was to identify the factors correlated with Generation Z's positive WOM in the organic food sector. The hypotheses were tested using the IBM SPSS Statistics software platform, applying Pearson's correlation test to determine if there is a statistically significant relationship between them. Results indicated a positive and statistically significant correlation between all identified variables with Generation Z's positive WOM in the organic food market, with the highest correlation related to EED5 suggesting that consumers with a strong ethical commitment are more likely to recommend organic food products.

One limitation of this study is its exclusive focus on traditional word-of-mouth marketing, whereas the advent of digitalization compels marketers to also examine electronic word-of-mouth systems (Litvin et al., 2006). Future research should explore the positive electronic word-of-mouth (eWOM) generated by Generation Z concerning the organic food market.

Additionally, this study focuses on the post-purchase phase, specifically examining consumers' willingness to recommend organic food. Future research could explore the pre-purchase phase, examining how much consumers trust in recommendations and how significantly those recommendations influence their purchasing decisions.

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CHARACTERISTICS OF RURAL TOURISM SUPPLY IN THE FEDERATION OF BOSNIA AND HERZEGOVINA - POSSIBLE PERSPECTIVES BASED ON THE DEMAND MODEL

Abstract: Rural tourism has become increasingly popular, due to a new perception of travel. It has a high potential to stimulate local economic growth and social change because of its complementary with other economic activities. Local and national governments have found that rural tourism can benefit communities by increasing business, employment and income. Most rural areas around the world, and also in Bosnia and Herzegovina, are facing population decline and changes brought about by industrialization and urbanization. Rural tourism is recognized as a significant factor in the recovery and preservation of nature, landscapes, historical sites and traditional lifestyles. The most important consequence of the development of rural tourism in the Federation of Bosnia and Herzegovina is the progress of rural communities and rural tourism supply, and also the improvement of the socioeconomic status of the rural population. The aim is attracting more tourists who will be satisfied with rural tourism supply.

That's why the following hypothesis is put in the paper: "The development of rural tourism has a statistically significant effect on the level of satisfaction of tourists in the Federation of Bosnia and Herzegovina." The questionnaire research technique was used to collect data for both the dependent and independent variable of the defined hypothesis. For both variables, the survey question was asked in the form of a Likert scale with five levels. Considering the above data, both the dependent and independent variables of this hypothesis were of a quantitative nature, so the statistical method of least squares, the linear regression method, was used to test the hypothesis. The results of the conducted research show that the development of rural tourism affects the satisfaction of tourists in the Federation of Bosnia and Herzegovina (correlation and determination show a connection of medium strength, and the model is significant at level 1 % statistical significance, $p=0.001$). So, it can be concluded, regarding the results, that the development of rural tourism has a significant effect on the level of satisfaction of tourists in the Federation of Bosnia and Herzegovina.

Keywords: rural tourism, ethnic villages, rural tourism supply, demand and satisfaction of visitors.

1. INTRODUCTION

Today, with an endless variety of destinations, activities, modes of transport, accommodation, and more, it is possible for anyone to plan perfect trip. It is not surprising that the travel and tourism industry is one of the most competitive in the world and has a great contribution to gross domestic product. This paper deals with special type of tourism and that is rural tourism and its characteristics in the Federation of Bosnia and Herzegovina. Rural tourism means travelling to

non urbanized places with low population. An incredible chance to connect with local communities, support them and immerse yourself in their local culture.

In the Federation of Bosnia and Herzegovina, the number of interesting and unknown destinations in rural areas is growing. Eco and ethnic tourism has been developed with numerous tourist centers. During data collection and analysis (paper writing), we visited certain ethnic villages in the Federation of Bosnia and Herzegovina. We had conversations with the owners or employees and interviewed some of the guests (visitors). We obtained some data on supply, but also demand, such as preferences and satisfaction of users of ethnic village services. Some of the visited ethnic villages are: ethnic village Čardaci (complex with cottages, indoor and outdoor pools, restaurant, spa center, green area); village Zlatna nit, Bosanska Krupa (agriculture production, accommodation, wellness, restaurant); agrotourism Matuško, Neum (agriculture production, restaurant, swimming pool, accommodation); Eko-Fis Vlačić (accommodation, adrenaline park, sports, spa center, hiking); eco village Semešnica (restaurant, bungalows, pond fish, green area), Babići ethnic village, Rostovo (bed and breakfast, restaurant, hiking, cycling, children playground, wellness); ethnic village of Begovo, Ilijaš (accommodation within cottages, restaurant) with authentic Bosnian dishes); Herceg ethnic village, Međugorje (stone houses, restaurant, outdoor swimming pool, banquet hall); ethnic zone Oasis of Peace, Donji Vakuf (accommodation, restaurant, children playground); SRC Ajdinovići, Olovo - the only all-inclusive center in Bosnia and Herzegovina with a large number of facilities (spa center, sports fields, indoor and outdoor pools, zoo, riding school, motorized touring), ethnic village Mirna dolina, Mačkara, Gornji Vakuf (agricultural production, restaurant, tennis court, playground for children).

Because of the growing importance of rural tourism in the Federation of Bosnia and Herzegovina, especially ethnic tourism, and its impact on local economic development, we have chosen topic related to rural tourism. We find it very interesting to analyze rural tourist supply and expectations of visitors and their satisfaction. Our scope is to have satisfied tourists and tourists who will be back one day or who will give good marks and recommendations. There are some studies in Bosnia and Herzegovina (Peštek and Tufo, 2018; Knežević et al., 2017; Krajinović et al., 2011) which deal with rural tourism, in general, and there are also some similar studies in Croatia (Mesić et al., 2021; Škaberna, 2017; Gojak, 2016; Piskač, 2016).

Combination of desk (relevant publications) and field research method (survey questionnaire) was used as data sources. Within our research we reach some answers about rural tourism supply, tourist satisfaction and expectations and how they rate rural tourism offer. It will be presented, including some additional elements of research, within this paper.

2. LITERATURE REVIEW

The World Tourism Organization (UNWTO) (2021) has recognized that “tourism is one of the driving forces of global economic growth and is currently responsible for the creation of 1 in 11 jobs. Tourism is an activity that contributes directly and indirectly to the development of rural areas. But this development needs to be sustainable. To do this, appropriate policies that positively influence these areas from an economic, social and cultural point of view must be implemented (Lopez-Sanz et al., 2021). Svržnjak et al. (2014) emphasize how tourism, in general, is largely responsible for knowledge about the need for sustainable development because it is most interested in the sustainability of all resources which are the basis for its development and sustainability.

Rural tourism is seen as an environment - friendly and permanently sustainable. It is based on the need of getting closer to nature (Skalova and Peruthova, 2016). For Polo (2010), the development of the rural tourist activity is very suitable for improving the development of the rural areas, likewise Marzo-Navarro (2017) stated that rural tourism promotes the development and economic growth of the destination areas, for which it is a priority to achieve the objectives of economic, sociocultural, and environmental sustainability. Rural tourism consists of several activities that harmonize with nature, the culture of the rural area, and the lifestyle of the local people (Lane, 2009)

Rural tourism aims to achieve local sustainable development and provide a sufficient response to modern society's leisure needs within a new social harmony between city and rural. The traditional rural economy, which is based on agriculture, forestry, crafts, and other sectors, benefits greatly from rural tourism. (Jha, 2021). Rural tourism has developed rapidly as more and more people are looking for a new space to escape from the city's busy everyday life (Schmidt, 2016)

Among the most influential variables, satisfaction is a key factor that indicates what the trip has meant to the tourist (Lopez-Sanz et al., 2021). Tourist satisfaction has been measured and assessed by a variety of tools – namely overall satisfaction, performance, expectation, positive recommendation, etc. (Yoon and Uysal 2005). If tourists are satisfied with tourist destination it can be expected that they probably will be back one day and promote tourist destinations within social media.

There are already, in the Federation Bosnia and Herzegovina, a lot of interesting destinations: rural households, camps, guesthouses, vineyard houses, mountain huts and ethnic villages that provide rural tourism services. We put focus on ethnic villages. And services that they usually supply to the visitors are as follows: accommodation, domestic food and beverage within restaurants, spa centers (some of them), agriculture production (some of them), sports fields, outdoor swimming pools, zoo, riding school, playground for children, hiking, motorized touring,...However, there are also numerous difficulties faced by those who have decided to stay in their local community and develop it through the

provision of tourist services. And the biggest problem is definitely undefined legal framework for this area which should be the task for local communities and higher government levels, first of all for cantons and the Federation. Some features, that also can be seen as challenges, are following as: seasonality, fragmentation, cooperation between internal and external market, role of women and economic role. These features play an important role in creating rural tourism supply as well as achieving satisfaction within demand of visitors.

3. RESEARCH METHODOLOGY

The setting of the research methodology is conditioned by the defined hypothesis, more precisely by the research technique that was applied for the purpose of collecting data for testing it.

The survey questionnaire research technique was used to collect data for both the dependent and independent variables of the hypothesis. For both variables, the survey question offered closed-ended answers, i.e. a five-level Likert scale was used. Given the above data, both the dependent and independent variables of this hypothesis are of a quantitative nature, so the statistical method of least squares, the linear regression method, was used to test the hypothesis.

Linear regression refers to any approach to modeling relationships between one or more variables marked with Y, and one or more variables marked with X, in such a way that such a model depends linearly on unknown parameters estimated from the data. Most often, linear regression refers to a model in which the conditional mean of Y, for a given value of X, is an affine function of X. The case with one independent variable, as will be used in this research, is called simple linear regression.

The quality of the defined statistical model was tested with additional statistical tests of the model specification, with the aim of reaching a final conclusion on the suitability of the defined model and accepting/rejecting the hypothesis.

4. RESEARCH RESULTS

The survey was conducted on a sample of 45 respondents in selected ethnic villages in FBiH.

Of the total number of respondents, 42.2% were men, and 57.8% were women. Visitors to ethnic villages in the FBiH are mostly young and middle-aged people, more precisely respondents between the ages of 21 and 31, and 43 and 53, cumulatively occupying 57.8% of the total number of respondents. Domestic tourists are mostly present in the ethnic villages of the FBiH, more precisely 84.4% of respondents included in this research come from BiH.

Tourists visit ethnic villages in FBiH mostly once every six months (35.6%) or even less often, once a year (22.2%) and other (24.4%).

The conducted research showed that in 62.2% of cases, tourists are satisfied and absolutely satisfied with the rural tourist offer in FBiH. 31.1% of respondents do not have an opinion about the satisfaction with the tourist offer of ethnic villages in FBiH, which is expected considering the intensity of visits to them.

Among ethnic villages in FBiH, tourists like the natural resources that are represented in them the most (31.1%). In addition to the natural resources, tourists are also satisfied with the food and the friendliness of the staff in ethnic villages. 60% of the answers to this survey question were "other", which means that tourists like more things in ethnic villages, so in addition to the natural resources, they also like the gastronomic offer or the friendliness of the staff.

Respondents included in this research assessed that the degree of development of rural tourism in FBiH is good in 46.7% of cases that is, very good and excellent in 22.2% of cases cumulatively. 28.9% of tourists believe that the degree of development of rural tourism in FBiH is sufficient. These results indicate that providers of rural tourism in FBiH have a lot of things for advancement in terms of exploiting available natural resources, as well as specialization and a more comprehensive business management policy.

The results of the conducted research also show the great importance of agritourism within the framework of rural tourism in FBiH. As many as 80% of respondents, cumulatively, consider that agritourism is an important and absolutely essential segment of rural tourism in FBiH, which can also be a useful development guideline for managers of ethnic villages in FBiH.

When it comes to the material status of the respondents, 64.4% of the respondents have a monthly income in the interval 1001-2001 KM, 24.4% have an income in the interval 2002-3002, 8.9% have an income over 3002 KM, while 2.2% of the respondents have an income of less than 1000 KM. From the above, it can be concluded that, for the most part, tourists in the ethnic villages of FBiH are with medium incomes.

In the continuation of the research, the hypothesis was tested using the method of least squares within the SPSS statistical software package.

Table 1.: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	.510 ^a	.260	.243	.72815	.260	15.091	1	43	.000

a. Predictors: (Constant), How would you rate the development of rural tourism in FBiH

b. Dependent Variable: How satisfied are you with the rural tourism offer in FBiH

Source: Independent work of the author

From the results in table 1, it is evident that the correlation coefficient is 51%, which means that there is a moderately strong relationship between the satisfaction of tourists in FBiH and the level of development of rural tourism. Equal results are shown by the coefficient of determination whose value is $R^2=0.26$, which according to Chadock's scale means a relationship of medium strength. In this case, the direction of the relationship is positive, which means that the increase in tourist satisfaction in FBiH is influenced by a higher degree of development of rural tourism.

Table 2.: ANOVA test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.001	1	8.001	15.091	.000 ^b
	Residual	22.799	43	.530		
	Total	30.800	44			

a. Dependent Variable: How satisfied are you with the rural tourism offer in FBiH

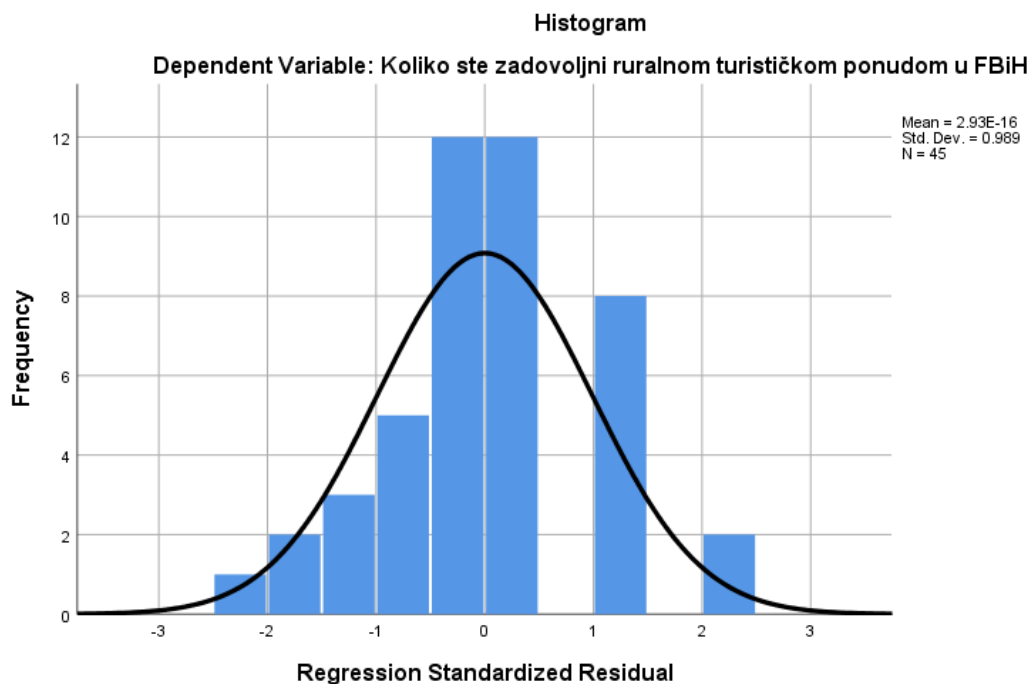
b. Predictors: (Constant), How would you rate the development of rural tourism in FBiH

Source: Independent work of the author

The defined model is statistically significant at the level of 1% statistical significance according to the ANOVA test results ($p = 0.000$, table 2.)

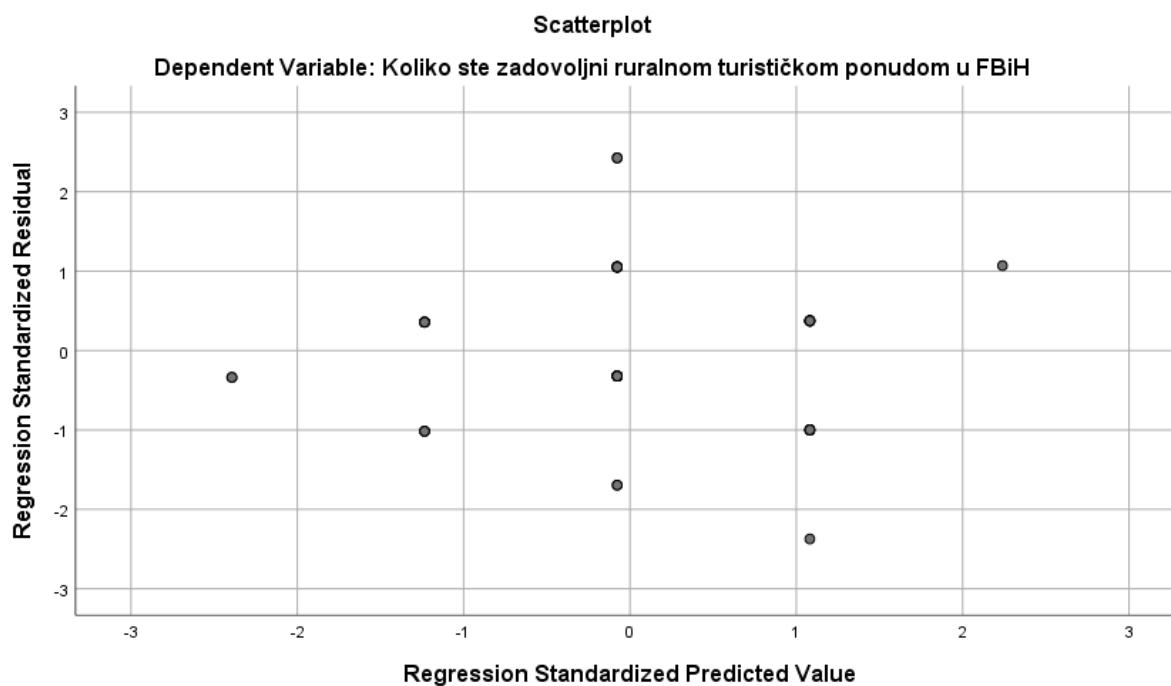
In order to additionally examine the quality of the model and make a final judgment on the acceptance/rejection of the hypothesis, additional tests of the statistical validity of the model were performed. Thus, the histogram shows the normal distribution of the data (graph 1.), while the scatterplot indicates the linearity of the model without the presence of heteroskedasticity (graph 2.).

Graph 1.: Histogram



Source: Independent work of the author

Graph 2.: Scatterplot



Source: Independent work of the author

Based on the results of the method of least squares and additional statistical tests of the quality of the model, it can be concluded that the hypothesis is accepted, the development of rural tourism in FBiH affects the degree of satisfaction of tourists in FBiH.

With that, on the basis of table 3. (regression coefficients), the following regression equation of the model can be written:

$$Y = 0,752 + 0,494X$$

and which can be interpreted as a unit increase in the rating of rural tourism development in FBiH, increases by approximately one rating and the degree of satisfaction of tourists in FBiH.

Table 3: Regression coefficients

		Coefficients ^a									
		Unstandardized Coefficients		Standardized Coefficients			Correlations			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.752	.405		1.858	.070					
	How would you rate the development of rural tourism in FBiH?	.494	.127	.510	3.885	.000	.510	.510	.510	1.000	1.000

a. Dependent Variable: How satisfied are you with the rural tourism offer in FBiH

Source: Independent work of the author

5. CONCLUSION

Tourism is one of the driving forces of global economic growth. Due to this, it is not surprising that the travel and tourism industry is one of the most competitive in the world. As tourism continues to be developed in rural areas in order to counter the economic decline in the primary production sectors, the need for sustainable forms of development is recognized. Rural tourism development has been driven by the need for economic growth and diversification and it gives many benefits to rural areas community. When tourists travel to rural areas, they support the local economy and helps in various way. Rural tourism could attract the tourists by providing an excellent glimpse of the village ambiance with local cuisine.

Within our hypothesis we put in relation the development and supply of rural tourism and satisfaction of tourists in the Federation of Bosnia and Herzegovina. According to this the questionnaire research technique was used to collect data and to make some important conclusions and observations. The conducted research showed that in 62.2% of cases, tourists are satisfied and absolutely satisfied with the rural tourist offer in FBiH (cumulative percentage). Among ethnic villages in FBiH, tourists like the natural resources that are represented in them the most (31.1%). In addition to the natural resources, tourists are also satisfied with the food and the friendliness of the staff. According to the survey results, the degree of development of rural tourism in FBiH is good in 46.7% of cases, very good 17,8% and excellent in 4,4% of cases. The hypothesis was tested using the method of least squares within the SPSS statistical software package. It is confirmed that the correlation coefficient is 51%, which means that there is a moderately strong relationship between the satisfaction of tourists in FBiH and the level of development of rural tourism. We need some improvements in this area if we want more satisfied tourists: legal framework, better infrastructure, higher quality of tourist products and services, building employee competencies and using rural resources in the right way. We should be aware that satisfied tourists will promote our potential and bring higher level of local economic development.

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R5

IMPLEMENTATION OF IPARD FUNDS IN SERBIA: ANALYSIS OF THE CURRENT STATE AND PERSPECTIVE OF RURAL DEVELOPMENT

Abstract: The IPARD is a key financial mechanism of the European Union aimed at improving agriculture and rural development in candidate countries and potential candidates for EU membership. The aim of this work is to analyze the current implementation of IPARD funds in Serbia, with a special focus on the efficiency of using available funds, institutional capacities and obstacles in the implementation of the program. The research is based on the analysis of relevant strategies and reports on the implementation of IPARD measures. The results show that the key challenges in the implementation of IPARD in Serbia are complex administrative requirements, insufficient information of potential beneficiaries, and the slowness of the approval and disbursement procedures. On the other hand, IPARD funds enabled the modernization of agricultural holdings and the development of rural infrastructure, which indicates their significant potential for long-term sustainable rural development. The conclusions of the work provide recommendations for improving the efficiency of the IPARD program in Serbia, including simplifying administrative procedures, strengthening technical support for users and increasing the transparency of the funding allocation process. These steps are key to maximizing the benefits that IPARD funds can bring to Serbian agriculture and rural areas in the EU accession process.

Keywords: IPARD funds, rural development, agriculture, EU integration, Serbia

1. INTRODUCTION

The process of European integration in Serbia includes reforms in various sectors, where agriculture and rural development are of particular importance, given the large share of agriculture in the country's economy. According to Erjavec et al. (2021), the EU Common Agricultural Policy (CAP) represents the benchmark for future policy of Serbia, so pressures of the EU accession negotiations, as well as EU pre-accession support will be the key elements in the process of adapting policies to the CAP. Looking at the time, the creators of the Rural Development Assistance (RDA) in EU are moving away from strict income support and agriculture towards supporting producers through environmental schemes and rural development measures. It is necessary to emphasize that the budget reduction for the EU's 2021-

2027 programming period will primarily affect the reduction of funds for the second pillar of the Rural Development Assistance (RDA), i.e. rural development measures, while the priority remains on direct income support (the first pillar of the Rural Development Assistance); with an increasingly significant role for agri-environment-climate schemes, whereby it will be possible to allocate certain funds from income support to environmental measures (Matthews, 2018). Rural development policy remains focused on three main axes, defined as: farm competitiveness, environmental protection and climate action, and improving infrastructure and quality of life in rural areas. The goal of the agricultural policy of Serbia in the future should be to increase the share of funds for rural development, which should have a dominant share of the agricultural budget after EU accession. Pre-accession assistance is important for candidate countries for membership, given that they are economically less developed than EU members. These funds are particularly important for countries that have a high relative importance of agriculture and rural areas in the overall economy, with the candidate country having to effectively establish and implement rural development strategies at national, regional and local levels.

One of the most important areas of agricultural policy in the EU accession process is the implementation of the Instrument for Pre-Accession Assistance in Rural Development (IPARD). **The aim** of this work is to analyze the current implementation of IPARD funds in Serbia, with a special focus on the efficiency of using available funds, institutional capacities and obstacles in the implementation of the program. The research is based on the analysis of relevant strategies and reports on the implementation of IPARD measures in Serbia. IPARD funds are focused on the development of the agricultural sector and rural areas, i.e. the aim is to prepare the candidate country for the effective implementation of the programmes under the European Agricultural Fund for Rural Development (EAFRD), after accession to the EU. Given that budget expenditures for the second pillar of support, i.e. for rural development, are still at a low level, the use of IPARD funds is extremely important for solving key problems of agriculture and rural development in Serbia. The European Commission (2020a) states that the spending of European funds from IPARD should be a priority to avoid the return of unused funds. That is, it is necessary to take advantage of the availability of these funds, primarily by establishing efficient institutions and directing them to as many beneficiaries as possible. The relevant institutions in Serbia responsible for the implementation of the IPARD program are: the Ministry of Finance in the function of the National Fund and the National Authorizing Officer; The Rural Development Sector of the Ministry of Agriculture, Forestry and Water Management in the role of the Managing Authority and the Agricultural Payments Administration as a body within the Ministry of Agriculture, Forestry and Water Management entrusted with the tasks of the IPARD Agency (Đurić, 2018).

The IPARD II Programme is the most important programme of pre-accession assistance for rural development and the first document in the field of agriculture and rural development of the Republic of Serbia approved by all European Union members in 2015. The main goal and purpose of this Programme is to support agricultural producers and processors, as well as population of rural areas in the Republic of Serbia, to gradually increase their capacities and potentials to prepare timely and properly for the fulfilment of the European standards in the field of agriculture, agri-food industry and environmental protection (Ministry of Agriculture, Forestry and Water management, 2024). The IPARD III in Serbia, for the period 2021-2027, was officially launched in 2023, when the first public calls for the allocation of funds were published. The program lasts until 2027 and brings improvements in administrative procedures and financial support, with the aim of more efficient modernization of Serbian agriculture and rural areas.

This scientific work is divided into several segments. After the introduction, a literature review is given, with a special focus on the importance and role of IPARD funds, as well as rural development strategies in EU countries. This is followed by the results, which show the success of the IPARD II in Serbia and identification of important factors of inefficiency in the use of these funds. Then, in the conclusion, list of the necessary steps for a more successful implementation of IPARD III is given.

2. LITERATURE REVIEW

Creating an appropriate rural policy in Serbia within the conditions of current European integration requires harmonization with the EU's CAP, which is one of Serbia's future priorities (Jurjević et al., 2021). According to Knickel et al. (2004), the European Commission describes the European agricultural model as: a modern and competitive agricultural sector, capable of taking a leading position in the world market, while maintaining domestic producers, living standards and income levels; a sustainable and efficient agricultural sector, which provides consumers with appropriate quality products, while protecting the environment; and a sector committed to preserving rural communities and maintaining their rich traditions and diversity. One of the future focuses of the CAP, as defined in the next programming period 2021-2027, will be on small farms and the environment by setting a target for small and medium-sized households to maintain a certain level of income in rural areas, together with sustainable resource management (Matthews, 2018). To achieve the targets, nine priorities have been set for the period 2021-2027 (European Commission, 2020a):

- Ensure income for farmers (reducing income disparities; reducing income variability; income sustainability in all sectors; contributing to territorial balance with a focus on areas with natural constraints).
- Improve market position and increase competitiveness (increased productivity, improved export/import of agri-food products).

- Improve farmers' position in the food supply chain (increased value added for primary producers in the food chain).
- Contribute to climate change mitigation with sustainable energy sources (reduced emissions from agriculture, increased soil organic carbon, increased renewable energy production).
- Sustainable development and efficient management of natural resources such as water, soil and air (reduced soil erosion, improved air and water quality).
- Protect biodiversity, improve ecosystems and preserve habitats and landscapes (increased bird populations (Farmland Bird Index), protection of biodiversity and ecosystem heterogeneity).
- Attracting young farmers to rural areas (generational renewal in rural areas).
- Promoting employment, social inclusion and local development in rural areas, including sustainable forestry (creation of new jobs, poverty reduction, infrastructure development).
- Protecting food quality and safety, health and animal health (reducing the use of antibiotics in agriculture, sustainable use of pesticides, adequately responding to the increasing demand for safe food).

These nine specific objectives are aimed at achieving the economic, environmental and sociological sustainability of agriculture and rural areas in the EU. CAP for the programming period 2021-2027 focuses on the environment and is potentially compatible with the EU Green Deal. The European Green Deal aims primarily to reduce greenhouse gas emissions by 2050, i.e. the agreement seeks to protect the health and well-being of citizens from environmental risks (Haines and Scheelbeek, 2020). Accordingly, the European Commission and the European Parliament plan to finance EUR 387 billion over the next 7 years through CAP, so that farmers can meet the requirements defined under the EU Green Deal (European Commission, 2020b). In addition to a higher share of funds for environmental programmes, for the programming period 2001-2027 increased investments in knowledge, innovation and digitalisation in agriculture are foreseen, which will benefit farmers and rural communities (European Commission, 2020a). The new CAP reform also aims at increased flexibility and greater freedom in the allocation of funds for EU Member States, as well as simplified administration, where EU Member States will submit a single strategic plan, which is approved by the European Commission.

According to a study by the European Parliament, there are several rural development strategies: priority on measures to increase competitiveness (Axis 1), priority on environmental measures (Axis 2), a mixed approach of the first two axes with a greater focus on competitiveness, a mixed approach of the first two axes with a greater focus on the environment, a mix of the first two axes equally, a mixed approach with a focus on rural diversification (Axis 3); with a change in orientation in different EU countries between the two programming periods (2007-2013 and 2014-2020) (European Parliament, 2016). According to this study, the largest number of Member States that joined the EU before 2004 in both programming periods give priority to environmental measures, with several older Member States (Belgium, Germany, Denmark) with a mixed strategy from 2007-2013, but for the period of 2014-2020 they have moved to a strategy with more environmental protection measures. Southern countries (Spain and Portugal) have also given more priority to environmental measures, while Italy has changed its strategy in the opposite direction towards prioritizing measures to increase competitiveness (considering that Italy is a large country with regional disparities within the country). In large countries with regional disparities within the country, such as Italy, France, Germany, Spain, it is more appropriate to define the distribution of rural development funds at the regional level. Among the new EU Member States (accession after 2004), Poland has maintained a strategy that prioritizes the first axis (competitiveness), Slovakia has maintained a mixed approach of the first two axes with a stronger focus on the environment, and Estonia has maintained a mixed approach with a focus on rural diversification. Romania, Bulgaria and Latvia have switched from a mixed approach with a focus on rural diversification to a mixed approach with a focus on the environment, while Lithuania has switched from a priority on competitiveness to a mixed approach strategy with a stronger focus on rural diversification. The Czech Republic and Slovenia have chosen a strategy that prioritizes environmental measures for the 2014-2020 programming period.

The expansion of the EU to the east (to the CEE countries) has led to a deepening of regional differences, both in socio-economic issues and in agricultural models. All candidate countries for EU membership are entitled to financial assistance from Brussels to prepare for full membership in the Union as soon as possible (Janković, 2009). For example, for a more adequate accession of the CEE countries, the EU programs were launched in the late 1990s: Assistance for Restructuring their Economies (PHARE), Instrument for Structural Policies for Pre-Accession (ISPA), and Special Accession Programme for Agricultural and Rural Development (SAPARD), with the aim of preparing future members for economic reform, Cohesion Policy, or the CAP (Gorzelać, 2020). Bachtler and Ferry (2020) point out the importance of using these funds when CEE countries join the EU, identifying several different strategies that are implemented in these countries after accession: most of the funds go to the main, capital regions and eastern regions, to the detriment of the more developed western regions (Hungary and Poland); funds are directed to poor, peripheral and most often eastern regions (Slovenia and the Czech Republic); funds are distributed to poorly developed regions, poorly to financing capital regions (Slovakia, Romania and Bulgaria); funds are distributed evenly to regions with the capital city and other urban centres and peripheral, underdeveloped regions, i.e. across the entire territory (the Baltic model characteristic of Latvia, Lithuania and Estonia).

The European Commission began implementing the first program (PHARE) for assistance to candidate countries in 1989, with all aid funds being merged into the Instrument for Pre-Accession Assistance (IPA) from 2007 (Janković,

2009). IPA is a mechanism established to support democracy, the rule of law, public administration reform, economic reform, respect for human and minority rights, civil society, as well as regional and cross-border cooperation, with assistance being based on two groups of countries: candidate countries and potential candidate countries (Gjorgjeovski, 2008). IPA consists of 5 different components: Transition Assistance and Institution Building; Cross-Border Cooperation (with EU Member States and other countries eligible for the IPA programme); Regional Development (transport, environment, regional and economic development); Human Resources (strengthening human capacity and combating social exclusion) and Rural Development. The fifth component of IPA, IPARD aims to upgrade the agricultural sector and improve the quality of life in rural areas. Countries eligible for the IPARD program are required to prepare a national Rural Development Programme, which must include a description of the current situation, funding priorities, a presentation of financial resources and their sources, and a proposal for activities and measures within the projects (Janković, 2009). Recipient countries have the option of choosing measures, considering the specificities of the rural areas of each candidate country (Zekić, Matkovski, & Jurjević, 2016). IPARD is based on measures established by the European Commission (European Commission, 2020c):

- Investments in physical assets (facilities and machinery) in agricultural holdings (Measure 1).
- Support to agricultural associations (Measure 2).
- Investments in physical assets related to the processing and marketing of agricultural products, with the aim of achieving EU food safety and environmental protection standards (Measure 3).
- Agri-environment-climate measures and organic production (Measure 4).
- Implementation of local development strategies (LEADER approach) (Measure 5).
- Development of rural infrastructure (Measure 6).
- Diversification of agricultural holdings and business development (Measure 7).
- Training activity (Measure 8).
- Technical assistance in training, analysis, monitoring, capacity building and preparation of local action groups (Measure 9).

The financing of measures is defined depending on the program approved for a particular candidate country. For example, in early 2015, the European Commission adopted IPARD II for Serbia, with funds allocated to investments in physical assets of farms (Measure 1), investments in physical assets related to processing and marketing of agricultural products (Measure 3), diversification of agricultural farms and business development (Measure 7) and technical assistance (Zekić Matkovski, & Jurjević, 2016). Once the European Commission approves a particular program, it is further managed by national institutions (Managing Authority) responsible for writing the operational plan and selecting measures, and the national IPARD Agency, which is the most important institution in the use of funds, project implementation, and monitoring of the entire process (Vapa Tankosić & Stojavljević, 2014).

3. RESULTS AND DISCUSSION

Before 2012, when Serbia became a candidate for membership, i.e. from 2011 to 2013, two pilot measures were defined within IPARD, with the aim of preparing for the IPARD Programme after becoming a candidate. It was not until 2016 that the IPARD Programme for the Republic of Serbia for the period 2014-2020 was adopted, i.e. IPARD II, with a total planned budget of EUR 230,096,080 (of which EUR 175,000,000 EU contribution and EUR 55,096,080 national contribution) within which, based on national priorities, objectives and sectoral analyses, six measures were selected from the set of available measures (Zekić Matkovski, & Jurjević, 2016):

1. **Measure 1** - Investments in physical assets of agricultural holdings (planned approximately 44% of the total IPARD II budget).
2. **Measure 3** - Investments in physical assets related to the processing and marketing of agricultural products (planned approximately 35% of the total IPARD II budget).
3. **Measure 4** - Agri-environmental-climate measures and organic production measures (planned approximately 5% of the total IPARD II budget).
4. **Measure 5** - Implementation of local rural development strategies - LEADER approach (planned around 3% of the total IPARD II budget).
5. **Measure 7** - Diversification of agricultural holdings and business development (planned around 10% of the total IPARD II budget).
6. **Measure 9** - Technical assistance (planned around 3% of the total IPARD II budget).

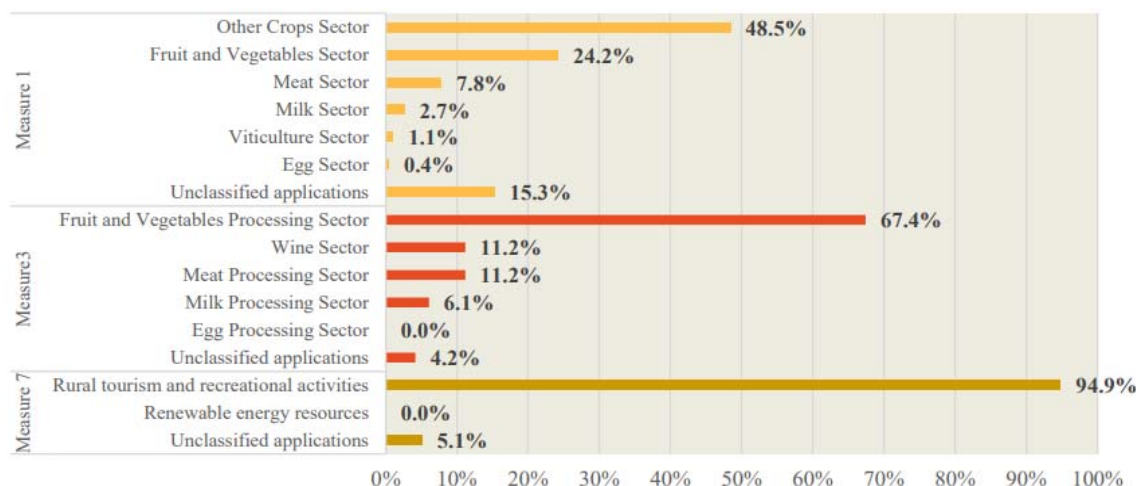
According to the financial plan of the IPARD (IPARD program za Republiku Srbiju za period 2014–2020. Godine, 2016) for the period 2014-2020 it is defined that for Measures 1 and 3 the EU contribution is 75% of the total funds, while the national contribution is 25%, with the following sectors eligible for Measure 1: the milk, meat, eggs, fruit and vegetables, viticulture and other crops (cereals, oilseeds and sugar beet) sectors; and for Measure 3: the milk, meat, eggs, fruit and vegetable processing sectors, as well as wine. According to the Annual Report on the Implementation of IPARD for the period 2018-2019, it is defined that (Sector for Rural Development, 2020):

- The largest number of applications submitted for Measure 1 is within the other crops sector, namely cereals, with the largest number of applications related to the procurement of tractors (69%), while other investment

groups have a smaller share (14% for equipment and mechanization excluding tractors, 7% construction of storage facilities).

- The largest number of applications submitted for Measure 3 is within the fruit and vegetable sector, with 36% of applications for the modernization of processing and packaging equipment and 25% of applications for the construction/reconstruction/modernization of processing facilities.

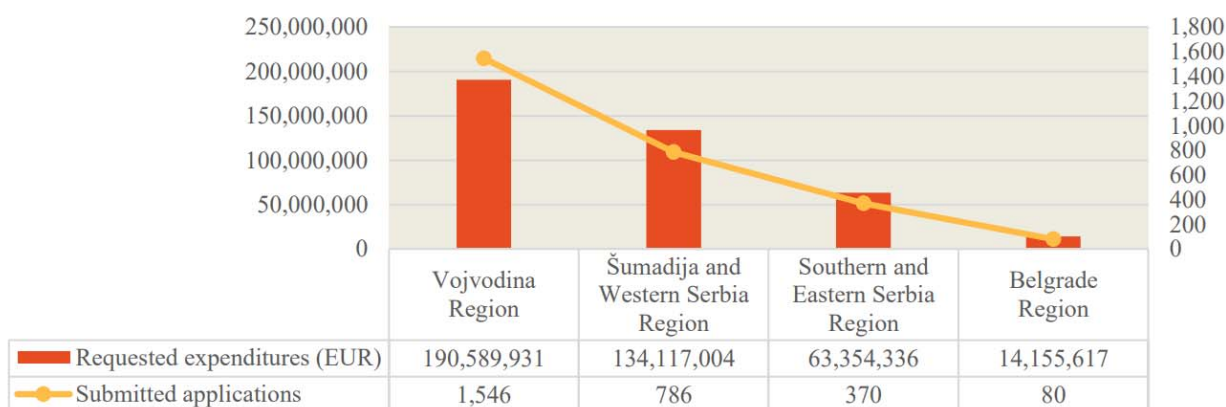
Until December 2023, 15 calls were published, namely: seven for Measure 1, with a total allocated EU contribution in the amount of EUR 111.2 million, four for Measure 3, with total allocated funds in the amount of EUR 81.5 million, two for Measure 7, with total allocated funds in the amount of EUR 26.3 million and two for non-investment Measure 9: Technical Assistance in the total amount of EUR 986,327 (Ministry of Agriculture, Forestry and Water management, 2024).



Picture 1: Structure of submitted IPARD II applications per sector (%)

Source: Ministry of Agriculture, Forestry and Water management, 2024

Regarding regional distribution, the Vojvodina Region is dominant both in terms of the number of submitted IPARD applications (1,546 applications, i.e. 55.6%), and in terms of requested public expenditures (EUR 190.6 million, i.e. 47.4%) (Picture 2).



Picture 2: Submitted IPARD applications and requested expenditures per region

Source: Ministry of Agriculture, Forestry and Water management, 2024

Measure 4 and Measure 5, i.e. Agri-environmental-climate measures and organic production measures and Implementation of local rural development strategies, have been left for the next period of implementation of the IPARD. Harmonization of the agricultural policy of Serbia and the CAP should move towards increasing funds for agri-environmental measures. Within the framework of IPARD, a certain part of the funds will be financed for Measure 4, primarily aimed at organic production. Although there are noticeable changes in the framework of Serbia's rural development policy towards harmonization with the CAP, there is a lack of clear intention to reform the policy in line with support for Areas facing Natural Constraints (ANCs) and the LEADER approach (Volk et al., 2017). Accordingly, the importance of IPARD funds for Measure 5 - Implementation of local rural development strategies is highlighted. Activities on the implementation of LEADER in Serbia started in previous years, i.e. from 2011 to 2013, through the project "Capacity Building for the Establishment and Implementation of LEADER in Serbia", within which the creation of 24 potential Local Action Groups (LAGs) was supported (Bogdanov, 2018). Today, activities on the implementation

of this approach will initially be supported under Measure 9 - Technical Assistance, to acquire the skills of potential local action groups and develop local development strategies. Realization of IPARD supports records a continuous increasing tendency during Programme implementation on an annual basis. The lowest amount of support was paid in 2019 (EUR 4.6 million), and in each subsequent year a larger amount of total IPARD support was paid compared to the previous. The largest amount of EU support was paid in 2023, which represents an increase in the total amount of paid IPARD support compared to the previous year by 82.2% (Table 1).

Table 1: Execution of the Program budget for completed projects, cumulative

Measure	Realization of EU support (EUR)						Target value 2014-2020 (EUR)	Execution rate (%)
	2018	2019	2020	2021	2022	2023		
						a	b	c=(a/b)
Measure 1	0	4,577,520	6,645,922	15,581,227	24,808,136	49,074,599	88,322,473	55.6
Measure 3	0	0	3,043,987	6,221,997	10,628,933	14,903,271	43,461,806	34.3
Measure 7	0	0	0	0	0	586,282	26,200,000	2.2
Measure 9	0	0	0	0	0	0	500,000	0.0
Total	0	4,577,520	9,689,909	21,803,224	35,437,069	64,564,152	158,484,280	40.7

Source: Ministry of Agriculture, Forestry and Water management, 2024

The European Commission in its reports most often states that the most common reasons for the underutilization of IPARD funds are the unpreparedness of local governments, both in terms of infrastructure and human resources (primarily advisory services), given that rural development policy is created at the national level, but implemented at the local level (Đurić, 2018). Also, Volk et al. (2017) state that rural development policy in the region (Western Balkans) has not taken root, despite the occasional adoption of certain projects and programs, primarily due to modest funds, as well as the direction of these funds towards investment in agriculture, in addition to the insufficient adaptation of IPARD to real needs in Serbia. Also, the experience gained in the IPARD II implementation will have a positive impact in the implementation of the IPARD for the programming period 2021-2027 (IPARD III).

4. CONCLUSION

The insufficient use of IPARD funds, even if a small share for financing the second pillar of support within the agricultural budget of Serbia, further hinders the development of rural areas in Serbia. In addition, within the framework of rural development measures, funds are mostly allocated for investment measures in the agricultural holdings, while agri-environmental measures, investment in rural infrastructure or diversification of activities are financed to a minimal extent. Of course, IPARD funds cannot solve all the problems of agriculture and rural areas in Serbia, because a systemic solution requires a national, long-term strategy for the development of these areas, with a significant increase in the funds of the national, agricultural budget. However, the IPARD project enables a more adequate harmonization of Serbia's agricultural policy with the CAP, whereby it should move in the direction of increasing funds for rural development, with a greater focus on the environment and natural resources being imposed as the future direction of agricultural policy.

Given its importance, in the future it is necessary to strengthen the institutions for implementing the IPARD fund programs for preparing documentation, implementation, assistance in applying for certain calls, etc. It is necessary to improve the efficiency of the IPARD Programme in Serbia, including simplifying administrative procedures, strengthening technical support for users and increasing the transparency of the funding allocation process. Given the competitiveness of the agricultural sector, it is difficult to expect a shift in Serbia's agricultural policy towards environmental protection programs, which are dominant in highly developed countries, whose agriculture is competitive and at an adequate technological level of development. Also, the EU's rural policy insists on supporting young people and their families, which aims to keep young people in rural areas. Large rural-urban migration in Serbia should indicate the need to change agricultural policy measures, i.e. to direct more funds towards young people in rural areas.

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DIGITAL TRANSFORMATION OF FINANCIAL SERVICES: GLOBAL AND REGIONAL ASPECTS

Abstract: The digitalization of financial services, which is rapidly expanding, brings numerous changes through mobile banking, digital payments, and fintech innovations. The aim of this paper is to analyze global and regional trends and their application in Serbia. The study utilized secondary source analysis and a comparative method. The results indicate growth in digital services, accompanied by various regulatory and user trust challenges. Further development depends on regulatory support and digital education.

Keywords: Digitalization, financial services, fintech, regulatory challenges, user trust

1. INTRODUCTION

During the last two decades, the international financial system has undergone profound structural changes, which have significantly redefined global, regional and local flows in financial services. The growth of international financial flows, stimulated by the liberalization and privatization of financial markets, has changed the business conditions and the basic principles of market functioning at the global level (Vesić, Nikolić & Cogoljev, 2019).

Digital transformation encompasses a wide range of changes, including the digitization of all aspects of business, and by this is meant the transition from traditional to digital work models. The basic elements of this process are the application of data analytics, which enables financial institutions to better understand the needs and behavior of users, as well as the automation of business processes and user experience, which directly affects business efficiency. An essential part of the digital transformation is the implementation of digital payments, which provide users with faster, simpler and more secure transactions. The importance of digital transformation is reflected in its potential to enable financial institutions to improve the services they offer, reduce operating costs and gain a competitive advantage in the market.

One of the most important changes in this process is digital transformation and the development of Internet technologies, which have significantly affected the financial sector. In the Balkans and Serbia, these changes have accelerated the introduction of modern technologies, such as mobile banking, digital payments and fintech innovations. Digital transformation enabled faster and more economical money transfer, improved the quality of financial services and increased the availability of financial tools to users throughout the region (Vasić, Srebro & Cvetković, 2023).

At the global level, digitization implies the integration of information and communication technologies into financial processes, while at the regional level, as is the case with Serbia and the Balkans, it represents a key factor in the modernization of the financial sector. These technologies bring not only improvements in efficiency and productivity, but also significant changes in organizational structures, work skills and ways of doing business. However, the specificities of the market in the region, such as legislative challenges and the level of digital literacy, still represent key obstacles in further implementation. The paper will present key aspects of the digitalization of the financial sector, such as mobile banking, digital payments and the application of new technologies, as well as the challenges facing the region, including regulatory barriers, digital literacy and user trust.

2. LITERATURE REVIEW

Today's business environment is characterized by dynamic and rapid transformations, which are the result of the continuous development of technology and the increasing application of knowledge about its use. Technological innovations do not stay only in the sphere of information and communication technologies, but are gradually integrated into other areas of the economy and society. This process has a particularly strong impact on finance and financial services, where digitization brings changes in business models, user expectations and operational efficiency, redefining the basic principles of business in this sector (Stojanović, 2017).

The digital transformation of financial services began with the digitization of monthly reports, enabling paperless business. This process laid the foundation for further development, where financial institutions significantly expanded and deepened their offerings through digital delivery channels. In order to maintain a competitive edge and respond to increasingly complex market demands, financial institutions of all sizes are faced with the need to continuously improve their digital maturity. This process involves not only tactical projects focused on user experience in front offices, but also strategic investments in back-office processes and technological infrastructure. Such investments enable deeper business transformation, increase efficiency, reduce costs and ensure long-term development of digital solutions in the financial services sector (Zelenović & Mijatović-Dukić, 2019).

Technological innovations in financial services have had the greatest impact on payments and money transfers. They contributed to the strengthening of the trend of moving from traditional cash payments to various forms of electronic and mobile payments, as well as to the further development of card systems, including technologies such as PayPass, Gcas and mPOS. Services have been significantly improved through the wider use of ATM and POS devices, which enable quick and practical access. Technological progress has brought about the development of additional channels of communication and services, for example contact centers and SMS notifications, which has influenced the greater availability and accessibility of financial services for users. This advancement is not only changing the way financial institutions do business, but also transforming the daily experience of users, adapting to their needs for faster, safer and more convenient solutions (Dragišić, 2022).

The adoption of new technologies and digitization by financial institutions has brought significant benefits to their operations. These technologies have made it possible to increase benefits and wealth through more efficient management of resources and the provision of advanced services to clients. In addition, investments encouraged innovation and diversification of the offer, while the use of modern technologies contributed to the reduction of information asymmetries between financial institutions and their users. The needs of users of financial services have changed very quickly with the tendency of further change, which implies that there is an increased influence of these technologies on different layers of users of these services (Deutsche Bank, 2020).

As technology advances rapidly, numerous new opportunities are opening up, because through the Internet, users around the world and mobile networks connect faster and more efficiently, integrating into a single global market. This process of digital connectivity enabled the rapid expansion of the field of application of digital technologies in the financial sector. The result is the creation of a wide network of opportunities that enable financial institutions to improve business processes, introduce innovative services and better connect with clients (Kozarević & Ibrić, 2022).

3. GLOBAL TRENDS IN DIGITALIZATION OF FINANCIAL SERVICES

Digital technologies and modern information systems are key factors in the development of financial services and institutions, as they enable the implementation of innovative business models. In the context of the financial sector, these technologies not only enable faster, cheaper and more efficient transactions, but also play a significant role in differentiating banks, insurance companies and other financial institutions in the market (Čelik, 2020).

With the help of digital solutions, financial institutions can provide personalized services to their customers, improve the customer experience, as well as optimize internal processes, such as data analytics and risk management. Also, the application of modern information systems enables greater security in transactions, reduces the possibility of fraud and improves user confidence, which is crucial for establishing a competitive advantage in the market.

Digitization plays a key role in the transformation of the financial sector, as it enables financial institutions to provide services that are faster, more efficient and more accessible to users. In the banking sector, these technologies have enabled numerous innovations that have improved the quality and variety of financial services, increasing banks' competitiveness in the market.

One of the significant innovations was the introduction of automatic speaking machines, which enabled faster and easier interaction with clients. Credit and debit cards, as well as different types of loans, enabled users to have easier access to money and faster transactions. Also, innovations in the transfer of funds, such as electronic transfers, have improved the way in which international and domestic transactions are made (Mirković & Lukić, 2015). Some financial institutions have already introduced digital forms of financial instruments and assets, such as digital currencies, electronic transfers and online lending, which have significantly changed the way the money market works. For example, digital currencies like Bitcoin or stablecoins, as well as other blockchain technologies, enable faster, safer and cheaper transactions, thus

reducing costs for financial institutions and users (Malyshev, 2023). For the sake of illustration, a brief overview of the key aspects of digitalization of the financial sector at the global and regional level is provided.

Table 1: Overview of key aspects of digitalization in the financial sector at the global and regional level

Category	Description	Source
Productivity Growth Driven by Digitalization	A 10% increase in the level of digitalization in the financial sector is associated with an average productivity growth of 0.1 percentage points, with stronger effects in industries rich in intangible capital.	OECD, Digitalisation of Financial Services and Economic Performance, 2022
Access to Finance for SMEs	Digitalization facilitates better credit allocation and reduces credit constraints for small and medium-sized enterprises (SMEs), directly contributing to a more inclusive financial system.	OECD, Digitalisation of Financial Services and Economic Performance, 2022
Development of Advanced Technologies	Innovations such as Artificial Intelligence (AI), blockchain technology, and automation reduce data processing costs and increase operational efficiency in financial institutions.	BIS, The Future of Payments, 2022
Digital Maturity of Banking Institutions	Banks in the Southeast European region exhibit varying levels of digital maturity; leading institutions are introducing globally competitive digital services, while the average level of development remains lower.	Deloitte, Digital Banking Maturity Study, 2022
Regional Trends	Northern Europe leads in digital maturity and implementation of digital services in the banking sector, while Southeast Europe shows significant growth in this segment in recent years.	Deloitte, Digital Banking Maturity Study,

Source: Author's Research

Data from the OECD, BIS and Deloitte indicate that digitalization has a positive impact on productivity, improves access to finance for SMEs, and reduces operational costs through the application of advanced technologies such as artificial intelligence, blockchain and automation. In addition, an analysis of the digital maturity of banking institutions and regional trends shows a clear differentiation in the rapid adoption of digital solutions, with Northern Europe leading the way, while South-Eastern Europe has made significant progress in recent years. These trends clearly demonstrate how digitalization is shaping the global financial sector, as well as its evolution in regional markets.

The digital transformation of financial services brings both advantages and challenges. On the one hand, digitalization enables greater efficiency, faster services and increases the competitive advantage of financial institutions. Key aspects of this process include online cash loans, mobile banking and the development of digital payments, which are becoming more accessible and secure. Digitization also carries certain risks, such as data theft, fraudulent activities, money laundering and hacker attacks. These challenges require constant improvement of security systems and regulatory framework. In this sense, the application of modern technologies, such as artificial intelligence and cloud computing, enables better auditing, risk management and business compliance (Milanović, 2022). The digital transformation of financial services not only changes the way financial institutions operate, but also affects the development of the entire economy and financial system, making them more adaptable and resistant to future challenges.

4. THE IMPACT OF DIGITALIZATION ON THE FINANCIAL SERVICES SECTOR IN SERBIA

Digitization has profoundly transformed many aspects of our daily lives, and its impact is particularly pronounced in the financial sector. In Serbia, as in other countries, digital technologies have redefined the way financial institutions function and interact with users. In Serbia, digitization has enabled the growth of electronic payments and the development of innovative solutions, such as mobile applications for account management, online lending and advanced security systems for the protection of user data. Also, digitization has encouraged the growth of efficiency and

transparency of financial institutions, enabled better access to financial products and services, as well as improved user experience. A brief overview of examples of digitization of the financial sector in Serbia is provided:

1. Introduction of the Instant Payment System (IPS) by the National Bank of Serbia (NBS) - The National Bank of Serbia has implemented the Instant Payment System (IPS), enabling the transfer of funds between payment participants in real time, 24 hours a day, 7 days a week. This system allows users to make payments quickly and efficiently, regardless of the time or day of the week (<https://nbs.rs/sr/ciljevi-i-funkcije/platni-sistem/nbs-operator/ips-nbs/>);
2. Development of electronic and mobile banking - Banks in Serbia have significantly improved their electronic and mobile platforms, enabling clients to access various services such as checking account balances, transferring funds, paying bills and managing finances via the Internet or mobile applications. These services became especially important during the COVID-19 pandemic, when the need for digital channels of communication and transactions increased;
3. Digitization of the loan approval process - Some banks in Serbia have implemented digital platforms that allow clients to apply for a loan, submit the necessary documentation and monitor the status of their request completely online, without the need to physically come to the bank. This reduces application processing time and increases the efficiency of the loan approval process;
4. Implementation of contactless payment cards - Banks in Serbia have introduced contactless payment cards that allow users to make payments simply by touching the card to the POS terminal, without the need for physical contact or entering a PIN for smaller amounts. This technology increases the speed and security of transactions, which is especially important in the context of reducing physical contact during the pandemic (Živković & Vojinović, 2018).

In the context of digitalization of financial services, mobile and internet banking are key channels for performing payment transactions. We will present data on the number of users of these services in Serbia for the period of 2023 and 2024. The data were obtained from the statistical database of the National Bank of Serbia.

Table 2: Number of users by type of specific payment services (internet payment and mobile payment) in 2023.

	Reporting period (quarter)			
Type of service	I trimester	II trimester	III trimester	IV trimester
Internet payment	3.785.112	3.823.484	3.999.511	4.093.621
Mobile payment	3.494.654	3.657.691	3.866.868	4.044.357

Source: Author's Research

Based on the available data, an analysis of the change in the number of users for two types of payment services was performed: internet payment and mobile payment, in the period of 2023 and 2024, through three-month reporting periods.

Internet payment - 2023. year

The number of users in the second quarter increased by 1.01% compared to the first quarter. In the third quarter of the same year, a growth of 4.60% was recorded. During the 4th quarter, growth slowed to 2.35%

Mobile payment – 2023

During the second quarter, the number of users increased by 4.67%. In the third quarter, the growth was 5.72%, and during the last fourth quarter, the growth decreased to 4.59%.

Internet payment - 2024. year

In the second quarter, a growth of 1.65% was recorded. During the third quarter, growth increased to 2.06%, and in the fourth quarter of the observed year, a slight decrease was recorded to 1.91%.

Mobile payment – 2024

In the second quarter of the observed year, a growth of 2.61% was recorded. During the 3rd quarter, the growth was 3.78%, and in the 4th quarter there was a certain slowdown to 3.44%.

By comparing the number of users between 2023 and 2024, growth is observed in all quarters for both types of services during 2024. The number of internet payment users in the first quarter of 2024 is higher by 9.97% compared to the same quarter of 2023, while in the case of mobile payments, this growth is as much as 19.62%. In the second quarter, the number of internet payment users increased by 10.66% compared to the same period of the previous year, while the increase in mobile payment was 17.27%. In the 3rd quarter of 2024, internet payment recorded a growth of 7.97%, while mobile payment grew by 15.12%. In the 4th quarter of 2024, internet payment has an increase of 7.50% compared to the 4th quarter of 2023, while mobile payment grows by 13.86%. The number of mobile payment users is growing at a faster pace than internet payment. Also, growth was more pronounced at the beginning of the year, while it slowed down towards the end of the year.

What is noticeable is that the impact of digitization on the financial sector in Serbia is specific and characterized by challenges, such as the need to adjust the regulatory framework, increasing user trust in digital platforms, as well as continuous improvement of employees' digital skills. It is necessary to emphasize that when it comes to further development and progress in the sphere of digitization of financial services and the financial system in Serbia, it is the improvement of the security of digital transactions, the development of open banking where a step has already been

taken by the adoption of the Law on Amendments to the Law on Payment Services and more adequate support for fintech innovations.

CONCLUSION

Digital transformation is an inevitable process that significantly contributes to improving the competitiveness and efficiency of the financial sector. The use of advanced technologies enables the modernization of financial services, improves customer experience and facilitates business operations. The implementation of digital solutions plays a key role in creating a stable and innovative financial system, which not only supports economic growth, but also responds to the increasingly complex demands of the market and users.

Modern digitized financial institutions are increasingly adapting their business models to the needs of clients, instead of basing them exclusively on product categories. By focusing on customer segments, they enable personalized services, faster availability of financial products and more efficient interaction with users. This approach not only improves customer experience, but also contributes to greater customer loyalty and competitive advantage in the market.

Financial institutions, regardless of their size, are faced with the imperative to continuously improve their digital maturity. This entails strategic investments in modernizing back office operations and technology infrastructure, not just in initiatives that improve user experience at the surface level. An efficiently digitized back office enables faster data processing, greater operational efficiency, more secure transactions and compliance with regulatory requirements. Only through a holistic approach to digital transformation can financial institutions achieve long-term competitive advantage and ensure market stability.

Digitization of financial services in Serbia is becoming an increasingly important factor in improving the efficiency and availability of banking and payment services. Innovations in the financial technology sector, including automated processes and advanced analytical tools, enable faster data processing, cost optimization and improved customer experience. In addition, regulation in Serbia increasingly follows global trends in digital transformation, thereby additionally ensuring the safety and stability of digital financial operations. It is expected that the further modernization of digital services will contribute to greater inclusion of the population in the financial system and stimulate economic growth.

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CURRENT TRENDS IN SUPPLY CHAIN MANAGEMENT

Abstract: Modern companies must manage their supply chain to ensure efficiency, cost reduction, customer satisfaction, and overall profitability. In the past 15 years, revolutionary changes have occurred in the field of information technology that have inevitably influenced the development of supply chain management. Having that in mind the main goal of the paper is to identify perspectives and issues discussed in the area of Supply Chain Management. The authors analyzed abstracts of research papers registered in the Scopus database in the period 2010–2025. Latent Dirichlet Allocation Analysis was used in the analysis of abstracts of research papers. All calculations were conducted using programs prepared in the Python language. The paper analyzes the most significant topics identified in the published research papers.

Keywords: Supply chain management, Scopus, Latent Dirichlet Allocation Analysis, Topics.

1. INTRODUCTION

The supply process is a crucial aspect of every enterprise, as its efficiency directly affects the overall efficiency of the company. Additionally, its costs significantly impact on the final product's pricing, thereby influencing its competitiveness in the market. Supply chain disruptions within a company are almost certain to affect the production of final products, and the impact can extend further, leading to supply issues for other companies in the role of buyers.

The supply chain represents the flow of materials (raw materials, semi-finished goods, and final products), information, money, and services from raw material suppliers, through manufacturers, to warehouses and end customers. It encompasses the entire life cycle of a product or service. The material flow refers to the movement of materials from suppliers to consumers or in the reverse direction in the case of reverse logistics. The information flow involves the transfer of detailed data among supply chain members, such as order details, customer information, order fulfillment, and delivery status. The financial flow includes payment transfers and financial arrangements such as payment schedules, credit terms, and electronic fund transfers. (Turban et al., 2018)

Supply chains today are becoming increasingly complex, as companies have multiple suppliers and customers across various locations, presenting challenges for decision-makers. The digital transformation of operations and supply chain management offers a potential solution to these challenges. Companies must undergo the digitalization of their business processes to remain competitive, with real-time monitoring, visibility, and automation playing a key role in this transformation. The digitalization of operational management and supply chain management requires advanced technology and capabilities. (Baycik & Gowda, 2024) Industry 4.0 technologies such as blockchain, IoT, Big Data analytics, and artificial intelligence are emerging as potential solutions that are being increasingly applied in these processes. (Al-Okaily et al., 2024; Culot, Podrecca, & Nassimbeni, 2024)

The main advantages of blockchain technology in SCM include enhanced traceability, more efficient product deliveries, improved coordination among companies, increased product security and safety, better quality control and management practices, and reduced illegal counterfeiting. (Agrawal et al., 2024; Al-Okaily et al., 2024; Raj et al., 2024; Sahoo et al., 2024) Artificial intelligence can significantly impact various supply chain management functions by improving operational efficiency, performance, and sustainability. By utilizing AI technologies such as big data analytics, manufacturers can enhance resource efficiency, product customization, predictive maintenance, and production process optimization. (Patalas-Maliszewska, Szmolda, & Łosyk, 2024; Shahzadi et al., 2024) The use of IoT technology in industrial applications leads to more efficient production processes, better communication between operators and machines, and improved quality control while reducing losses. IoT technology can enhance tracking and visibility in supply chains. (Al-Okaily et al., 2024)

Considering all these technologies, which have undeniably found application in supply chain management, the authors set the objective of their research to identify the most significant topics in SCM over the past 15 years. To achieve this goal, the authors will analyze the abstracts of research papers indexed in the Scopus database from 2010 to 2025 and answer the following research questions:

- RQ1: What research topics were raised during the period analyzed, and how has interest in the identified topics evolved over time?
- RQ2: What is the connection between the identified research topics?

A Latent Dirichlet Allocation (LDA) analysis will be performed on the dataset of abstracts from the Scopus database within the defined period.

2. RESEARCH METHOD - LATENT DIRICHLET ALLOCATION ANALYSIS

Latent Dirichlet Allocation (LDA) is a classical method for topic identification in large sets of textual documents represented in the form of frequency matrix. It was proposed in Blei et al. (2003) LDA methods try to identify a user-defined number of topics in an unsupervised learning process, where a frequency matrix is used as the learning set. Recognized topics are described by distribution over words and are represented the Φ matrix:

$$\Phi = \begin{bmatrix} \phi_{1,1} & \dots & \phi_{1,LV} \\ \dots & \dots & \dots \\ \phi_{LT,1} & \dots & \phi_{LT,LV} \end{bmatrix}$$

Where:

- $\phi_{i,j}$ is a probability of occurrence of the j -th word in the i -th topic,
- LT is a number of topics,
- LV is a number of unique words appearing in all analysed documents.

It is assumed that the i -th row of the Φ matrix is a random variable taken from the Dirichlet distribution (it means that every $\phi_{i,j} \in [0;1]$ and that $\sum_{j=1}^{LV} \phi_{i,j} = 1$).

After topic recognition, every document may be presented as a mixture of identified topics. The structure of the whole corpus of the documents is defined in the Θ matrix:

$$\Theta = \begin{bmatrix} \theta_{1,1} & \dots & \theta_{1,LT} \\ \dots & \dots & \dots \\ \theta_{LD,1} & \dots & \theta_{LD,LT} \end{bmatrix}$$

Where:

- $\theta_{i,j}$ is a probability of occurrence of the j -th topic in the i -th document,
- LT is a number of topics,
- LD is a number of documents.

Rows of θ matrix have Dirichlet distribution (therefore every $\theta_{i,j} \in [0; 1]$ and that $\sum_{j=1}^{LT} \theta_{i,j} = 1$).

Usually, Gibbs sampling method is used for estimation Φ and θ matrices (Heinrich, 2005). LDA model has generative character. It means that having Φ and θ matrices new documents can be created. However, it should be considered that during generation, a frequency matrix representing new documents is created, not the documents themselves.

3. RESULTS - MAIN TOPICS IN THE AREA OF SUPPLY CHAIN MANAGEMENT

Below are 15 topics (figure 1, 2 and 3) in the area of supply chain management along with the words that most frequently appear within each topic. In the first topic (topic 1, figure 1), the most mentioned words are logistics, business, and management, which is not surprising since Supply Chain Management is often associated with logistics management within business. The next second topic includes research, management, and literature. The second topic (topic 2, figure 1) is likely formed based on articles that provide a literature review, many of which exist. Sustainability is a current topic in many fields, including Supply Chain Management, which forms the third topic (topic 3, figure 1) that includes the words sustainability, study, and practice. The fourth topic (topic 4, figure 1) includes the words risk, supplier, and decision, and refers to risks associated with decision-making within the supplier segment. The next, fifth topic (topic 5, figure 1) includes technology, data, and information, as modern supply chain management cannot be imagined without modern information technologies for storing/managing data from which information is derived. This can further be expanded to system and network, which, together with the word model, form the sixth topic (topic 6, figure 1).

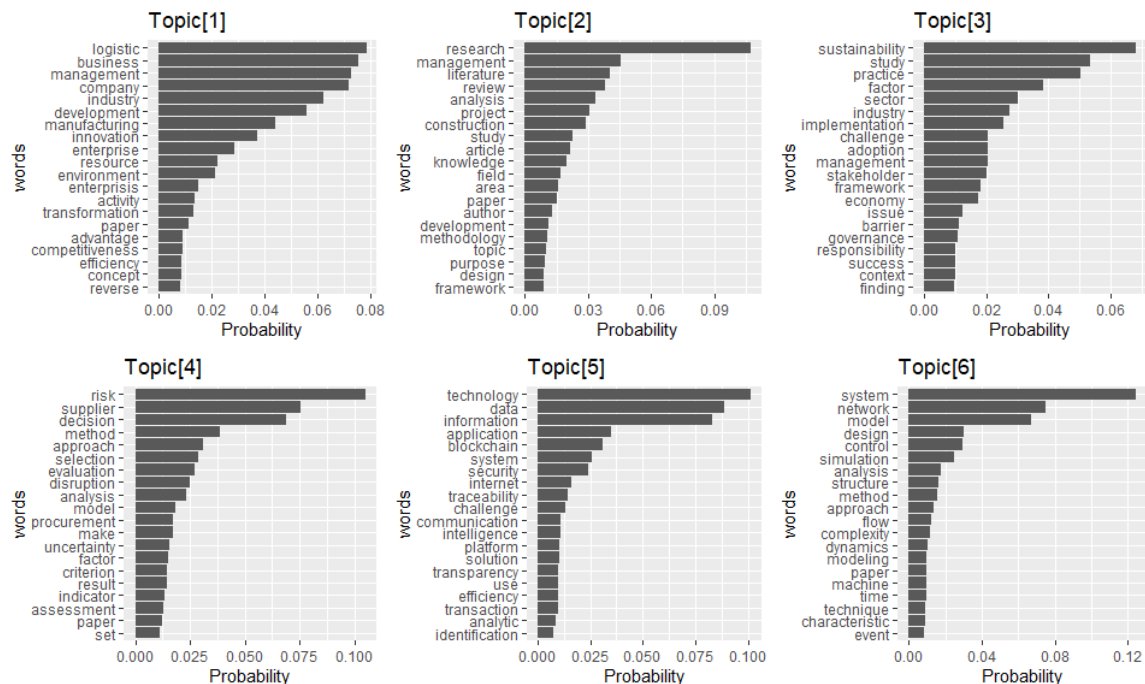


Figure 1: Topics 1 to 6
Source: the authors

The next, seventh topic (topic 7, figure 2) is formed by the most frequent words energy, waste, and production. If we look at the other words that follow, it can be concluded that this topic is formed based on the need to manage energy loss within production and environmental protection management. The eighth topic (topic 8, figure 2) includes the words supply and chain. The ninth topic (topic 9, figure 2) refers to manufacturers, distributors, and prices, which is an important component of the supply chain. The problems of forming a cost model for the supply chain, especially the consumption of inventory and time, form the tenth topic (topic 10, figure 2). The eleventh topic (topic 11, figure 2) includes the words food, water, and production. Then, as the twelfth topic (topic 12, figure 2), a supply chain management strategy appears.

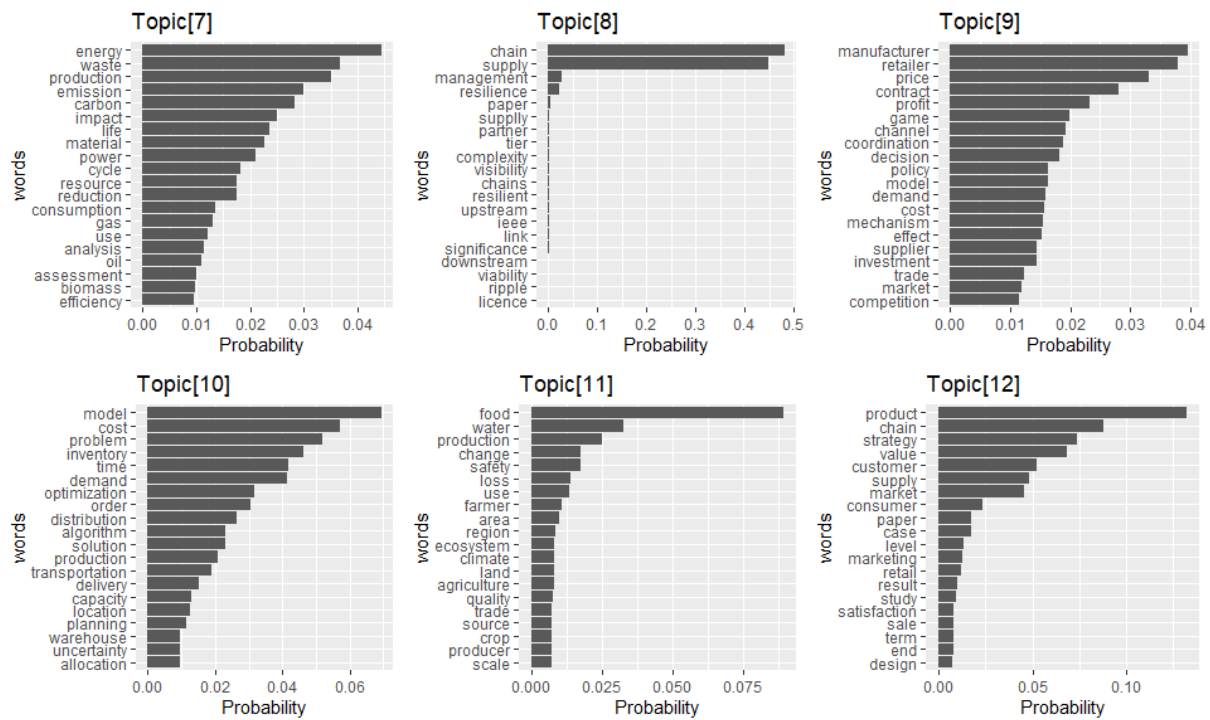


Figure 2: Topics 7 to 12
Source: the authors

The thirteenth topic (topic 13, figure 3) mainly includes the words performance, study, and relationship. The recent COVID pandemic influenced an increase in research related to the pandemic itself, so the fourteenth topic (topic 14, figure 3) includes the words health, COVID, and country. Process service management is an important segment of supply chain management, and these words form the final fifteenth topic (topic 15, figure 3).

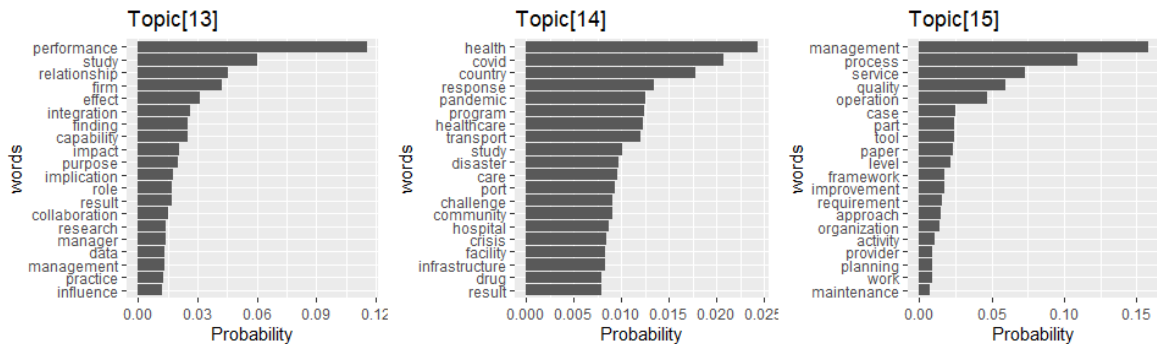


Figure 3: Topics 13 to 15
Source: the authors

In the following figure (figure 4), the significance of topics over the years is shown. Of course, the dominant topic throughout the past 15 years has been theme number 8, which contains the themes supply, chain and management. The topic 3, which includes themes such as sustainability, study, and practice, and topic 5 (with themes technology, data and information) has become increasingly popular over the past three years. Additionally, topic 14, which includes health and COVID, was relevant during the COVID outbreak years, but not before or after.

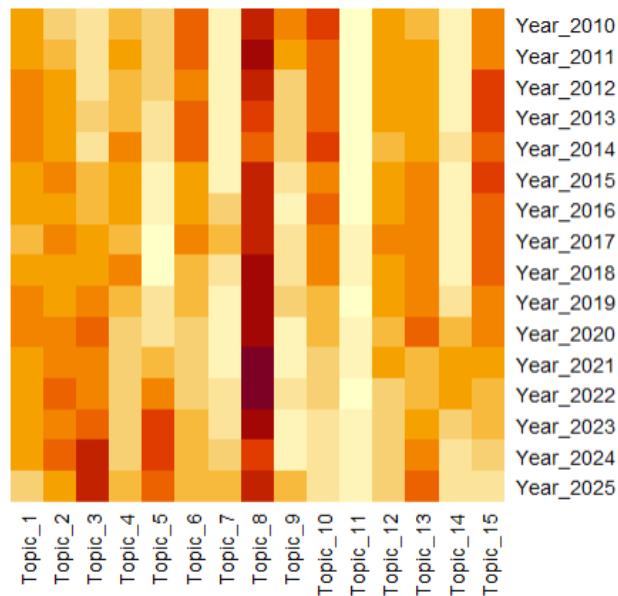


Figure 4: significance of topics over the years
Source: the authors

Figure 5 shows the connection between individual topics. This analysis also indicates that topic 8 (supply, chain and management) is connected to the most other topics (topics 1, 2, 3, 4, 5, 9, 10 and 13). It can also be seen that topics 8 and 9 (manufacturer, retailer and price) have strong connection. Additionally, topic 13 (performance, study and relationship) is strongly connected to topic 3 (sustainability, study and practice).

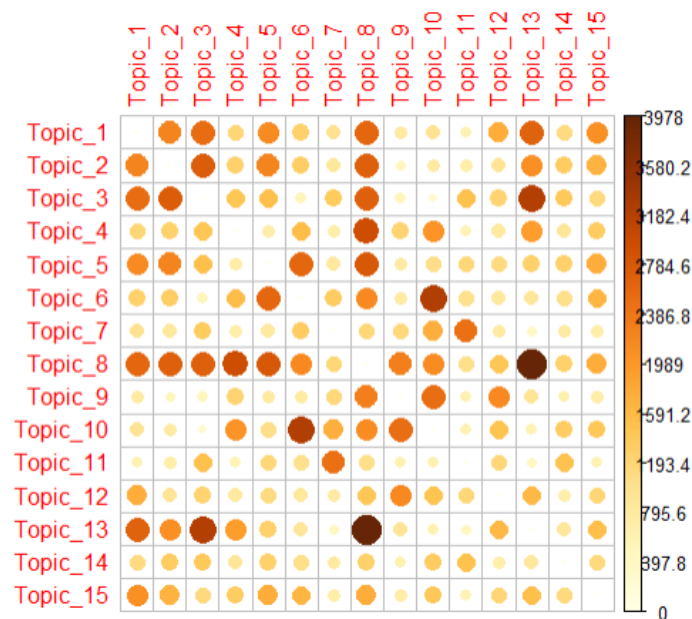


Figure 5: Connection between individual topics
Source: the authors

CONCLUSIONS

Information technology has been changing the world in various spheres for decades. Supply chain management has also not remained immune to the emergence of different technologies, particularly those belonging to the set of Industry 4.0 technologies. To identify key trends in supply chain management over the past 15 years, a study was conducted through a literature analysis using Latent Dirichlet Allocation Analysis on a dataset obtained from the SCOPUS indexed database of scientific papers.

The analysis results yielded 15 topics with the greatest relevance for practice and theory. These topics were formed in a way that includes the most frequently occurring words within each topic, making them a relevant input for identifying current research themes in the scientific community. In addition to the identified topics, the research findings also highlight the significance of certain topics over the past 15 years, as well as the interconnections between specific topics, which may also serve as indicators for future research.

A limitation of the conducted study is the exclusive use of a single citation database of scientific papers. For future research in the field of supply chain management, the authors will use the presented results and select one of the topics to continue further research.

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ARTIFICIAL INTELLIGENCE IN BUSINESS – FROM BASICS TO IMPLEMENTATION: A WORKSHOP AGENDA FOR MANAGERS

Abstract: This paper presents a comprehensive analysis of the syllabus for a two-day executive workshop titled "Artificial Intelligence in Business – From Basics to Implementation". Developed for middle and senior-level managers, the syllabus is designed as a structured and practical guide for understanding, adopting, and managing AI technologies within various business environments. It offers a step-by-step approach to AI integration, combining foundational knowledge with applied learning, tailored specifically to decision-makers who are responsible for driving innovation and organizational change. The workshop agenda covers a range of key topics, including the basic principles of AI, its capabilities and limitations, and the most relevant legal and ethical frameworks — such as the EU AI Act, GDPR, and emerging global standards. In addition, the syllabus emphasizes AI governance, risk management, and responsible use of AI tools. Through interactive sessions and case-based learning, participants are introduced to practical tools like ChatGPT, Copilot, Midjourney, and Jasper, with hands-on opportunities to explore their application in domains such as operations, finance, marketing, HR, and product development. A special focus is placed on guiding managers through the process of preparing their teams and organizations for AI-driven transformation. The syllabus includes frameworks for change management, strategies for overcoming internal resistance, and methodologies for aligning AI tools with business goals. The final part of the workshop explores the future of AI and its expected impact over the next 1, 5, and 10 years, encouraging participants to build forward-looking strategies. By analyzing the content, structure, and intended outcomes of the workshop syllabus, this paper contributes to the ongoing discussion on how to effectively educate business leaders in the age of AI. The syllabus is presented as a replicable and adaptable model for executive training, with the potential to accelerate responsible and strategic AI adoption across industries.

Keywords: AI workshop syllabus, artificial intelligence, business transformation, AI governance, strategic management, digital tools, executive training

1. INTRODUCTION

How can we design an effective and practical AI workshop syllabus that prepares business leaders to face the challenges of the AI era? This paper addresses that very question by presenting the structure, logic, and goals of a two-day executive workshop titled "Artificial Intelligence in Business – From Basics to Implementation." The workshop is aimed at middle and senior-level managers and is built around a carefully developed syllabus that combines foundational AI knowledge, legal and ethical frameworks, practical exercises, and future-oriented strategy building.

As Artificial Intelligence (AI) continues to reshape industries and redefine how decisions are made, organizations increasingly expect their leadership to drive innovation, efficiency, and transformation through data and algorithms. However, despite growing AI adoption, many decision-makers lack a structured framework to understand and lead AI-driven initiatives effectively (Bughin et al., 2018; Davenport & Ronanki, 2018). Research shows that successful digital transformation depends not just on technology, but on capable leadership, cross-functional collaboration, and a strategic vision (Westerman et al., 2020).

The syllabus presented in this paper is positioned as more than just a training agenda — it is a strategic blueprint for AI capacity building within organizations. It blends conceptual learning with real-world application and includes critical themes such as AI governance, GDPR compliance, organizational readiness, change management, and applied innovation. Participants are guided through interactive sessions using tools like ChatGPT, Copilot, and Jasper, while also developing their own AI integration strategies tailored to their business environment.

By outlining the content, structure, and rationale of this syllabus, the paper contributes to the ongoing conversation on how to equip business leaders for responsible and forward-looking AI adoption. The proposed format can serve as a replicable model for executive education in AI across industries.

2. THEORETICAL BACKGROUND

The design of a syllabus for executive education in artificial intelligence must be grounded in a clear understanding of the strategic, organizational, and regulatory contexts in which AI operates. Numerous studies have highlighted a persistent gap between the technical capabilities of AI and the actual readiness of organizations to implement it effectively (Peric, 2023; Tanasijevic, 2022). Bridging this gap requires more than access to technology — it requires a new type of leadership, strategic literacy, and cultural readiness.

AI governance frameworks, such as the European Union's **AI Act**, **GDPR**, and the **Ethics Guidelines for Trustworthy AI** (European Commission, 2021), emphasize transparency, fairness, accountability, and risk management. These frameworks are essential references when designing content for a workshop syllabus that aims to foster responsible implementation in real business environments.

The theoretical foundation for this syllabus draws from three major domains: **strategic management**, **change management**, and **digital transformation**. These principles help structure the learning outcomes and define how participants will engage with AI both conceptually and operationally. Institutions like **MIT Sloan School of Management** and **INSEAD** have pioneered executive programs that blend these areas with AI-specific knowledge, confirming the importance of a multidisciplinary and application-driven approach. Recent literature and reports further underline the urgency and opportunity of equipping business leaders with AI knowledge. Harvard Business School Online (2024) identifies the development of an AI strategy as a core competency for long-term competitiveness. In the legal domain, Business Insider (2025) documents how firms are under pressure to adopt AI tools for efficiency and risk reduction. IBM (2024) stresses governance and internal alignment as central components of successful AI projects, while Microsoft (2024) offers concrete pathways for SMEs to begin implementation. On the operational side, Financial Times (2025) reports that AI is already being used to reduce theft and improve logistics in the retail sector.

Taken together, these sources shape the theoretical grounding for the proposed workshop syllabus — not only in terms of **what topics must be included**, but also in defining **how they are delivered, to whom, and with what expected impact**. The goal is to ensure that the syllabus supports managers not just in understanding AI, but in applying it confidently and ethically within their specific business contexts.

3. WORKSHOP STRUCTURE AGENDA

The workshop is structured as a two-day, 16-hour program, designed to provide a balanced combination of theoretical understanding, case-based discussion, practical tool usage, and strategic planning. Each session builds progressively on the previous one, guiding participants from foundational awareness of AI concepts toward applied thinking and personalized implementation strategies.

The structure of the workshop syllabus reflects the theoretical principles discussed in the previous section. It integrates key elements from strategic management (e.g., goal alignment, competitive advantage), change management (e.g., stakeholder engagement, overcoming resistance), and digital transformation (e.g., technology adoption cycles, organizational agility). These principles are woven into the agenda through interactive formats, peer collaboration, real-world examples, and scenario-based simulations.

The daily agenda follows a logical sequence that helps participants move from **understanding** to **action**:

- **Day 1** is focused on understanding the nature of AI, correcting misconceptions, exploring governance and ethics, and experimenting with tools that improve productivity and operational efficiency. The day concludes with an analysis of AI's impact across business functions.
- **Day 2** shifts toward decision-making, product and service innovation, organizational preparation, and future thinking. Managers are encouraged to design AI implementation strategies relevant to their contexts, considering both immediate actions and long-term adaptation.

Each session is crafted to include a mix of short lectures, live demonstrations, group work, and feedback-driven tasks. Participants are encouraged to reflect on their own companies, share experiences with peers, and leave with a concrete action plan.

In total, the agenda includes **8 sessions**, each 90 minutes long, with appropriate breaks and time for networking. By the end of the workshop, participants are expected to have not only gained new knowledge but also developed a personalized roadmap for AI adoption within their organizational roles.

3.1. Day 1: Understanding AI and Its Business Applications

The first day of the workshop is designed to build a foundational understanding of Artificial Intelligence, correct common misconceptions, and establish a responsible and business-relevant perspective on AI technologies. The agenda follows a logical flow from conceptual awareness to hands-on tool exposure and sector-specific applications.

Table 1: Syllabus – Day 1

Time	Session Title	Focus Areas
09:00 – 10:30	Interactive Kickoff: Debunking AI Myths	AI capabilities vs limitations, myths, live polls, exercises
10:45 – 12:15	AI Governance, Ethics, and Legal Aspects	EU AI Act, GDPR, bias, case studies, group discussions
13:45 – 15:15	Practical AI Tools for Managers	Tool demos, AI for automation/analytics, group exercises
15:30 – 17:00	Sectoral Impact of AI	Industry case analysis (HR, marketing, finance, operations)

Source: Author

3.1.1. Interactive Kickoff: Debunking AI Myths

This session is designed to challenge and correct common misconceptions about AI. Participants begin by identifying myths they have encountered in their industries, such as "AI will replace all human jobs" or "AI is always objective." These are contrasted with real-world limitations and capabilities of current AI technologies.

Interactive polling tools are used to engage participants, followed by facilitated discussion to align perceptions with facts. This exercise builds psychological readiness and opens space for critical thinking, which is essential before engaging with more technical or strategic content (Davenport & Ronanki, 2018).

3.1.2. AI Governance, Ethics, and Legal Aspects

This session explores the key frameworks that guide responsible AI implementation. It introduces participants to the **EU AI Act**, the **GDPR**, and the **AI Bill of Rights**, focusing on principles such as transparency, fairness, and accountability. Through case studies and discussion groups, participants examine dilemmas around bias in hiring algorithms or data privacy in customer service automation. These scenarios help them understand the real-world impact of AI regulation and ethics, aligning with the European Commission's Ethics Guidelines for Trustworthy AI (2021) and IBM (2024) guidance on AI governance.

3.1.3. Practical AI Tools for Managers

In this hands-on session, participants engage with a curated set of AI tools relevant for business managers. Tools like **Jasper** (text generation), **Midjourney** (creative content), and **ChatGPT** (knowledge assistance and automation) are demonstrated in live scenarios.

Participants are then divided into groups and tasked with choosing a tool, testing its potential use in a business context, and reflecting on its value and risks. This session emphasizes usability, creativity, and critical thinking in tool adoption — echoing the need for "AI literacy" in management, as highlighted by Harvard Business Review (2023).

3.1.4. Sectoral Impact of AI

The final session of the day explores how AI is already transforming key business functions. Case examples are presented from HR (resume screening), marketing (customer segmentation), finance (fraud detection), and customer support (chatbots).

Participants work in roundtable groups by sector, analyze a case, and then present how AI might enhance or disrupt their current workflows. This format not only contextualizes AI adoption but also encourages cross-sectoral learning — a method used in programs at INSEAD and MIT Sloan (Westerman et al., 2020).

3.2. Day 2: Implementing AI and Future Strategy

The second day of the workshop builds on the foundational understanding from Day 1 and shifts the focus toward strategic implementation and forward-looking leadership. Participants are guided through data-driven decision-making, innovation in AI-driven products and services, organizational readiness, and anticipating future shifts in the business landscape.

Table 2: Syllabus – Day 2

Time	Session Title	Focus Areas
09:00 – 10:30	AI in Strategic Decision-Making	Predictive modeling, simulations, business intelligence
10:45 – 12:15	AI in Product, Service, and Advisory Innovation	AI in CX and design, creative group work on AI-powered solutions
13:45 – 15:15	Preparing Teams for AI Transition	Change management, upskilling, overcoming resistance
15:30 – 17:00	Future of AI: 1, 5, and 10-Year Outlook	AI trends, labor market impact, strategic foresight

Source: Author

3.2.1. AI in Strategic Decision-Making

This session introduces participants to the use of AI in enhancing strategic decision-making. Using tools such as Power BI, Tableau, and Excel with AI plugins (e.g., Copilot), managers learn how predictive modeling and business intelligence can improve planning and operational outcomes.

Participants engage in data-driven simulations based on real-world business scenarios, helping them understand how to evaluate risk, detect trends, and optimize resource allocation. As highlighted by Davenport & Ronanki (2018), AI's value lies not only in automation but in augmenting executive judgment.

3.2.2. AI in Product, Service, and Advisory Innovation

This creative session explores how AI can drive innovation in both customer experience and internal advisory services. Participants work in teams to ideate new product or service concepts powered by AI — using tools like ChatGPT for prototyping and DALL-E or Midjourney for design inputs.

By the end of the session, each group presents a concept that integrates AI into a business value proposition. This exercise is grounded in design thinking methodology and encourages cross-functional creativity — an approach aligned with current innovation practices in leading tech firms (Harvard Business School Online, 2024).

3.2.3. Preparing Teams for AI Transition

Organizational readiness is often a bottleneck in successful AI implementation. This session introduces participants to practical frameworks for managing change and upskilling teams. Drawing on change management theory and real company examples, participants develop an internal action plan that includes training, communication strategies, and resistance mitigation.

Harvard Business Review (2023) emphasizes that organizations successful in AI adoption focus heavily on internal capability-building and clear leadership narratives. This session helps participants translate those insights into concrete, organization-specific plans.

3.2.4. Future of AI: 1, 5, and 10-Year Outlook

The final session looks ahead. Participants are introduced to macro-level trends in AI, such as the evolution of generative AI, labor market disruptions, and the emergence of hybrid human-AI roles. Using foresight techniques, participants explore scenarios for the future of their industry.

A moderated discussion and expert panel (live or recorded) help synthesize insights and encourage strategic visioning. This closing session reinforces the mindset that AI is not a one-off initiative, but a long-term transformational force (Bughin et al., 2018; IBM, 2024).

4. WORKSHOP DELIVERY APPROACH

The workshop is designed using a blended learning approach tailored for executive audiences. It combines structured content delivery, experiential learning, and collaborative problem-solving — all mapped to the practical needs of managers leading or supporting AI adoption within their organizations.

The methodological design draws on contemporary practices in executive education, including action-based learning, peer coaching, tool-based experimentation, and structured reflection. This aligns with recent findings that emphasize interactive and applied formats as the most effective for adult learners in complex domains like AI (Westerman et al., 2020; Harvard Business Review, 2023; Ransbotham et al., 2022).

The delivery format is built around five main components:

- **Short lectures for theoretical framing** - These provide the foundational understanding needed to engage with AI in a business context. Each topic begins with a concise lecture (15–20 minutes) supported by visuals and business examples to clarify abstract concepts such as governance models, algorithmic bias, or strategy frameworks. The goal is to equip participants with just enough theory to support further hands-on learning, following the "explain-show-do" model (Salas et al., 2022).
- **Interactive activities (polls, Q&A, group discussions)**
To maintain engagement and provoke critical thinking, sessions regularly include live polls, open-ended questions, and moderated group conversations. These are used to surface participant assumptions, contrast perspectives, and contextualize content within different industries. According to LinkedIn Learning (2023), executive learners retain more when encouraged to contribute personal experience.
- **Case studies from diverse industries** - Each day includes structured case discussions based on real examples from finance, healthcare, logistics, or consulting sectors. Participants analyze how AI was applied, what barriers were encountered, and what outcomes were achieved. Case-based learning encourages cross-sectoral thinking and has been shown to improve strategic decision-making in executive contexts (IESE Business School, 2023).
- **Hands-on testing of AI tools (e.g., ChatGPT, Jasper, Midjourney)** Rather than discussing tools abstractly, participants are invited to experiment with a curated set of AI tools using predefined business tasks. For example, they generate a product pitch using Jasper, analyze a client scenario using ChatGPT, or co-design a social media visual using Midjourney. This segment builds confidence and skills for tool integration — a step that is often missing in theoretical programs (McKinsey & Company, 2024).
- **Action planning and peer feedback sessions** The final portion of each day is dedicated to applying learned concepts to participants' own business contexts. Using structured templates, they outline how AI could be introduced in their domain, what challenges they foresee, and what support they would need. Plans are peer-reviewed in groups, which encourages accountability and collective learning. This approach supports transfer of knowledge into real change initiatives (Deloitte, 2024).

This multi-method approach ensures the learning experience is **not only informative but also immediately applicable**, allowing participants to leave the workshop with both insight and implementation direction. By aligning content, delivery style, and participant experience, the workshop adheres to the best practices of executive development in dynamic technological domains.

5. EXPECTED OUTCOMES

The expected outcomes of the workshop are aligned with its learning objectives, pedagogical design, and executive audience profile. They are formulated to ensure that participants not only acquire knowledge, but also develop applicable strategies, tools, and mindsets for AI-driven transformation in their specific organizational contexts. Each outcome is measurable, actionable, and relevant to the role of a manager or business leader.

5.1 Foundational understanding of AI principles

Participants will gain a clear conceptual understanding of how AI systems function, including their capabilities, limitations, and business relevance. This foundation allows them to evaluate AI initiatives with critical thinking, and to participate in technical discussions with confidence and clarity.

5.2 Practical application of AI tools in daily management

Managers will learn how to integrate tools such as ChatGPT, Jasper, Copilot, and Midjourney into their workflow for tasks like content creation, analysis, communication, or ideation. Practical application is key to overcoming resistance and building internal momentum for broader AI adoption (McKinsey & Company, 2024).

5.3 Awareness of ethical and regulatory considerations

Through exposure to GDPR, the EU AI Act, and real-world ethical dilemmas, participants will be able to identify and address the legal, reputational, and societal risks associated with AI use. This aligns with current expectations for AI accountability and responsible leadership (European Commission, 2021; IBM, 2024).

5.4 Development of a personal or organizational AI adoption plan

Each participant will leave the workshop with a draft roadmap for implementing AI in their team, department, or company. This includes identifying business priorities, tools, barriers, and change enablers. The plans are peer-reviewed and refined during the sessions, ensuring practical value.

5.5 Insight into future AI trends and labor market shifts

The final session provides a strategic foresight lens on how AI will likely reshape the workplace, business models, and leadership over the next 1, 5, and 10 years. Participants will be better prepared to anticipate disruption, reskill teams, and lead through uncertainty (Harvard Business Review, 2023; Financial Times, 2025).

6. CONCLUSION

Artificial Intelligence is no longer a distant technological possibility — it has become a central force in shaping business strategy, operations, and leadership. In this context, the capacity of managers to understand, evaluate, and implement AI solutions is not optional, but critical.

This paper has presented a detailed syllabus for a two-day executive workshop designed to address the practical and strategic needs of middle and senior-level managers. Through a carefully structured combination of theoretical framing, applied tools, interactive methods, and scenario-based learning, the syllabus equips participants with the mindset and methodology required to lead AI initiatives within their organizations.

The structure of the workshop reflects current research and best practices in executive education, with emphasis on responsible AI use, regulatory compliance, and long-term strategic thinking. By integrating content across business functions and combining it with industry-relevant examples and hands-on exploration, the workshop provides both clarity and confidence to its participants.

As a model, this syllabus is scalable and adaptable — it can be implemented across different industries, cultural contexts, and organizational sizes. Moreover, it contributes to the broader conversation about how to bridge the gap between technical innovation and business leadership through targeted, action-oriented education. In a time of accelerating AI adoption and growing societal expectations for ethical and effective use of technology, such educational formats are not only useful — they are essential.

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SOFTWARE ENGINEERING - KNOWLEDGE AREA - SOFTWARE MAINTENANCE: ANALYSIS OF THE LOGISTICS OF BUSINESS SERVICES OF THE E-CITIZEN SYSTEM

Abstract: The knowledge area of software maintenance is related to all other aspects of software engineering and because knowledge area description applies to all other knowledge area of software engineering, in this research paper we made analyses the logistics of business services of the Croatian e-citizen system, focusing on the knowledge area and user satisfaction with recommendations for improvement. Our analyses the logistics of business services of the Croatian e-citizen system, focusing on the post-delivery phase. Post-delivery activities of the Croatian e-citizen system include software monitoring, modification, training, and working with or liaising with the help desk. Software operation and maintenance support activities of the Croatian e-citizen system are performed during the pre-delivery phase and during the post-delivery phase. Pre-delivery activities of the Croatian e-citizen system include planning post-delivery operations, maintainability, and determining the logistical support required to transition from development to maintenance. The research aims to determine the extent to which Croatian e-citizen system, as a digital public administration service, meets logistics and user needs and identifies the business managerial challenges they face. In the first part of the research, we provide an overview of the theoretical framework of e-government and the digitalization of public services, with a short analysis of examples from other EU countries and region near Croatia (with examination the logistic and development of the Croatian e-citizen system in detail, including its functionality and usage statistics). In the second part of the research, which is empirical part of the research, we made analyses the logistics of business services of the Croatian e-citizen system, focusing on the knowledge area and user satisfaction with recommendations for improvement. Analytical results, about the logistics of business services of the Croatian e-citizen system, show that most of users recognize the importance of the Croatian e-citizen system for modernizing public administration but point out shortcomings in the intuitiveness of the user interface and limited-service integration. Based on these findings, several measures are proposed to improve the logistics of business services of the Croatian e-citizen system and enhance user satisfaction.

Keywords: Croatian e-citizen system, knowledge area of software maintenance, logistics of business services, user experience

1. INTRODUCTION

In this research about the software engineering, in knowledge area we focus our research interest in specific research area related to software maintenance, concretely in specific analysis of the logistics of business services of the e-citizen system in Croatia. According to the "SWEBOK Guide ver. 4.0" edited by Washizaki (2024) referring to projects and approaches

of software engineering, or knowledge area and software maintenance and according to research named “Managing IT projects: building a body of knowledge in IT project management” edited by Perera and Eadie (2021), software maintenance is defined as the totality of activities required to provide cost-effective support for software in operation. Software operation and maintenance support activities are performed during the pre-delivery phase and during the post-delivery phase. Pre-delivery activities include planning post-delivery operations, maintainability, and determining the logistical support required to transition from development to maintenance. Post-delivery activities include software monitoring, modification, training, and working with or liaising with the help desk. The knowledge area (KA) of software maintenance (SM) is related to all other aspects of software engineering. This description of KA applies to all other KAs for software engineering in relatively new guide edited by Washizaki (2024). The knowledge area of software maintenance is related to all other aspects of software engineering and because knowledge area description applies to all other knowledge area of software engineering, in this research paper we made analyses the logistics of business services of the Croatian e-citizen system, focusing on the knowledge area and user satisfaction with recommendations for improvement. Our analyses the logistics of business services of the Croatian e-citizen system, focusing on the post-delivery phase. Post-delivery activities of the Croatian e-citizen system include software monitoring, modification, training, and working with or liaising with the help desk. Software operation and maintenance support activities of the Croatian e-citizen system are performed during the pre-delivery phase and during the post-delivery phase. Pre-delivery activities of the Croatian e-citizen system include planning post-delivery operations, maintainability, and determining the logistical support required to transition from development to maintenance. The research aims to determine the extent to which Croatian e-citizen system, as a digital public administration service, meets logistics and user needs and identifies the business managerial challenges they face. In the first part of the research, we provide an overview of the theoretical framework of e-government and the digitalization of public services, with a short analysis of examples from other EU countries and region near Croatia (with examination the logistic and development of the Croatian e-citizen system in detail, including its functionality and usage statistics). In the second part of the research, which is empirical part of the research, we made analyses the logistics of business services of the Croatian e-citizen system, focusing on the knowledge area and user satisfaction with recommendations for improvement. Analytical results, about the logistics of business services of the Croatian e-citizen system, show that most of users recognize the importance of the Croatian e-citizen system for modernizing public administration but point out shortcomings in the intuitiveness of the user interface and limited-service integration. Based on these findings, several measures are proposed to improve the logistics of business services of the Croatian e-citizen system and enhance user satisfaction. The paper analyses the logistics model of e-Citizen’s system services with a focus on user satisfaction and recommendations for improvement. The research sought to determine to what extent e-Citizens, as a digital public administration service, logistically meets the needs of users and what challenges they face. Part of the research paper provides a brief overview of the theoretical framework for e-government and the digitalization of public services, along with an analysis of examples from other EU countries. The development of the e-Citizens system, its functionality, and statistical data on usage are very briefly analysed. The empirical part of the research paper includes a survey of user satisfaction with the e-Citizens system and its logistics services. The results mainly show that users recognize the importance of the system for the modernization of public administration but point to shortcomings in the intuitiveness of the user interface and limited integration of services. Based on these and other findings, specific measures were proposed to improve the logistics of services and the entire system to increase user satisfaction and direct the maintenance and development of the e-Citizens software. This work and research would analyse the logistics of business services of the e-citizen system (as a part of software engineering, knowledge area, software maintenance) in terms of whether the logistics of the service provides all the expected and sufficiently diverse services that can be useful to the majority of interested citizens, i.e. the respondents in this research, in general and in everyday life, and to verify the common opinion that citizens often do not use the aforementioned services due to their insufficient information or even their poor education as potential users of the e-Citizen system. This research paper analyses all the main features of the system perceived by the respondents, and additionally explores their experiences in using e-services and what are the suggestions of the respondents (citizens) as their users for improving the system in general and specifically for some of the segments of the e-Citizen system, that is very important for software maintenance, as part of software engineering, knowledge area (Dennis, & Wixom, 2000; World Bank, 2009; Malecki, 2002; Musa, & Đurman, 2016; Kovač, 2018; Frankiewicz, & Chamorro-Premuzic, 2020; Official Gazette, 2023).

2. RESEARCH PROBLEM, SUBJECT, GOALS, HYPOTHESES, METHODS

Despite the many advantages that the e-Citizens system offers, users continue to face various challenges and dissatisfactions. The research problem lies in identifying and understanding these challenges and in finding ways to eliminate them to improve the efficiency and acceptance of the system among citizens. One of the key problems is the logistical complexity of using the system. Although the system is designed to be intuitive, many users, especially the elderly population or those with a lower level of digital literacy, often have difficulty navigating and using different functionalities. This can result in frustration, giving up using the system and returning to traditional methods of interaction with public administration. Another problem lies in technical and logistical difficulties and possible unreliability of the system. Users often report problems with the logistical complexity of the system, especially accessing services, loading pages, or even technical failures that prevent the completion of necessary procedures. Such problems not only affect user

satisfaction but can also reduce citizens' trust in the system and public administration. Furthermore, users often face a lack of logistical support and a lack of information. In cases where they encounter a problem or have a question, they often do not have an easy way to get help or additional information. This can further increase frustration and reduce overall satisfaction with the system. The research problem also involves identifying differences in satisfaction among different groups of users. For example, satisfaction can vary depending on demographic characteristics such as age, education, digital literacy, and frequency of system use. Understanding these differences can help in adapting the system during software maintenance and system improvements, and for the system to better meet the needs of all users. It is also important to investigate how the current services of the e-Citizen system can be improved during software maintenance. This includes analysing user feedback and suggestions for improvement, as well as exploring best practices from other countries that have successfully implemented similar digital systems. The research problem focuses on identifying and addressing barriers that hinder users from fully and effectively using the e-Citizen system. By understanding and eliminating these problems during software maintenance, we are getting closer to the desired goal, which is: "to increase user satisfaction, improve system efficiency and encourage wider use of digital services in public administration, especially through the e-Citizens system". Through the analysis and recommendations that will emerge from this research, we hope to contribute to the creation of a more efficient, accessible and user-oriented e-Citizen's system. The subject of the research is the analysis of the logistical functionality and efficiency of the e-Citizens system, with an emphasis on user experience and satisfaction with the services offered by the system, with the aim of better software maintenance of the system. The e-Citizens system provides its users with access to numerous government and public services via the Internet. The work aims to examine how users experience these services, what are the recommendations for their use and where there are opportunities for improvement. The experimental part of the research is based on a survey conducted among users whose responses were analysed to collect data on their satisfaction, frequency and method of use, problems they encounter and suggestions for improving the system, through better logistical and software maintenance of the system. The objectives of the research work include the analytical identification of relevant literature and relevant e-content, etc. on the available e-services of the e-Citizens system, the analytical and comparative assessment of technical and other relevant characteristics and basic user interfaces, additional analytical research of the user experience, studying the diversity of user e-profiles, and assessing the overall logistical availability, with an analysis of the logistical and general efficiency of e-services, etc., and identifying the most common expectations and needs of users of the researched e-Citizens system. The research will propose specific recommendations for improving the system with the aim of increasing user satisfaction. The aim of the paper is to prove or disprove the given two hypotheses: Hypothesis 1: The e-Citizens system represents a positive step towards the digitalization of public administration, but the user interface is not intuitively designed, which makes it difficult to navigate and reduces user satisfaction; Hypothesis 2: The functionality of the e-Citizens system is limited due to insufficient integration of related systems, which does not give users access to comprehensive information and services. Main research questions (RQ) arise from the previously defined research objectives: (RQ 0) Demographic characteristics of the respondents? (RQ 1) How often do you use the services of the e-Citizens system? (RQ 2) How satisfied are you with your experience using the e-Citizens system? (RQ 3) How clear and intuitive is the user interface of the e-Citizens system? (RQ 4) Is the content and information on the system clearly written? (RQ 5) Are you concerned about data security when using the e-Citizens system? (RQ 6) Do you notice improvements in the system from the first use to today? (RQ 7) What level of credentials do they use to log in? (RQ 8) How would you rate the overall experience of using the e-Citizens system? (RQ 9) Please list at least one thing that you consider the most valuable or positive about using the e-Citizens system. (RQ 10) Please list at least one aspect of the e-Citizens system that you would like to improve. (RQ 11) Please list the 3 services that they use most often. (RQ 12) Do you use the m-Tax application? (RQ 13) How likely are you to refer a friend to use the e-Citizens system? This research paper used methods of data qualification collected from secondary sources such as books, scientific and professional articles, statistical reports, legal regulations and internet sources. The method of research and content analysis of relevant literature was applied, which provided a thorough insight into existing works, studies and documents related to e-Government, digitalization of public administration and the e-Citizens system. Furthermore, the pilot research method was used, which consisted of conducting an anonymous survey on the use of the e-Citizens system. In this way, data on user experiences and satisfaction and their suggestions for improving the system were collected first-hand. The modelling method was used to create conceptual models based on the collected data, while the methods of analysis and synthesis, including classical analysis, SWOT analysis were applied to identify the strengths and weaknesses of the e-Citizens system as well as opportunities for their improvement. Also, the methods of inference and hypothesis testing were used to confirm or reject assumptions. Finally, they apply statistical methods and analysis with the use of appropriate tools to quantitatively analyse the collected data from the survey and reach a conclusion based on objective indicators.

3. SWOT ANALYSIS, RESEARCH RESULTS WITH INTERPRETATION

It should be noted that for the purpose of writing this paper, a study was conducted in which an anonymous survey questionnaire created using the Google Forms application was used. The survey can be viewed as a quantitative research method.. The target group of this study were adult citizens of Croatia. The main goal of conducting the survey was to investigate the level of use of e-Citizen system services and the attitudes of the respondents. The survey questionnaire consisted of four parts. The first part contained questions related to general (demographic) data of each respondent, such

as: age, level of education, place of residence. The second part of the survey was intended for people who do not use e-Citizen system services. The third part of the survey was intended for respondents who use services via the e-Citizens system and their attitudes about it. The total number of questions in the survey was eighteen. The research was conducted in the period from June 1, 2024, to June 20, 2024, and a total of 173 respondents responded to the questionnaire. Table 1 shows the identified factors for each individual SWOT category. It should be noted that the area of public administration digitalization in Croatia is characterized by pronounced weaknesses, while the external environment offers favourable opportunities, so it is necessary to mitigate or neutralize weaknesses to better exploit the available opportunities (Wilson, 2002; Malecki, 2002).

Table 1: SWOT analysis of digitalization of public administration

Strengths	Weaknesses
Secured record financial resources through NPOO A complete legal framework is provided Continuous increase in users of e-services Established operational model of accelerated digitization of public services Successful development of the e-Citizens system and the START platform High pace of creation and launch of new e-services Existing experience of digitization in certain sectors The shared services centre (CDU) migrated the systems of 300 institutions In the openness of data of public authorities above the EU average	Lack of administrative simplification and redesign of public services according to the concept of "citizen at the center" before the digitization of the service itself The practice of coordinated prioritization of public services that need to be digitized has not taken hold Croatia is far below the EU average in terms of the amount of pre-filled data in digital forms of public services - insufficiently applied "only once" principle (repeated request for data) Lack of public service analysis from the perspective of user experience The existence of numerous active functionalities of digital public administration whose potentials are not fully utilized Insufficient use of analytical tools over large data sets in the decision-making process and policies in public administration Insufficient use of analytical tools over large data sets in the decision-making process and policies in public administration Availability of digital public services for citizens and businesses below the EU average Lack of a single contact center for all public e-services Insufficient level of digitalization of supporting business processes in public administration Insufficient measurement of satisfaction of users of public (e-services) The most important administrative procedures for cross-border users are not fully available online in the Republic of Croatia
Opportunities	Threats
Existence of EU funds for technical assistance and financing of the implementation of measures for the digitalization of public administration A high level of awareness achieved at all levels of government about the necessary cooperation in the development and introduction of advanced e-services Existence of global, proven business cases for the application of advanced e-services in providing higher quality and more efficient digital public services Availability of private sector capacities for additional support in the accelerated digitalization of the public sector and services Availability of examples of good practice in strategic thinking and the implementation measures and projects of digitization of public administration of other highly digitized member states.	The continued outflow of professional staff will cause a lack of resources for the implementation of measures of accelerated digitization of public administration. Increasing risks of computer security incidents and hacker attacks on national public services Global security threats that can divert resources and digitization efforts from public administration to other spheres of public action Lack of interest of key stakeholders in participating in consultation processes and advocating key changes related to digital transformation

Source: Authors.

Below is a presentation and interpretation of the research conducted. (I.) The first question related to the age structure of the respondents (173 respondents fully answered this questionnaire question). The smallest share, 4%, is made up of respondents older than 65 years. 8.1% of respondents are in the age group from 51 to 65 years, while 37.6% belong to the age group from 41 to 50 years. The largest share of respondents, 42.8%, belongs to the group from 25 to 40 years. Overall, 80.4% of respondents are in the age range from 25 to 50 years, which indicates a relatively younger population among the surveyed users of the e-Citizens system. (II.) The second question is about the level of education of the respondents (173 respondents fully answered this questionnaire question). The largest number of respondents has a university degree,

50.9%. This is followed by respondents with a higher education degree, 24.3%, and those with secondary school, 17.3%. The smallest share, 7.5%, is made up of respondents with postgraduate or doctoral studies. This distribution of educational levels indicates a high level of education among the surveyed users of the e-Citizens system. (III.) To the third question about the place of residence according to the size of the settlement (this question of the questionnaire was fully answered by 173 respondents), most respondents, 67.1%, stated that they live in a city with more than 50,000 inhabitants. A further 19.7% live in a city with a population of up to 50,000, while 13.3% of respondents come from smaller municipalities. This distribution suggests that the largest share of surveyed users of the e-Citizens system is concentrated in urban areas. (IV.) The fourth question to choose their status (173 respondents fully answered this question of the questionnaire) yielded the following answers: Students 9.8%, Unemployed 3.5%, Public sector employee 41.6%, Private sector employee 34.7%, Business owner/craft 12.1%, Retired 4.6% and Parent/caregiver status 0.6%. Most respondents are employees in the public or private sector, with the number of employees in the public sector being slightly higher. (V.) The answers to the fifth question on the use of the e-Citizens system (173 respondents fully answered this question of the questionnaire) are as follows. A total of 7.5% of respondents do not use the e-Citizens system, so the second section asks why they do not use it. The reasons they give are as follows: Lack of need: Some respondents point out that they simply did not have the need to use the e-Citizens system, which suggests that the perception of user needs is an important factor in encouraging the use of digital services; Perception of complexity: There is a partial feeling that the system is too complicated to use, which may indicate the need for a better user interface and a more intuitive design; Amount of information requested: Some respondents believe that the amount of data requested from them is too large, which may create the impression that the system is not adapted to the average user; Doubts about data security: Insufficient information about security protocols and personal data protection further contributes to caution towards using the system; Personal preferences: There are also respondents who simply do not want to use the system, which may indicate deeper social or psychological reasons that go beyond technical aspects; Technical problems: Some respondents state that they have encountered problems related to credentials, which affected their motivation to continue using the system; Insufficient experience: A certain number of respondents state that they have not had the opportunity to use the system so far, which may indicate the need for additional education and informing citizens about available services; Aversion to technology: Some respondents point out that they are not familiar with technology and do not feel comfortable using it; General lack of interest: Finally, some respondents simply do not see the need to use the e-Citizens system, which may include lack of information or insufficient recognition of the value of digital services. All other answers refer to respondents who answered affirmatively to the question of whether they use the e-Citizens system. In the following questions, the query was set in the form of a Likert scale (the Likert scale consists of statements, usually 15 to 20, which express a positive or negative attitude towards an object of the attitude. Each statement is usually accompanied by five possible answers. They express the degree of agreement, or disagreement with the attitude expressed in the statement (complete agreement, agreement, undecided/neutrality, disagreement, complete disagreement)) with 5 levels, ranging from "completely agree" to "completely disagree". (VI.) To the sixth question in the form of the statement "I often use the services of the e-Citizens system" (this question of the questionnaire was fully answered by 160 respondents), most respondents expressed a high degree of agreement. The results show that 30.6% of respondents chose answer 5 (I completely agree), while an additional 30% chose answer 4 (I agree). A neutral position, answer 3, was taken by 22.5% of respondents. Answer 2 (I disagree) was chosen by 12.5% of respondents, while the smallest number of respondents, 4.4%, completely disagreed with the statement, choosing to answer 1. These data suggest that a total of 60.6% of respondents tend to say that they often use the services of the e-Citizens system, while a smaller share of respondents, 16.9%, disagreed. (VII.) To the seventh question in the form of the statement "I am satisfied with the experience of using the e-Citizens system" (this question of the questionnaire was fully answered by 160 respondents), with 23.8% of respondents choosing the highest satisfaction rating, answer 5 (I completely agree), while the largest part of the respondents, 46.9% of them, chose answer 4 (I agree). A neutral attitude towards this statement, answer 3, was taken by 16.4% of the respondents. A lower level of agreement is expressed by 8.1% of the respondents with answer 2, while 5% of the respondents are completely dissatisfied, choosing to answer 1 (I completely disagree). These data show that a total of 70.7% of the respondents are satisfied with their experience of using the e-Citizens system, while a relatively small part, 13.1% of them, expressed dissatisfaction. (VIII.) To the eighth question in the form of the statement "The user interface of the e-Citizens system is clear and intuitive" (this question of the questionnaire was fully answered by 160 respondents), the respondents' answers on a 5-point Likert scale show the following distribution: 13.8% of respondents completely agree with this statement (answer 5), while 27.5% choose answer 4, which also indicates a positive attitude. A neutral position towards the clarity and intuitiveness of the interface was taken by 28.7% of respondents, choosing answer 3. A lower degree of agreement is expressed by 18.1% of respondents (answer 2), while 11.9% of respondents completely disagree with the statement, choosing to answer 1. The results show that a total of 41.3% of respondents consider the user interface to be clear and intuitive, while 30% express disagreement. (IX.) To the ninth question in the form of the statement "The content is adapted and the information on the system is clear" (this question of the questionnaire was fully answered by 160 respondents), the respondents' answers were distributed as follows: 13.1% of respondents completely agree with the statement (answer 5), while 32.5% choose answer 4, which indicates a positive attitude towards the clarity of information. A neutral attitude towards the content of the system is held by 31.9% of respondents with answer 3. A lower degree of agreement is expressed by 15.8% of respondents (answer 2), while 8.9% of respondents completely disagree with the statement, choosing to answer 1. These data show that 45.6% of respondents are satisfied with the clarity and adaptation of the information on the system, while 24.7% express disagreement. (X.) To the 10th question in the form of the statement "When using the e-Citizens system,

data security is not a problem for me" (this question of the questionnaire was fully answered by 160 respondents), the respondents answered as follows: 40.6% of the respondents completely agree with the statement (answer 5), while 35.6% choose answer 4, which also indicates a high degree of trust in the security of the system. A neutral attitude towards this statement is taken by 16.9% of the respondents, choosing to answer 3. Less disagreement is expressed by 5% of the respondents with answer 2, while 1.9% completely disagree, choosing to answer 1. The results show that a total of 76.2% of the respondents do not have a problem with trust in data security when using the e-Citizens system, while only 6.9% expressed concern about this issue. (XI.) To the eleventh question in the form of the statement "Since the first use of the system until today, I have noticed improvements in the e-Citizens system" (this question of the questionnaire was fully answered by 160 respondents), the respondents' answers were distributed as follows: 15% of respondents completely agree (answer 5), while 24.4% choose answer 4, which indicates a positive perception of changes in the system. Most respondents, 43% of them, take a neutral position, choosing to answer 3. Less disagreement is expressed by 11.3% of respondents (answer 2), while 6.3% completely disagree with the statement, choosing to answer 1. These results show that a total of 39.4% of respondents notice improvements in the e-Citizens system, while 17.6% expressed disagreement regarding the progress of the system. (XII.) To the twelfth question "What level of credentials do you use?" (160 respondents fully answered this question of the questionnaire), the results show the following distribution of responses among respondents: 16.3% use a low level of security, 66.3% use a medium, or significant, level of security, while 35% of respondents use a high level of security. These results show that most users (66.3%) prefer a significant level of security, while a slightly smaller but significant portion of respondents (35%) is oriented towards the highest level of credential security. (XIII.) To the thirteenth question "Please rate your overall experience of using the e-Citizens system" (160 respondents fully answered this question of the questionnaire), the respondents' responses were distributed as follows: 19.4% of respondents chose the highest satisfaction rating, answer 5, while the largest part of respondents, 47.5%, rated their experience with a rating of 4. 26.9% of respondents chose a neutral rating of 3, while 4.4% chose answer 2, and the smallest part, 1.9%, expressed complete dissatisfaction with a rating of 1. These data show that most respondents (66.9%) have a positive experience with using the e-Citizens system, while only a small proportion, 6.3%, expressed dissatisfaction. (XIV.) To the additional fourteenth open-ended question "Please list at least one thing that you consider most valuable or positive about using the e-Citizens system.", respondents gave the following answers: (A) Availability of documents and speed of access: Respondents highlighted advantages such as "Availability of documents", "Quick access to necessary documents and medical findings", "Speed of issuing a certificate without going to offices", "Speed of obtaining the requested information, data, papers", "Speed of getting documents" and "Speed of obtaining a document". Many additionally emphasized the benefit of "I don't have to go to the counters of institutions", as well as "No waiting for certificates for 7 working days or more" and "No waiting in lines".; (B) Health services (health portal and e-Health): There are frequent responses that emphasize the benefits of health portals, such as "Health", "Health Portal", "E-Health" and "e-Health Portal", with users highlighting the possibilities of "tracking health referrals and prescriptions" and "reviewing medical findings".; (C) Electronic performance of administrative tasks without physical attendance: Users praised the system for the possibility of "I don't have to visit counters for every nonsense", "That I can do everything without leaving home" and "I can take over everything without coming to institutions". Specific responses also included tasks such as "registering a newborn", "enrolling a child in kindergarten" and "importing a car without going to customs".; (D) Tax services: Many highlighted tax-related services, such as "e-Tax" and "Inspection of PK card". The convenience of "When I get my tax refund" and "Tax, health portal (orders and findings)" was particularly appreciated.; (E) Wider availability of services and digitization of processes: Responses included praise for "Availability of an increasing number of services", "Availability of documentation via the Internet" and possibilities such as "Downloading of documents (e-registers and others)", "Electronic obtaining of documents and certificates" and "Data available online". (E) Saving time and easing bureaucracy: Several respondents emphasized time savings, with specific statements such as "Time saved by not having to go for paperwork", "I don't have to wait at counters for various certificates", "Reduced walking around different institutions and quick access to the documents and data you need".; (F) Ease of access and transparency: Some respondents mentioned the importance of "Everything available in one place", "All necessary documents are at hand" and "Easier way to obtain documents".; (G) System Security and Different Credentials: Several respondents valued "Login Security through Different Credentials" and "Security".; (H) Specific services for parents and students: Some users mentioned additional services, such as "E-diary", "I have access to my child's grades and exams" and "Excuses for absences". (XV.) In response to the additional fifteenth open-ended question "Please list at least one aspect of the e-Citizens system that you would like to improve", respondents stated the following: (A) User interface and user experience (UX): Respondents often cited the need for a "clearer interface", "better information transparency", and an interface that is "more intuitive and adapted to all citizens". Many described the system as "confusing" and "inconsistent" and that it requires further simplification to make it easier to use. Specific suggestions include: "Page clarity", "easier document search", "more accessible home page", as well as a better explanation of credentials and security levels, which users consider important for easier navigation. Several respondents suggested "better harmonization of the application" and a more consistent user experience, highlighting that the user interface is "too cumbersome" and requires "improvement of intuitiveness and consistency".; (B) Authentication and login: Users expressed dissatisfaction with the authentication process, with suggestions such as: "Authentication via e-personal ID must be easier", "Easier login" and "Easier access to the system". Several respondents highlighted frustration with "constant approval and confirmation of consent to switch between systems", suggesting that a single login should allow access to all services without additional confirmation.; (C) Additional services and expansion of existing ones: Some users want to see "a greater number of available services",

including “additional services such as voting in elections” and “better integration with other public administration systems”. Specific suggestions include “availability of all public health findings on e-Citizens”, “expanding the number of services in the Tax System” and “enabling services related to justice”.; (D) Health Portal and Health Services: Several respondents highlighted the need for improvements in the "Health Portal", citing a problem with the availability of information as "sometimes the findings are available and sometimes they are not". Other suggestions include "better functionality of the health portal" and "full integration of health findings and data".; (E) Communication and Notifications: Users suggested "better notifications about the delivery of information and documents", stating that they want "e-mail notifications about the arrival of messages or documents".; (F) Simplification of language and instructions: Some respondents suggested "clearer instructions for navigating the system" and "simplified descriptions of functions", considering that the explanations are "sometimes written in technical and incomprehensible language". (XVI.) To the additional sixteenth open-ended question “Please list the 3 services you use most often.”, respondents answered the following: (A) Tax services (e-Tax): The most frequently used tax services include income tax filing, tax refunds, access to tax and accounting data, and issuance of receipts and tax liability status certificates.; (B) Health services (Health Portal, HZZO): Respondents often mentioned access to health data via the Health Portal, including downloading test results, supplementary health insurance through HZZO, and e-Health services for children.; (C) Issuance and retrieval of certificates and documents (civil registry books, Ministry of Internal Affairs): Issuance of birth certificates, citizenship certificates, certificates of no criminal record, and various other official certificates is a common practice. Services such as civil registry books and residence records at the Ministry of Internal Affairs are also highlighted.; (D) User mailbox and receiving notifications: Many users use the user mailbox to check mail and notifications, which includes receiving important documents and official notifications from various government systems.; (E) Educational services (e-Dnevnik): The e-Dnevnik application for parents and students is often used to check grades, attendance and absences in schools.; (F) HZMO services and the pension system: Insight into pension service and related information are also among the frequently used services, with an emphasis on employment and legal status.; (G) Cadastre and land registry services: Many users use e-Cadastre and related land registry services to view and issue title deeds and view cadastral data.; (H) Children's registration and document issuance services: Kindergarten registration services, issuing documents for children and viewing their educational and health data are also among the frequently used functions. (XVII.) To the seventeenth additional question "Do you use the mPorezna application?" (160 respondents fully answered this question of the questionnaire), the results showed that 35% of respondents answered affirmatively, while 65% of respondents chose a negative answer, not using this application. These data suggest that the majority of respondents (65%) do not use the mPorezna application, while a smaller part of users (35%) use this service. (XVIII.) To the additional eighteenth question "On a scale of 1 to 10, how likely is it that you would refer a friend to use the e-Citizens system?" (160 respondents fully answered this question of the questionnaire), the respondents' answers were distributed as follows: 37.5% of respondents rated the probability with 10 (the highest rating); 11.3% chose a rating of 9; 18.1% of respondents gave a rating of 8; 13.1% chose a rating of 7; 10% of respondents gave a rating of 6; 3.1% gave a rating of 5; 3.1% chose a rating of 4; 0.6% of respondents rated it 3; 1.9% gave it a rating of 2; 1.2% of respondents chose a rating of 1 (the lowest rating). These data indicate that a significant portion of respondents (48.8%) expressed a very high probability of recommending the e-Citizens system, while a smaller percentage of respondents (3.1%) expressed a low probability of recommending it. The following is an interpretation of the results and recommendations for improving the logistics of e-citizen services. From the data collected in the survey, about the e-Citizens system, but also about the respondents, it is possible to additionally conclude the following: (A) More than 80% of respondents are between 25 and 50 years old, which shows that the system is most often used by people of working age, who are more digitally literate and often use online services for business and personal needs. Users older than 65 years of age make up only 4% of respondents, which may indicate challenges in accessing or perceiving digital services among the older population.; (B) Over 50% of respondents have a university degree (VSS) or higher, which indicates users with a higher level of education, who are already familiar with online services. However, a significant percentage also has a secondary education (17.3%), which may indicate the need for a more adapted and simpler interface for the wider population.; (C) The majority of respondents (67.1%) live in larger urban areas, meaning that digital services are more accessible and used in cities, while only 13.3% are from smaller municipalities. This may signal the need for expanding digital services in rural areas and additional training on the use of the system. (D) The largest group is employees in the public sector (41.6%) and the private sector (34.7%). This is important because the public sector may often use e-Citizens for various administrative procedures, while the private sector may have needs related to taxes and business permits. Only 9.8% of respondents are students, while the unemployed, retirees and caring parents together make up a smaller percentage, indicating that they are the most represented in the working population.; (E) Given the demographic data and users' responses on aspects they would like to improve, here are some recommendations: (E1) Simplification of the user interface and experience: The largest number of respondents indicates the need for a clearer, more intuitive and less complicated interface. Given the high level of education of users, but also the representation of those working in different sectors, the system should enable more intuitive search and consolidation of services in a single interface. Special attention should be paid to the integration of various subsystems (such as e-Health, e-Tax and e-MUP services) so that users avoid a fragmented experience and frequent re-login.; (E2) Improvements for specific needs of user groups: It is necessary to adapt certain functionalities depending on different user profiles. Older users (over 65 years of age) need easy-to-access options and educational content that can help them use services. Less digitally literate users will also benefit from simple guides for basic procedures, especially in segments that include important certificates and documents such as birth certificates, certificates

of no criminal record, etc.; (E3) Ensuring stability and consistency of login: System users are bothered by the frequent need for multiple logins when using different subsystems. It is recommended to introduce a consistent login through a central portal that would enable seamless access to all services once logged in.; (E4) Adding new services and accessibility through mobile platforms: Given the working age and mobility of users, as well as the highlighted needs for expanding services, it is recommended to add additional administrative and health services (e.g. availability of all health findings, pension-related certificates, easier access to CES services). Optimizing mobile applications would be useful for easier access, especially for documents and health findings. (E5) Promotion and education about services in smaller towns: Most users come from larger cities, which may reflect limited knowledge about the e-Citizens system in rural areas. It is recommended to conduct information campaigns and education in smaller towns to encourage use of the system among people who find online access to administrative services more difficult. Finally, according to the responses and demographic characteristics, users are mostly satisfied, but primarily emphasize the need for a more transparent, integrated and functionally stable interface.

4. CONCLUSION

The analysis of the obtained results revealed that although users recognize the value of digital access to public services, they often encounter obstacles in using the services themselves, the most prominent of which is the lack of adaptation of the interface to different demographic groups. Difficult access to services causes a sense of frustration among users, while the lack of a comprehensive centralized approach further complicates the use of the system. The results indicate the need for strategic improvements aimed at a simpler, more transparent, and more user-friendly experience for a wider spectrum of the population. In the broader context of the digitalization of public administration, this research confirms the key role of digital systems in the process of modernizing administration and improving the availability of public services. The digital transformation of the public sector represents not only an opportunity to improve the logistics of software services and their improved maintenance, and an opportunity to increase the efficiency of public administration, but also a potentially powerful tool for strengthening transparency, reducing bureaucratic obstacles and adapting services to the needs of modern society. The analyzed e-Citizens system, despite the progress achieved, still shows several technical, logistical and structural shortcomings, which indicate the need for further research and adjustments through the improvement of software service logistics and their improved maintenance. The integration of various digital services into a single and coherent system, while ensuring the stability and reliability of functionality, remains a key challenge for the future development of e-Citizens. The introduction of modern technological solutions, such as a user-friendly interface and advanced personalization of services, could significantly improve the user experience. Also, the application of user needs research methods and iterative functionality testing could contribute to improving the intuitiveness of the system. Only systematic digitalization, which includes cooperation with experts from UX/UI design, sociology and informatics, can ensure long-term user satisfaction and citizens' trust in the e-Citizens system. Therefore, it is necessary that future initiatives within the framework of the digital transformation of public administration follow the results of scientific research and technological progress, so that public administration systems are adapted to the needs of all citizens and fully utilize their potential for improving the quality of life in the digital environment. Based on the research conducted, the following conclusions can be drawn in relation to the hypotheses set: (A) Hypothesis 1: The research results confirm that the e-Citizens system is indeed a significant step in the digitalization of public administration. Users have recognized this as a positive development. However, the research also showed that the user interface is not intuitive enough. Users encountered difficulties in navigation and finding their way around, which affected their satisfaction. These findings confirm the first hypothesis, suggesting that improving the user interface can further improve the user experience through improving the logistics of software services and their improved maintenance.; (B) Hypothesis 2: The research showed that users feel limitations in the functionality of the system due to insufficient integration with other related systems. It was observed that users cannot always access the complete information and services they need. The research indicates that the e-Citizens system represents an important advance in digital public administration, but there is room for improvement in terms of the user interface and integration with other systems. By developing a more intuitive design and better networking, through improved logistics of software services and their improved maintenance, the system can become even more useful and efficient for citizens.

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RECOMMENDER SYSTEMS FOR PERSONALIZED OFFERS

Abstract: The development of information and communication technologies has forced companies to keep pace with technological innovations. This is referred to as digitalization, which leads to significant changes in companies' processes. It reshapes business environments, reconfigures business models and strategies, and enhances overall business performance and competitiveness. Compared to small and medium-sized enterprises, large companies tend to adopt digitization and digital transformation more quickly. However, their long-term survival in the market requires that small and medium-sized enterprises engage in digitization and digital transformation processes, as well. Digitalization is strongly linked to user experience, while personalization is the key to improved experience and satisfaction. It also influences sales and improves competitive position, while targeted advertising contributes to the optimization of the company's budget through more effective marketing campaigns that maximize return on investment. Concerning said, one of the challenges that small and medium-sized companies face is related to the application of information and communication technologies in the personalization of the product/service offer and targeted advertisement. As a limiting factor, the authors recognize insufficient knowledge and understanding of the possibilities and limitations of digital technologies, particularly artificial intelligence (AI), for improving the personalization of the offer and targeting customers by their preferences, habits, and aspirations. AI-driven product recommendation systems are key to improving customer experience and sales growth. To generate personalized recommendations that will align with individual preferences or behavior, recommendation systems utilize advanced machine learning algorithms and natural language processing techniques and process large amounts of customer and product-related data, both structured and unstructured. The paper aims to contribute to understanding the possibilities and benefits of applying AI-based recommendation systems in customer offer personalization through a review of current literature, with a closer look at the types of recommender systems and the possibilities and limitations of their functioning or implementation.

Keywords: recommender systems, personalization, customer experience, digitalization, digital transformation.

INTRODUCTION

The development of information and communication technologies has forced companies to keep pace with technological innovations. This is called digitalization, which leads to significant changes in companies' processes. It reshapes business environments, reconfigures business models and strategies, and enhances overall business performance and competitiveness (Ubiparipovic et al., 2020). Digitalization is strongly linked to user experience, while personalization is the key to improved experience and satisfaction. It also influences sales and improves competitive position (Grljević et al., 2024).

AI-driven product recommender systems are crucial for customer experience improvement and sales growth. They can guide users in a personalized way, providing suggestions the users will most plausibly use (Ricci et al., 2011; Burke, 2002). Recommender systems are used in various fields, such as e-commerce (Abdul Hussien et al., 2021), online marketing (Hwangbo & Kim, 2019; Guo et al., 2021), transportation (Quijano-Sánchez et al., 2020), healthcare (Tran et al., 2021; De Croon et al., 2021; Shaikh et al., 2022), tourism (Hamid et al., 2021; Sarkar et al., 2023), online articles (Raza & Ding, 2022; Feng et al., 2020), streaming platforms (Al-Ghossein et al., 2022), etc. If businesses utilize recommender systems in the right way, they can increase sales, personalize offers, reduce marketing costs, encourage passive customers to make purchases, attract new customers, help in the process of expanding into new markets, optimize the supply chain, etc. According to the research (Griesch, Rittelmeyer, & Sandkuhl, 2024), the financial benefits of AI-driven recommender systems are significant. Companies record 10-20% increase in conversion rates and revenues. These benefits can enhance the competitiveness of a business. On the other hand, consumers can reduce the duration of the decision-making process, discover new items or services, identify previously unknown preferences and desires, interact more with appealing and personalized content, reduce the overload of irrelevant information, and more.

Large-sized enterprises tend to adopt digitization and digital transformation more quickly than small and medium-sized enterprises (SMEs). However, their long-term survival in the market requires that SMEs engage in digitization and digital transformation processes. One of the challenges that SMEs face is related to the application of information and communication technologies in the personalization of the product or service offer. As a limiting factor, the authors recognize insufficient knowledge and understanding of the possibilities and limitations of digital technologies, particularly artificial intelligence (AI), for improving the personalization of the offer and targeting customers by their preferences, habits, and aspirations (Wang et al., 2023; Norveel et al., 2022; Steinlechner et al., 2021; Gong & Ribiere, 2021). This paper aims to answer the following research question in the context of the described research subject:

RQ1. How recommender systems enhance personalization of offerings?

RQ2. Which challenges SMEs might face during development of personalized recommender systems and how to overcome them?

The paper is structured as follows. The first section provides the literature review reflecting the importance of digitalization, digital transformation, and limitation for their adoption in SMEs. The following section details on how personalization is achieved in recommender systems. Section Fundamentals of Recommender Systems offers an overview of main types of personalized recommender systems, following the section on development challenges and approaches to overcoming them. Concluding remarks are presented in the section Conclusion.

1. DIGITALIZATION, DIGITAL TRANSFORMATION AND SMES

Modern digital technologies, such as AI, the Internet of Things (IoT), blockchain, cloud computing, augmented reality, chatbots, big data, and nanotechnology, are accelerating the digitization process in all industry sectors. Digitization enables organizations to improve efficiency, productivity, and sales. It facilitates product and service innovation, and the development of new forms of customer relationships. The digitization process also affects the change in market conditions and represents an important factor in securing a competitive advantage (Ubiparipovic et al., 2020).

Digitization is closely related to the digital transformation of organizations' operations. According to Ismail et al. (2017), the digital transformation of business is the process of applying various digital technologies, through which companies use the synergy of those technologies to achieve better business results and ensure a more favorable competitive position in the market. In essence, the digital transformation of business means the implementation of changes in the way the organization works, which are necessary due to the application and exploitation of the advantages of modern digital technologies (Matt et al., 2015).

The scope and content of the transformation depend on the industry branch and the degree of digitization. According to the authors Ismail et al. (2017), the digital transformation of business can include several business dimensions: business model, user experience during the use of digitized products and services, business processes and decision-making methods, simultaneously influencing the necessary skills and talents of people in the company, organizational culture, and the entire system of value creation. Also, the author Wade (2015) defined the "digitalization piano" framework presenting organizations with seven business categories that can be subject to digital transformation: the organization's business model, organizational structure, people, processes, IT capability, products and services, engagement model (with customers, suppliers, and other business partners). Both authors consider the business model the highest level and the most demanding dimension for transformation, as it includes all the elements necessary for the organization's operations (Ismail, Khater, & Zaki, 2017). According to Osterwalder and Pigneur (2010), a business model consists of nine elements: customers, value offered, key activities, key resources, key partnerships, distribution channels, customer

relations, income streams, and costs. These business model elements point to the conclusion that the business model includes the entire chain of value creation in the organization, which is why it represents the most challenging aspect of digital transformation. The business model defines how the organization creates and delivers value to customers and partners, but also how part of that value is returned to the organization, in the form of income (Schallmo & Williams, 2017).

An important part of the business model that impacts other elements as well refers to customer relations. Digital transformation of customer relationships is centered on the improvement of customer experience and satisfaction (Ismail, Khater, & Zaki, 2017). Personalized offerings, tailored by individual preferences, increase customer satisfaction, and their overall experience, and impact companies' financial results (Singh, 2024; Plečko et al., 2023). The modern concept of personalization implies various user data processing, such as geo-location data, data collected through mobile applications, social media, or over-the-top technology (Pearson, 2019). The variety and volume of data exceed the possibilities of traditional approaches to their processing, and AI takes a central place in personalization processes, not only because of the possibility of processing and analyzing large amounts of data but also because of their ability to perform optimizations in real-time, such as the automated formation of consumer segments that are most likely to be more responsive to the upcoming campaign, based on the attributes that currently drive the desired response (Pearson, 2019). In addition to the current AI-driven-personalization chatbots and virtual assistants that contribute to the improvement of customer experiences across different types of businesses (Shafiquzzaman Bhuiyan, 2024), recommender systems are another AI-based technology that enables personalization of products and services. Personalized recommendation technology offers more accurate and diverse choices to consumers and, as authors (Yin, Qiu, & Wang, 2025) found such relevant, inspirational, and insightful experiences significantly promote consumers' clicking intention.

Although large organizations are leading the digitalization process, digitalization and digital transformation represent an equally important process for SMEs enabling business growth, competitiveness, and market survival. However, SMEs experience certain barriers on the path of digitalization. In addition to the lack of financial resources for investments in digital technologies (Favoretto et al., 2022; Ramachandran et al., 2023; Cirillo et al., 2023) and organizational barriers that are reflected in people's resistance, especially the introduction and application of new ways of managing innovations (Andersen et al., 2021; Caputo et al., 2023; Hewitt et al., 2020), the most prevalent barrier in the literature is the lack of digital competences and knowledge of capabilities of modern digital technologies and opportunities for their implementation in the business processes. Many authors believe that it is necessary for management to systematically work on the education of employees, but also for greater involvement of the academic community in assisting SMEs (Norveel et al., 2022; Steinlechner et al., 2021; Gong & Ribiere, 2021; Wang et al., 2023; Vuchkovski et al., 2023; Ramachandran et al., 2023; Dalenogare et al., 2023).

In this context, the authors of this paper aimed to increase the amount of knowledge needed by SMEs in terms of understanding the possibilities, limitations, and adequate application of AI-based technologies, with a special focus on recommender systems as a central technology that enables the personalization of companies' offers. In this way, the authors believe that they contribute to reducing this key barrier in the digital transformation process of SMEs.

2. PERSONALIZATION AND RECOMMENDER SYSTEMS

An abundant market supply affects both consumers and businesses. For businesses, it means increased competition and constant effort to reach customers. For consumers, the decision-making process is harder and requires more time to find a product or service with the best price-quality ratio. Recommender systems are a solution that can help both consumers and businesses to achieve their goals. They can be defined as software tools and techniques for providing item suggestions that users may wish to use (Ricci et al., 2011) or systems that can guide users in a personalized way to relevant items in a wide range of possibilities (Burke, 2002). The term „recommender system“ is proposed by Resnick and Varian (1997) indicating they can recommend interesting items while identifying those out of interest scope that should be filtered out.

Personalization in information systems is a process in which the system is modified to correspond to user preferences (Blom, 2000). In order to provide personalized recommendations, recommender systems need to identify similar users or determine relevant items based on user interests. Over 35% of Amazon sales, 60% of movie interactions on Netflix, and 38% of reads on Google News are result of recommendations (Gulzar et al., 2018). Personalized recommender systems can encourage users to engage more with recommended content while also reducing the cognitive effort needed to choose specific items, allowing them to focus more on interacting with the content itself (Beam, 2014). The main reasons for implementing personalized recommender systems are increased sales, product and service diversification, enhanced user satisfaction, and repeated user interactions, which indicate user loyalty (Polatidis & Georgiadis, 2013). Personalization can help businesses target specific customers and their needs, while also enabling them to grow by recommending long-tail products, segmenting users, and monitoring their activities. Personalization recommender systems can be used in different areas like travelling (Renjith et al., 2020), education (Kundu et al., 2021; Gulzar et al.,

2018), music (Han et al., 2010), social networks (Yu et al., 2011), tourism (Lim et al., 2018), e-commerce (Markellou et al., 2005), restaurants (Zeng et al., 2016), online news (Wu et al., 2023), etc.

The main challenges in these types of recommender systems are privacy concerns, social media integration, and enhanced role-based access control. Privacy issues arise when users are asked to share personal information, which can lead to negative behaviour. While collecting user data to personalize offers, recommender systems must prioritize user privacy and ensure it is protected with a high level of security (Li et al., 2020). Another consideration is the process of data collection and preparation in integration with social media, as it can be complex and security concerns may arise when implementing authentication with a role-based structure to determine user access to resources (Polatidis & Georgiadis, 2013).

3. FUNDAMENTALS OF RECOMMENDER SYSTEMS

Based on the underlying approach used to generate recommendations, Aggarwal (2016) classifies recommender systems on collaborative filtering, content-based filtering, knowledge-based filtering, and hybrid systems. Each utilizes specific approach to data and knowledge on user behavior and/or item characteristics to generate product/service recommendations that align most closely to the users' interests and current needs.

Collaborative filtering recommender systems are based on the opinions of other people, which are processed in real time to develop personalized and relevant suggestions for a particular user. Users' opinions can be presented in a user-item matrix (Table 1), often referred to as utility matrix, where the intersection of a row and a column represents the user's opinion about a particular item.

Table 1: User-item matrix example

	Item 1	Item 2	Item 3	Item4
User 1	5	3	-	4
User 2	-	3	1	1
User 3	2	-	3	5
User4	4	3	5	-

Source: (Schafer et al., 2007)

User opinions can be noted using a scalar, binary, or unary rating. Ratings can also be explicit (when a user provides an opinion) or implicit (when inferred from user actions) (Schafer et al., 2007). The goal of collaborative recommender systems is to suggest items that a user has not interacted with (marked as "-" in Table 1), based on the preferences of users with the most similar tastes who have interacted with those items and rated them with a high score. There are two types of collaborative filtering, memory-based and model-based (Aljunid et al., 2025). In memory-based collaborative filtering the system aims to generate recommendations based on identified similarities between users or items. If similarities are sought between users it is referred to as user-based collaborative filtering and item-based refers to the systems aiming to find similarities among items (products or services), (Aljunid et al., 2025). In model-based collaborative filtering ratings are obtained using advanced machine learning approaches, such as classification, regression, clustering, association rules, neural networks, matrix factorization, or other methods (Aljunid et al., 2025).

Content-based recommender systems suggest items similar to items a user previously liked (Balabanović & Shoham, 1997). These systems analyse the descriptions (metadata) of items that the user has rated in the past and build a model based on that information. The recommendation process relies on matching the attributes that user prefers with the descriptions of items they have not yet interacted with. Compared to collaborative filtering, content-based recommender systems offers advantages, such as user independence, transparency, and the ability to recommend new items that have not received any prior interactions. To achieve this, they utilize traditional classification and clustering techniques, including Support Vector Machines and Nearest Neighbour (Lops et al., 2011).

Knowledge-based recommender systems collect user preferences through dialog (e.g., conversational chatbot) and recommends items that correspond to user preferences based on the predefined set of recommendation rules (constraint-based approach) or based on similarity metrics that reveal similar items to users' preferences (case-based approach), (Uta et al., 2024). Knowledge-based recommender system are surpassing issues related to providing recommendations for new users or new products, referred to as a cold-start problem, and they do not require large datasets. However, the biggest challenge is to create a knowledge base which often requires expert knowledge in a particular domain. Two main components of knowledge-based recommender systems are knowledge base and user profile (Bouraga et al., 2014).

Hybrid recommender systems combine content-based and collaborative filtering approaches (Kulkarni & Rodd, 2020; Adomavicius & Tuzhilin, 2005), as well as knowledge-based and utility-based techniques, to overcome the limitations of individual methods (Fakhar et al., 2023). Authors Adomavicius & Tuzhilin (2005) categorize hybrid recommender systems based on the approach of combining collaborative and content-based filtering to enhance recommendation quality:

- Combining predictions. The system combines predictions obtained separately through collaborative filtering and content-based filtering to generate recommendations.
- Enhancing collaborative filtering system with features related to items.
- Enhancing content-based system with features obtained from collaborative filtering, such as user-item interactions data.
- Building a single model that combines features from both approaches.

4. RECOMMENDER SYSTEMS DEVELOPMENT CHALLENGES

Although recommender systems revolutionized personalization of products and services and contributed to the overall success of the companies that manage to implement them successfully, they face various limitations and challenges that jeopardize the quality of recommendations, such as cold-start problem, sparsity, scalability, explainability, diversity, novelty, and serendipity. These challenges are often surpassed by introduction of auxiliary data and innovative AI-based methods and techniques. Their introduction into recommender systems contributes to the enrichment of user profiles and items, going beyond data on user interactions with items or amounts of purchased products. The challenges are discussed in the remaining of the section with references on potential AI-based approaches to overcome them.

The **cold-start** problem occurs when new users or items appear in a system, which is common in collaborative filtering-based recommender systems. When there is no information about previous user ratings, it is hard to find similar users, and when there are no item ratings, it is difficult to recommend that particular item (Hasan & Khatwal, 2023; Shao et al., 2021). Solutions to this problem can be found in cross-domain recommender systems, enriching user profiles with association rules or clustering techniques, identifying demographic or other similarities among users, utilizing user browsing information, initiating user interactions to collect new data, incorporating content-based information into collaborative filtering, imputing missing values in the user-item matrix, and applying deep learning methods (Revathy & Anitha, 2019), etc.

The **sparsity** problem is common in collaborative filtering recommender systems and occurs when there is a large number of items and users, but only a small number of interactions between them. Users do not rate many items, leading to a sparse user-item matrix. For example, a single user will not consume every product offered on the e-commerce platform or will rate every product they consume. Those reasons make it difficult to find similar users because there are not enough historical records (F. Zhang et al., 2020). In this situation, sparsity problem can lead to unreasonable recommendations for users without ratings (Al-Bakri & Hashim, 2018). There are different approaches to solving this problem, such as dimensionality reduction techniques, hybrid recommender systems that use content-boosted algorithms or model-based algorithms, etc. (Su & Khoshgoftaar, 2009).

The **scalability** problem arises when the number of users and items grows (leading to high dimensionality), making it challenging for the model to process data efficiently and provide recommendations within an acceptable time (Singh, 2020). With the rise of big data, this problem has become increasingly common. Dimensionality reduction, cluster-based techniques, fuzzy logic, and unsupervised learning-based recommender systems are the most common strategies for solving this problem (Roy & Dutta, 2022).

The **explainability** problem occurs when the system does not provide explanation why a particular item was recommended, causing users to lose trust in the recommender system. If an explanation is provided, it helps system to improve transparency, effectiveness, trustworthiness, and user satisfaction (Y. Zhang & Chen, 2020). There are different ways to provide explanations in recommender systems, such as model factorization, topic modelling, graph-based and knowledge-graph models, deep learning or rule mining (Y. Zhang & Chen, 2020).

One of the challenges in recommender systems is **diversification**. Even if a recommender system is accurate, diversity becomes a problem when recommendations are too similar. However, the goal of a recommender system should be to suggest items that are different, thereby expanding user preferences. Bradley and Smyth define diversity as the opposite of similarity (Bradley & Smyth, 2001). Diverse suggestions increase user satisfaction and help mitigate the overfitting problem in recommender systems (Kunaver & Požrl, 2017). Diversity metrics can be divided into three groups: collaborative (using user feedback), metadata-based (calculated based on domain-specific item attributes), and content-based (based on the unstructured content data of the items) (Dokoupil et al., 2024). There are many different approaches to increasing diversity (Kunaver & Požrl, 2017) including topic diversification (Ziegler et al., 2005), item

ranking techniques (Adomavicius & YoungOk Kwon, 2012), hybrid approaches (Premchaiswadi et al., 2013), using only collaborative data (Bridge & Kelly, 2006), etc.

Novelty is a characteristic of recommender systems which enables them to suggest items with specific features that the user has not interacted with before (for example a new movie genre). The basic idea of these systems is to suggest items that users are likely to select in the future rather than in the present. Natural way to measure novelty is through experiment where we ask users were they aware of provided recommendation before (Aggarwal, 2016). A better understanding of the item space in an unbiased manner, along with considering how humans interact with new items until reaching a peak, can help design recommender systems that facilitate novelty attainment (Gravino et al., 2019).

Serendipity refers to a surprising recommendation that the users did not know they would like. Serendipitous recommendations are diverse and novel, leading to an unexpected and surprising experience for the user. Some authors believe that there is no controllable method to manage serendipity (Makri et al., 2014), while others argue that although this process cannot be fully controlled, there are possible ways to make progress and influence serendipity (Ziarani & Ravanmehr, 2021). There are various ways to enhance serendipity in recommender systems, such as using collaborative filtering with association rule mining (Khoshahval S. et al., 2018), deep learning (Deng et al., 2019), graph-based methods (de Gemmis et al., 2015), hybrid approaches combining Latent Dirichlet Allocation and Principal Component Analysis (Meng & Hatano, 2014), etc.

CONCLUSION

In today's digital world, all companies must follow the advancement of technology and adapt their business. One of the key elements of digital transformation is use of modern technologies for user experience improvement, which focuses on providing the consumer with a better and easier experience with products and service. A positive customer experience increases customer satisfaction, which can lead to an expansion of the customer base, stronger relationships with them thereby increasing their loyalty, and increased profitability.

The personalization of the offer, with the use of a recommender system, can further improve the user experience and satisfaction. These systems, based on artificial intelligence, help companies to better understand the needs of users and, based on that data, create personalized recommendations for products and services. This approach allows companies to build long-term relationships with customers and secure a stable income through the loyalty of their users.

Small and medium-sized enterprises face various challenges in the digitalization process. The biggest obstacle is the lack of knowledge and understanding of how modern technologies can be adequately applied in order to improve business. With deciphering their capabilities and development challenges, the paper can serve as a modest contribution to closing the identified barrier for SMEs' digitalization.

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OPPORTUNITIES AND CHALLENGES OF ERP SYSTEM IMPLEMENTATION IN THE CONTEXT OF DIGITAL BUSINESS TRANSFORMATION OF ENTERPRISES

Abstract: Digital business transformation is a concept without which many things in the 21st century would not look the same. The integration of digital technologies into business processes enables more efficient functioning and the execution of tasks that are part of a business process. In the context of digital business transformation, technologies and tools such as IoT (Internet of Things), cloud computing, big data, artificial intelligence, ERP systems, and many others are used. The focus of this paper is on ERP systems and their role in the context of digital business transformation. ERP systems facilitate easier coordination, monitoring, and optimization of various business processes and their integration into a unified whole. Since ERP systems are centralized, all business processes are fully tracked. This reduces the time spent on various activities within a business process, as all relevant information is available at the right time and in the right place. The implementation of ERP systems brings numerous benefits to a company, one of which is labor cost savings, as the application of an ERP system ensures a reduction in the number of employees. Although the benefits of applying digital technologies in daily business operations are significant, there are also many challenges that companies face during the process of digital business transformation through the application of various technologies, including ERP systems. This paper will first discuss the concept of digital business transformation, followed by a discussion of ERP systems in the context of digital business transformation, where an overview of their opportunities and challenges will be provided. The first part of the paper will utilize the literature review method. The second part defines the concept of an integrated information system, as well as the opportunities and challenges related to the implementation of ERP systems in the context of digital business transformation. In the final part of the paper, a case study example will be used to describe the application of ERP systems in the operations of courier companies in Bosnia and Herzegovina, which will help in understanding both the opportunities and challenges of ERP system implementation.

Keywords: Digital technologies, digital business transformation, ERP systems

1. INTRODUCTION

The progress and development of technologies have an impact on the everyday functioning of humans, and thus on business operations as well. In today's conditions, it is nearly impossible to imagine business operations without the application of modern technologies, which bring numerous opportunities and certain challenges. Automation and digital

transformation of business operations have led to a complete reorganization of business processes, with a focus on improving the quality of products and services, as well as reducing the time required to execute business processes. Before the emergence of digital technologies, business operations were much more complicated, and numerous procedures required significantly more people and time to complete all necessary activities. Errors in various calculations were often made, a situation everyone strives to avoid (Srećko Ilić, Srđan Damjanović, 2024). Digital technologies include numerous technologies used today, some of which are: artificial intelligence (AI), machine learning, cloud computing, big data, blockchain, the Internet of Things (IoT) and many other technologies. The focus of this paper is on the opportunities and challenges of integrating ERP systems in the context of digital business transformation. In order for a company to operate successfully in conditions shaped by the so-called "global market," it is concluded that digital transformation of business is no longer an option, but an imperative. Digital transformation of business involves the complete integration of digital technologies into all segments of business operations in order to improve business processes and organizational models, as well as organizational culture. The ERP system represents an integrated information system, or a software platform that integrates all key business processes and functions within an organization into a unified whole. This integration of business processes and functions ensures data centralization and automation of numerous business processes, which ultimately contributes to improving efficiency, productivity, and the quality of business decision-making. In addition to the advantages mentioned, the implementation of an ERP system in the context of digital business transformation brings numerous challenges, such as inadequate infrastructure, insufficient staff capabilities to work with it, and the high costs of implementing these systems (Marijana Živković, Srđan Maričić, 2023).

The key research question posed in this paper is: "What is the importance of ERP systems for business process execution in express mail operations?" The first part of the paper deals with the literature review in which digital technologies and digital business transformation are defined. The second part defines the concept of an integrated information system and reflects on the opportunities and challenges associated with implementing ERP systems in the context of digital business transformation. The third part describes a case study of the application of an integrated information system in Bosnia and Herzegovina's express postal services regarding the automation of the billing process for express mail services provided.

2. RESEARCH METHODOLOGY

This paper uses a literature review as a research method. The research includes scientific papers found in the Google Scholar and ResearchGate databases. Key terms used for the search were ERP systems, digital business transformation, implementation, opportunities, and challenges. Only papers published in scientific journals and conference proceedings were considered for this work. The search results based on the mentioned terms, which included theses (bachelor's, master's, and doctoral dissertations) or papers that were not fully accessible, were not used in the preparation of this work. In addition to the literature review, the third part of the paper analyzes a case study of the integrated information system used in the operations of express postal services in Bosnia and Herzegovina.

3. LITERATURE REVIEW

Many authors have written on the topic of ERP systems. Below is a brief overview of some works that describe the significance of ERP system implementation in modern business.

The development of technologies is an ongoing process that happens daily. Digital technologies have caused changes in many areas of human life, including business. Business digital transformation refers to the application of digital technologies across all business areas, which leads to the creation of new business processes, models, software solutions, and systems. The goal of digital transformation for any business entity is to increase revenue, reduce costs, and, among other things, enhance competitive advantage (Schwertner, 2017).

The integration of digital technologies into all business segments brings about fundamental changes in how an organization operates. Organizational changes occur when a company moves from its current state to a new, desired state. The digital technologies most prevalent in the digital transformation process are: artificial intelligence, machine learning, cloud computing, big data, blockchain, IoT, and many other technologies, among which it is crucial, in line with the topic of this work, to pay special attention to integrated information systems—ERP systems (Schwertner, 2017).

Machine learning is based on mathematical and statistical techniques that allow computers to independently acquire knowledge based on prior experience related to data processing. Machine learning requires algorithms developed from empirical data and test data. Algorithms are a set of well-defined steps aimed at solving a particular problem. The goal of machine learning is to enable optimization of results and improve predictions through learning processes. Machine learning is a branch of artificial intelligence and is often confused with deep learning, but these two terms are not synonymous. Deep learning refers to working with neural networks. Artificial intelligence is the broadest term, encompassing machine learning and deep learning (Daniel Paschek, Caius Tudor Luminosu, Anca Draghici, 2017).

Big data refers to massive amounts of data that can be structured, unstructured, or semi-structured. Because of the variety of data types that can be collected, traditional statistical tools are inefficient for processing such large quantities of data, which is why this technology has taken on the task of processing these types of data. In addition to the advantages it brings, challenges arise concerning data sharing, analysis, management, visualization, and data security. This concept is applied in many aspects of business. Among other things, IoT technologies are supported by the big data concept, as smart devices in the IoT system collect vast amounts of data that need to be processed, and big data helps with that (Ahmed Oussous, Fatima-Zahra Benjelloun, Ayoub Ait Lahcen, Samir Belfkih, 2018).

Blockchain technology enables the transmission and storage of data in a decentralized manner, where data is not organized and stored in one place but is distributed across multiple locations. The advantages of blockchain technology in the context of business digital transformation include (Gokhan Kirbac, Berna Tektas, 2021):

- Increased reliability of events and documents
- Improved competitive advantage
- Order tracking
- Process optimization
- Increased productivity
- Digital document manipulation
- Expanded digital collaboration, etc.

Artificial Intelligence (AI) is one of the digital technologies that significantly contributes to business digital transformation. In recent years, a great deal of attention has been paid to implementing AI in business activities. Company management stands at a crossroads between exploiting existing technologies or investing in new AI technologies that would provide numerous advantages in future operations. The goal of implementing AI technologies in businesses is to enhance organizational capabilities. AI is one of the most important technologies contributing to the success of business digital transformation, especially in decision-making, where AI plays a key role due to its ability to process vast amounts of collected data. It is impossible to expect a human to process such vast quantities of data within the same time frame, which represents the greatest benefit of applying artificial intelligence in the context of business digital transformation (Holmstrom, 2022).

Cloud computing has changed the way organizations and individuals conduct business. Providers of necessary resources allow users access to servers, data storage, databases, networks, and software required for data processing and analytics. Accessing cloud services requires an internet connection, which compensates for the significant costs that businesses would need to incur to secure the necessary infrastructure without using cloud services. In addition to compensating costs, the administrative aspect of system maintenance is transferred to the service providers. The three service models that cloud enables are: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Cloud can be implemented in a company in several ways, including public cloud (implemented and managed by a specific organization), private cloud (implemented and managed within the organization using it), community cloud (resources shared among several organizations, with implementation and management handled by one of the organizations or a third party), and hybrid cloud (a combination of the aforementioned cloud types) (Ana-Gabriela Babucea, Octavian Sirbu, 2023).

IoT refers to a network of smart devices that collect environmental data, store it, and based on the processed data, execute commands, which can be manually assigned or automatically by the system if properly defined. Smart devices, as part of the IoT system, contain sensors that monitor the environment and record any changes. Not only homes, buildings, and cities but also manufacturing plants can be part of an IoT ecosystem, where these technologies can facilitate the digital transformation of business. Of course, IoT technology does not need to be implemented alone for digital transformation to occur; it often integrates with other digital technologies (Ahmed Oussous, Fatima-Zahra Benjelloun, Ayoub Ait Lahcen, Samir Belfkih, 2018). IoT technologies can achieve business process automation, which leads to improved product and service quality. In business processes, IoT technologies ensure increased productivity, reduced production costs, and enhanced accuracy and precision during product and service delivery. IoT systems can also conduct self-checks to detect components that could potentially cause delays in production facilities. In doing so, IoT technologies can alert responsible parties in advance about the situation, enabling corrective actions to prevent production delays or safety and security incidents involving employees (Srećko Ilić, Srđan Damjanović, 2024).

An Integrated Information System – ERP is a set of standard business functions integrated into a unified whole, ensuring the centralization of data and automation of organizational activities, which contributes to increased efficiency, improved business performance, and optimized operations. In ERP systems, all software modules are integrated with a central database, allowing employees and decision-makers to quickly access necessary information. There are several reasons why company management decides to implement an ERP system, and the most significant reasons are (Faisal Mahmood, Abdul Zahid Khan, Rahat H. Bokhari, 2019):

- Improving business performance
- Ensuring organizational growth
- Reducing costs and shortening the time required to perform business processes
- Increasing efficiency and effectiveness of the organization.

4. ERP SYSTEM IMPLEMENTATION

The decision to implement an ERP system is not made ad hoc, it follows a series of quantitative analyses. First, it starts with lower-level managers, who make operational decisions, including many employees who are well-acquainted with the working environment. The reason is simple—employees who know the work environment best understand what needs to be done to improve working conditions. Proposals from employees in the production sector, led by their lower-level manager, are passed to middle-level managers, who analyze these suggestions. Middle-level managers make tactical decisions, which are presented to top management, the highest level in the hierarchy. Finally, top management makes the final decision on whether to implement the integrated information system in the company. If the decision is positive, the first step is to identify and define the ERP system to be implemented in the company. This step involves dimensioning the information system according to organizational needs, quantitative and qualitative characteristics, procurement costs, upgrade and update possibilities based on needs, and the system's lifespan (Marijana Živković, Srđan Maričić, 2023).

The second step in implementing an ERP system is defining decision-making criteria and weighing the criteria themselves. Weighing the criteria involves determining the importance of each criterion based on absolute and relative comparisons. Absolute comparison involves comparing each criterion with the starting criterion, while relative comparison involves comparing each criterion with the other criteria. Decision-making criteria primarily include the quality of the information system and the capabilities that the information system offers the organization (Marijana Živković, Srđan Maričić, 2023).

When deciding on the implementation of an ERP system in an organization, it is advisable and should be considered by the decision-maker to explore alternative solutions that would be compatible with the main idea while ensuring that the cost of the alternative solution is acceptable. After successfully completing all the steps, a decision is made to implement new integrated information software. During the decision-making process, there are many limitations that can lead to a wrong decision. The integrated information system being implemented does not have to be complete or final at the time of implementation. Since an ERP system consists of several modules, its implementation can occur in phases, allowing the ERP system to be upgraded and supplemented over time. This flexibility is particularly beneficial for start-up companies with limited financial resources, as they can gradually introduce the ERP system into their business to enhance and automate their operations (Marijana Živković, Srđan Maričić, 2023).

The opportunities an organization has when deciding to implement an integrated information system are (Marijana Živković, Srđan Maričić, 2023):

- Unified IT costs for the organization – while implementing an ERP system initially requires significant financial investment, in the long term, IT costs will be unified, as all costs are directed to a single system. If a company does not use an ERP system, resources are spent on numerous individual systems needed for each functional area in the company.
- System transparency – all data related to the company's operations are stored in a central database, making it easy for management and data users to access.
- Centralization of information – all important information is located in a centralized location.
- Reporting and planning – the company has a unified reporting method for each department.
- Ability to compare and analyze functions in different departments – reducing the amount of communication required to obtain such information.
- Increased efficiency and cost-effectiveness – reducing IT costs, employee training costs, effort and time spent on daily tasks, reducing or eliminating manual operations, and achieving automated processes, allowing employees more time to focus on improving activities that impact the company's revenue.

In addition to the opportunities provided to the organization by the implementation of an ERP system, there are also certain challenges that the organization faces during the implementation of these systems, which include (Marijana Živković, Srđan Maričić, 2023):

- High cost of ERP systems – The amount of money that needs to be allocated in order to secure an ERP system is significant, especially for small and medium-sized enterprises.
- High implementation and maintenance costs of ERP systems – In addition to the costs related to purchasing the ERP system, the implementation costs can also be extremely high, potentially up to four times greater than the purchase costs. In addition to these costs, there are also time and labor costs to train employees to handle the system, as well as costs for programmers, experts, and consultants for ERP systems, as well as hardware costs to ensure the system operates as intended.
- Transition to a new ERP system and adaptation to the new integrated information system – The process of adapting to an ERP system can be very successful, but it can also be a complicated process that can easily get out of control. The adaptation process requires a lot of effort, work, time, and money, so when planning the budget for acquiring and implementing the ERP system, it is necessary to plan for all these activities to prevent the budget from being exceeded and to avoid halting the ERP system implementation.

ERP systems are increasingly being offered as solutions supported by cloud technology and are known as cloud ERP systems. Cloud ERP systems represent application packages that connect various areas and can be customized to meet

the needs of different users. Given the increasing number of suppliers entering the market, the ERP system market itself is estimated to be worth billions of dollars. Cloud ERP systems have a profound impact on organizations because they change the products that are purchased, the way purchases are made, and the buyers themselves. These integrated information systems integrate various business processes and sectors of the organization into a unified whole. This way, the management of the company has the opportunity to access data from all business units. Although cloud ERP systems provide numerous benefits to the entities that use them, the biggest challenge faced by companies that choose to implement such an integrated information system is data security, confidentiality, and ownership. The security of the data handled by the cloud ERP system is the responsibility of the cloud ERP system provider, from which it can be concluded that absolute data security cannot be guaranteed (Vuk Vuković, Nebojša Gagić, Nebojša Taušan, Lazar Raković, Slobodan Marić, 2024).

Opportunities offered to users of cloud ERP systems are (Modamed A. Abd Elmonem, Eman S. Nasr, Mervat H. Geith, 2016):

- Low initial costs – Only access to the cloud via the internet needs to be paid for;
- Low operational costs – The cloud service provider is responsible for delivering and managing cloud services;
- Quick implementation;
- Scalability – Cloud services are flexible, allowing resources to be increased or decreased according to needs;
- Focus on core activities;
- Fast system updates and upgrades;
- Accessibility, mobility, and usability;
- Integration with other cloud services;
- Improved resource access and disaster recovery – Backup, restoration, and recovery after failures and other economically damaging events are enabled;
- Cost transparency;
- Sales automation;
- Security standards;
- Free trial period – Potential clients can try cloud ERP systems before purchase.

Challenges faced by users of cloud ERP systems are (Modamed A. Abd Elmonem, Eman S. Nasr, Mervat H. Geith, 2016):

- Subscription costs for using cloud ERP systems – The services used must be paid periodically as long as they are used;
- Security;
- Limitations in customization and integration;
- Strategic risks – Companies must adhere to defined policies set by the cloud ERP service provider;
- Loss of IT sector expertise – Most of the work is done by the cloud ERP service providers;
- Service Level Agreement issues;
- Sensitivity of information;
- Limited control over the cloud ERP system – Cloud ERP systems are external to the company, while traditional systems are internal;
- Organizational challenges – Involvement of all future users in the implementation process and poor inter-functional communication.

Today, there is a wide variety of ERP software, with different modules and prices. An ERP system can include modules such as: fixed assets, production, employees, company clients, services provided by the company, products manufactured and acquired by the company, product and service sales, book of incoming and outgoing invoices, and many others. Depreciation of fixed assets is a crucial category for any business, and the ERP system facilitates the calculation of depreciation based on the method chosen by the business entity. In order for the depreciation of a fixed asset to be calculated, the asset must be entered into the database. When entering the fixed asset into the database, data about the acquisition, depreciation rate, and the method of depreciation are also entered. Thanks to the ERP system, various reports in PDF format or other formats, depending on the needs related to the depreciation of fixed assets, can be generated (Borislav Drakul, Srđan Damjanović, Predrag Katanić, 2019).

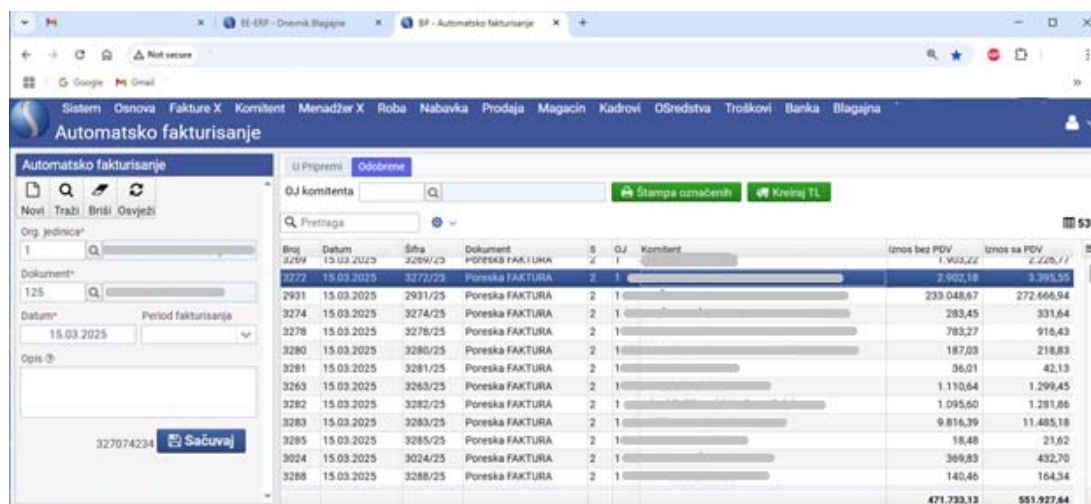
Production is a very complex process in which employees working in production require a lot of information. These pieces of information constantly change depending on the ongoing changes that occur in the company. Information intended for employees must be confidential, so it is necessary to pay attention to access authorization, meaning that only those to whom the information is intended should have access to it. The primary goal is to complete the work quickly and efficiently, with a minimal number of mistakes. Since mistakes in work are inevitable, it is important to determine where they occurred and who is responsible for them to avoid shifting the responsibility for errors to someone who is not at fault. The program allows monitoring of products through the raw materials necessary for their production, as well as the technologies required for their production. In this way, it is possible to track the amount of goods in the warehouse, including raw materials and finished products (Borislav Drakul, Srđan Damjanović, Predrag Katanić, 2018).

5. SINERGIS – INTEGRATED INFORMATION SYSTEM OF EXPRESS COURIERS IN BOSNIA AND HERZEGOVINA – CASE STUDY

The Integrated Information System "Sinergis" is software used by approximately 70% of courier services in Bosnia and Herzegovina. The system has successfully automated numerous processes using other technologies. Automated processes, such as invoicing for shipment deliveries, have contributed to reducing the time for recording the receipt of shipments, thus increasing data accuracy.

Considering the expansion of numerous online shopping platforms, such as Temu, AliExpress, and other similar platforms, the need for daily delivery of a large number of shipments has arisen. The manual invoicing process would be extremely complicated. Given that around 40,000 shipments are processed daily, it would be nearly impossible to invoice all shipments, considering that invoices are created based on the execution of the delivery service. The solution to this situation was to automate these processes with the help of the integrated information system, and the following text will describe the automatic invoicing process during shipment delivery to the address.

It is important to note that some data has been censored in the images that will be shown below due to the confidentiality of customer information.



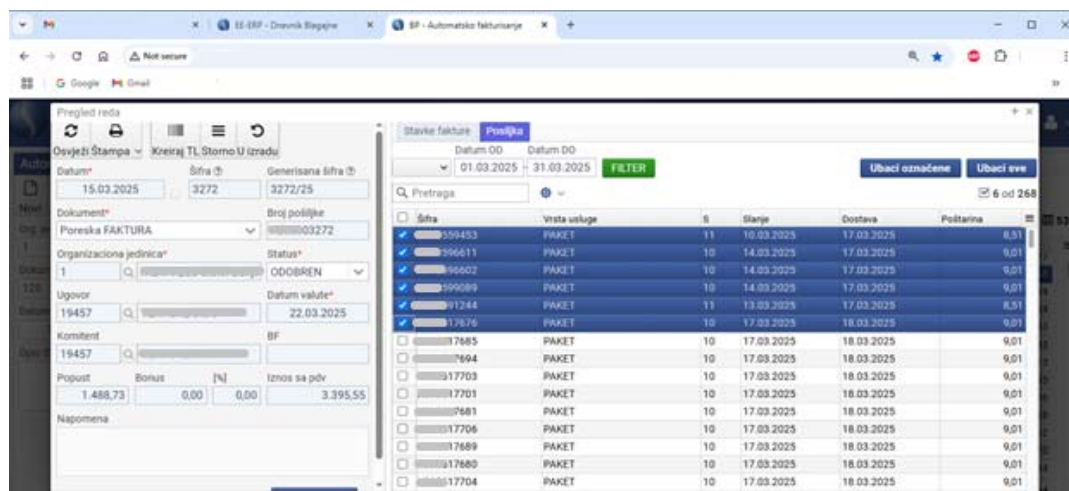
Broj	Datum	Sifra	Dokument	Iznos bez PDV	Iznos sa PDV
3272	15.03.2025	3272/25	Poreska FAKTURA	2.902,18	3.395,55
2931	15.03.2025	2931/25	Poreska FAKTURA	233.048,67	272.666,94
3274	15.03.2025	3274/25	Poreska FAKTURA	283,45	331,64
3278	15.03.2025	3278/25	Poreska FAKTURA	783,27	916,43
3280	15.03.2025	3280/25	Poreska FAKTURA	187,03	218,83
3281	15.03.2025	3281/25	Poreska FAKTURA	36,01	42,13
3263	15.03.2025	3263/25	Poreska FAKTURA	1.110,64	1.299,45
3282	15.03.2025	3282/25	Poreska FAKTURA	1.095,60	1.281,86
3283	15.03.2025	3283/25	Poreska FAKTURA	9.816,39	11.485,18
3285	15.03.2025	3285/25	Poreska FAKTURA	18,48	21,62
3024	15.03.2025	3024/25	Poreska FAKTURA	369,83	432,70
3286	15.03.2025	3286/25	Poreska FAKTURA	140,46	164,34
				471.733,13	551.927,64

Picture 1: Automatic Invoicing
Source: Integrated information system „Sinergis“

On Picture 1, individual invoicing for each client is displayed. Each of these invoices represents the total amount for all shipments delivered within a specific period. This process could also be performed manually, but it would be an extremely tedious and time-consuming task. For this reason, the integrated information system was developed to speed up the invoicing process for each client using the system.

It is important to note that only shipments for which the courier service has successfully completed the delivery are invoiced.

Each client is entered through the Client drop-down menu, where, in addition to entering new clients, incorrect data for a specific client can be modified or deleted, or an entered client can be completely removed.



Sifra	Vrsta usluge	Broj	Datum	Dostava	Poština
59453	PAKET	11	10.03.2025	17.03.2025	8,51
59611	PAKET	10	14.03.2025	17.03.2025	9,01
56602	PAKET	10	14.03.2025	17.03.2025	9,01
59689	PAKET	10	14.03.2025	17.03.2025	9,01
11244	PAKET	11	13.03.2025	17.03.2025	8,51
17676	PAKET	10	17.03.2025	18.03.2025	9,01
7685	PAKET	10	17.03.2025	18.03.2025	9,01
7694	PAKET	10	17.03.2025	18.03.2025	9,01
17703	PAKET	10	17.03.2025	18.03.2025	9,01
17701	PAKET	10	17.03.2025	18.03.2025	9,01
7681	PAKET	10	17.03.2025	18.03.2025	9,01
17706	PAKET	10	17.03.2025	18.03.2025	9,01
7689	PAKET	10	17.03.2025	18.03.2025	9,01
17680	PAKET	10	17.03.2025	18.03.2025	9,01
17704	PAKET	10	17.03.2025	18.03.2025	9,01

Picture 2: Review of Individual Deliveries by a Courier Service

On Picture 2, individual invoices for each courier delivery are displayed. The process by which automatic invoicing is carried out is as follows: when a courier arrives at the recipient's address with a package, they use a mobile application on a smartphone or tablet to record the successful delivery. The delivery information is then stored in a database. The integrated information system retrieves this data and, based on all necessary information, generates an invoice.

All invoice elements are automatically calculated, including amounts with and without VAT. The generated invoice is treated like any other invoice and is suitable for recording in KIF registers. This automation eliminates the need for manual work in creating invoices for each client.

The shipment delivery and invoicing process is as follows:

- The courier arrives at the recipient's address with the shipment.
- If the recipient is not at the address, the mobile application registers that the package was not delivered and will be taken to a local post office. A notification with the package's location is sent via email or phone message.
- If the recipient is present, the package is delivered by scanning the barcode on the shipment or manually entering the tracking number if barcode scanning is not possible.
- After scanning the barcode, the recipient confirms receipt with a signature.
- The successful delivery is recorded in the central database.
- Based on the recorded data, the system retrieves the necessary information to generate an invoice for the shipment delivery.

The invoice is saved in a predefined format (e.g., PDF) and can be printed, recorded in KIF, or electronically stored in the directory where outgoing invoices are tracked.

The automation of invoice management within the ERP system also supports automatic posting to the general ledger, automatic invoice emailing, and automatic invoice-to-shipment conversion for delivery via the courier network in document form.

CONCLUSION

Technological advancement is a process with a clear beginning but no foreseeable end. Innovations in this field occur on a daily basis. In today's business environment, companies no longer have many choices other than to follow technological changes to maintain and improve their operations and market position.

Digital transformation, or the integration of technology into all aspects of business, has become imperative. If companies do not decide to support their operations digitally, it is only a matter of time before they are forced to do so or face the reality that their business has no future. Technology brings both opportunities and challenges; however, when considering the overall impact, the benefits significantly outweigh the drawbacks. While negative effects of technology adoption cannot always be avoided, they can at least be minimized through rational and appropriate use.

The development of technology has created concerns that many jobs will be reduced or even eliminated, leading to fears about how displaced workers will sustain their livelihoods. However, as with every previous technological advancement, when certain jobs become obsolete, a wide range of new job opportunities emerges, often with high demand for skilled workers. This indicates that technological progress encourages continuous education and skill development. Technologies such as artificial intelligence, cloud computing, IoT, machine learning, and integrated information systems create a vast number of new job opportunities necessary for their development and maintenance.

Integrated information systems—ERP (Enterprise Resource Planning) systems—have significantly improved the execution of numerous business operations. Implementing an ERP system requires substantial investment, but in the long run, it is highly cost-effective. ERP systems are introduced gradually, allowing companies to improve and digitally transform various business processes step by step. The combination of ERP and cloud technologies has led to the rise of cloud ERP systems, which are becoming increasingly popular.

A case study described in this paper demonstrates how ERP systems can automate numerous business processes that would otherwise be tedious due to their complexity and volume. The ERP system ensures that such processes are accelerated while minimizing errors. After the implementation of the ERP system in the express mail business, tasks that were time-consuming and laborious for the employees who performed them were automated and significantly simplified. The process of automating invoice management within the ERP system enabled automatic posting to the general ledger, automatic sending of invoices by email, and automatic conversion of invoices into shipments for delivery via the courier network in the form of a document. In this way, the probability of errors in the process of creating these important documents and their timely recording was reduced. Like any other technology, ERP systems offer opportunities for business improvement while also presenting challenges that must be overcome. However, access to the right information at the right time and the ability to reduce process execution time motivate companies to embrace and navigate these challenges.

As previously mentioned, maintaining or improving a market position is highly challenging. Consequently, small and medium-sized enterprises are increasingly compelled to adopt digital transformation, a process that requires significant

investment. Initially, there was resistance to innovations and ERP implementation due to a lack of financial resources and IT personnel within companies. Over time, more businesses have embraced digital transformation, and newly established companies are integrating digital technologies from the outset. This leads to the conclusion that digital transformation is no longer an option but a necessity.

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ANTECEDENTS OF CO-CREATION OF EXPERIENCE IN THE HOTEL INDUSTRY: STRUCTURAL EQUATION MODELING APPROACH

Abstract: The focus on consumers is prevalent in numerous service industries, including the hotel sector. In this context, it is crucial for management to analyze guest experiences continuously. This is particularly significant for luxury hotels offering wellness spa services. Through the use of these services, guests have the opportunity to experience individual transformation, both physical and psychological. The achieved sense of well-being surpasses satisfaction and often fosters a willingness among consumers to participate in improving existing services and actively creating new ones. One of the well-known models highlighting the key components of consumer experience is the new Experienscape model. According to the structure of this model, the following components of consumer experience are distinguished: sensory, functional, natural, social, cultural, and hospitality cultural components. In the Experienscape model, the consumer is an active participant who strives to co-create their experience, transform it, and achieve satisfaction with the service and their life. This paper aims to identify the components of the Experienscape model that most significantly drive the co-creation of consumer experience. Structural equation modeling was applied to test causal relationships. The results of the study can provide a valuable foundation for improving the strategy of developing long-term relationships between hotels and users of their wellness spa services.

Keywords: hotel industry, wellness spa, Experienscape model, co-creation of experience

1. INTRODUCTION

Customers frequently alter their behaviors based on the surrounding environment, and recent trends have shown that changes in global markets, especially within the hotel industry, have led businesses to adopt stricter measures and innovate to address evolving challenges. These adaptations have produced positive results in the short term (Sharma et al., 2021). Service quality plays a critical role in building customer confidence and satisfaction, impacting various levels within a hotel organization (Sureshchandar et al., 2002). Key factors influencing customer satisfaction in the hotel industry include cleanliness, aesthetics, integrity, functionality, reliability, and security. These aspects are often significant sources of dissatisfaction and are associated with tangible service elements (Johnston, 1997). They continue to be top priorities for hotels and are expected to influence customers' decisions when choosing a hotel for booking (Sampaio & Régio, 2022).

The hotel industry is characterized by intense competition and a wide range of offers, making it challenging for hotel brands to stand out. (Veloso & Gomez-Suarez, 2023). When guests visit a hotel, they interact with a variety of products and services offered by the establishment. The quality of their experience is shaped by whether these offerings meet their needs and expectations. On the other hand, the nature of services provided in the hotel industry is hedonic, while the outcome of consuming these services is primarily psychological (Hemmington, 2007; Walls, Okumus, & Wang, 2011). Due to these characteristics, the hotel service sector is one of the most experience-intensive sectors. Given the

involvement of consumers in the service creation process, examining their experience is of great importance. Hemsley-Brown (2019) define customer experience in the hospitality industry as the “cognitive and emotional assessment of direct and indirect contacts with the service organization, physical environment, and social environment, coupled with the psychological, symbolic and cognitive outcomes accorded to the customer from specific encounters”.

Measuring consumer experience has gained increasing attention from experts in marketing, tourism, and hotel management, with recent studies focusing on the concept of transformative experience. This type of measurement is particularly crucial in the hotel industry. In this context, the **Servicescape** plays a pivotal role by shaping the overall experience and influencing customer perceptions, which in turn affects their sense of well-being and transformation. By examining the physical, social, and emotional elements of the hotel environment, the **Experienscape model** offers a comprehensive framework to better understand these triggers and how they impact the guest's experience.

In today's competitive market, many hospitality businesses are becoming more customer-focused and offering experience-based services (Knutson et al., 2006). Their goal is to create memorable experiences by not just meeting but exceeding the expectations of customers or tourists (Van Boven and Gilovich, 2003). Some companies aim to provide multicultural and immersive experiences (Scott et al., 2009; Miao, 2011) by engaging guests on sensory, emotional, cognitive, behavioral, and relational levels, rather than simply offering functional services (Pine & Gilmore, 2013; Lashley, 2008). These businesses focus on experience co-creation, where both the company and the guest actively collaborate to shape the overall experience. Ultimately, they strive to build interactions that foster shared value creation with their guests.

As businesses in the hospitality sector become more customer-focused and experience-driven, it becomes essential to identify the key components of the Experienscape model that significantly contribute to the co-creation of meaningful and memorable experiences for guests. Considering the above mentioned, this paper aims to identify the components of the Experienscape model that most significantly drive the co-creation of consumer experience.

The paper is structured into several parts. After the introductory section, the second part of the paper covers the customer orientation in a hotel industry with a focus on the experience co-creation and Experienscape model dimensions. The third part of the paper includes an explanation of the research methodology used, while the fourth part presents the results of the conducted research. The conclusion discusses the theoretical and practical implications and highlights the limitations and directions for further research.

2. LITERATURE REVIEW

2.1. Customer Orientation in the hotel industry

Marketing is central to the successful implementation of business strategies, as today's competitive environment demands a continuous focus on delivering superior quality services to customers (Day & Wensley, 1988). In fact, Hening-Thurau et al. (2002) argue that because services are intangible and require a high level of integration and interaction with customers, a strong customer orientation is crucial for the economic success of service companies.

This importance is especially evident in the hotel industry, which has unique characteristics compared to other sectors. Hotels sell both tangible products and intangible services, making the marketing process particularly challenging. Consumers often purchase hotel services without experiencing them firsthand, and they rely on reviews, recommendations, and promotional materials to form expectations about their stay. Consequently, achieving sustainable success in hotel marketing depends on customer satisfaction (Uğurlu, 2020).

The concept of marketing orientation reinforces this idea by emphasizing a customer-centric approach - one that focuses on understanding and meeting consumer needs to generate long-term profit through satisfaction (Kotler & Armstrong, 1994). As Ruekert (1992) defines market or customer orientation, it involves gathering and using customer information to develop strategies that respond effectively to their needs. Building on this, Bruhn (1995) defines customer orientation as the ongoing process of collecting, analyzing, and implementing customer expectations to establish stable and economically advantageous relationships over time. Thus, for hotels, being customer-oriented is not merely a sales strategy; it is a fundamental approach that should permeate every level of the organization. Active implementation of customer orientation creates a knowledge base that enables hotel management and employees to continuously learn about the perceptions and needs of current and prospective guests, ensuring that the services offered truly align with what customers desire (Uğurlu, 2020).

All characteristics mentioned make the hotel sector one of the most experience-driven industries. Given the active involvement of consumers in shaping the service experience, analyzing their experience is crucial (Alnawas & Hemsley-Brown, 2019). This emphasis on consumer experience highlights the importance of interactions between businesses and customers, where value is created through engagement rather than being delivered solely by the company.

The success of hotel marketing relies on creating positive customer experiences. This focus on engagement sets the stage for value co-creation, where customers and businesses work together to enhance the service experience.

According Service-Dominant Logic, businesses cannot independently create value. Instead, value is co-created through interactions between the business and the customer. Co-creation is defined as customer participation in the creation of

products or services by applying resources such as time, effort, or ability (Payne, Storbacka, & Frow, 2008). In this framework, the customer is not just a passive recipient but an active partner who “creates value with the firm” (Lusch et al., 2007). Recent studies suggest the need for further research to better understand the process of value co-creation and the participants' perspectives, which is essential for improving the management of this collaborative process (Navarro et al., 2014). Co-creation with tourists in the hospitality industry is a widely studied phenomenon. Navarro et al. (2016) have examined the relationship between value co-creation and customer satisfaction in spa services. Some scholars have presented a framework for customer engagement and co-creation with reference to hospitality transactions (Chathoth et al., 2016).

2.2. Servicescape and Experienscape

The Servicescape plays a critical role in shaping customer perceptions and behaviors in the hospitality industry. It encompasses the physical and social elements of the hotel environment that influence how customers interact with the space and make purchasing decisions. The Servicescape of a hotel significantly influences customer purchasing behavior and market segmentation (Hee Lee & Lee, 2015). Due to the simultaneous production and consumption inherent in the service industry, hotel customers often have limited knowledge of available services, leading to high levels of uncertainty and perceived risk (Reimer & Kuehn, 2005). In this context, Servicescape components enhance customer awareness of the hotel's offerings and facilitate informed evaluations (Artuğer, 2020).

Kotler (1973) defines Servicescape as “design of buying environments to produce specific emotional effects in the buyer that enhance his or her purchase probability”. More specifically Rosenbaum and Massiah (2011) found that “Servicescape comprises not only objective, measureable, and managerially controllable stimuli but also subjective, immeasurable, and often managerially uncontrollable social, symbolic, and natural stimuli, which all influence customer approach/avoidance decisions and social interaction behaviors”. Bitner (1992) categorized Servicescape into three key dimensions: ambient conditions, spatial layout, and signs, symbols, and artifacts. Ambient conditions encompass sensory elements such as temperature, lighting, noise, music, and scents, which influence the overall atmosphere. Spatial layout pertains to the arrangement of furnishings and equipment within a service environment, ensuring functionality and ease of movement (Siu et al., 2012). Signs, symbols, and artifacts serve as visual and interactive cues that communicate information, guiding customer behavior and shaping perceptions of the space (Liu & Jang, 2009).

However, Bitner's original Servicescape model did not account for the natural, cultural, and social aspects of the environment, which can Liu significantly enhance and transform the consumer experience (Dimitrovski et al. 2024). To address this limitation, Pizam and Tasci (2019) introduced the Experienscape model, an advanced framework that evaluates consumer experience through six key environmental components: sensory, functional, natural, social, cultural hospitality culture component. This model extends the traditional Servicescape concept, making it particularly suited for measuring and enhancing experiences in service industries like hospitality (Line & Hanks, 2020).

The “Experienscape”, widely considered synonymous with “Experiencescape”, refers to the “experience landscape” in which experiences are co-constructed (Pizam and Tasci, 2019). To provide a deeper understanding of the Experiencescape framework, the following dimensions will be explained as key components contributing to a memorable and satisfying customer experience.

Sensory Experienscape dimension encompasses visual, auditory, olfactory, tactile, and taste stimuli that enhance customer satisfaction and emotional connection (Dimitrovski et al., 2024). When customers perceive the atmosphere as favourable (for example attractive design and layout, pleasant music and comfortable lighting), such visual and sensory stimuli have the potential to enhance their on-site experiences (Chen et al. 2024).

Hotels, give significant attention to the functional aspects of the experience setting (Dimitrovski et al., 2024). Functional Experienscape focuses on the physical layout, furniture, and equipment that ensure comfort and ease, improving customer experience (Bitner 1992). Social dimension covers interactions between customers and staff, social atmosphere, and crowdedness, shaping the overall experience. This dimension was not part of Bitner's (1992) Servicescape but was used by other studies (Jang et al., 2015). Social interaction has long been recognized as a key factor in enhancing experience satisfaction in hospitality, whether it occurs between guests and hotel staff or among guests themselves (Dimitrovski et al., 2024). Rosenbaum and Massiah (2011) included a natural dimension to servicescape. This dimension includes green spaces, natural lighting, and scenic views that promote relaxation, well-being, and satisfaction. Pizam and Tasci (2019) defined hospitality culture as “a system of shared norms, values, beliefs, traditions and expectations whose ultimate goal is to provide exceptional service and memorable experiences to all the organization's stakeholders.”

Radic et al (2021) state that, in the tourism field, the concept of the Experienscape is relatively new and under-researched. However, despite its novelty, some scholars have already begun exploring this topic, shedding light on its potential impact across various tourism and hospitality contexts. Quan and Wang (2004) discussed the early mention of the “Experienscape” concept in tourism research. They laid the groundwork for understanding how the environment in which services are consumed affects customer experiences and satisfaction. Lemon and Verhoef (2016) highlighted the growing importance of customer experiences in tourism and hospitality, arguing that creating memorable experiences is a key objective for businesses in these industries. Similar to Quan and Wang (2004), O'Dell (2005) explored the concept

of, focusing on its application in tourism. They emphasized the role of the physical environment in shaping tourist experiences and the significance of emotional and sensory elements in creating memorable experiences. Dimitrovski et al (2025) found that besides social, all other dimensions of Experienscape are positive drivers of guest satisfaction with a wellness spa hotel experience.

All the Experienscape model components shape the overall guest experience. These components create a setting in which customers are not just passive recipients but active contributors, fostering experience co-creation. In this context, by engaging with the hotel's physical, social, and cultural cues, guests help tailor and enhance their own service experience, which in turn drives long-term customer satisfaction and value for the business (Kandampully et al., 2022). This interplay between the Experienscape elements and active guest participation ultimately leads to a more personalized, memorable, and co-created experience that benefits both customers and service providers.

1. METHODOLOGY

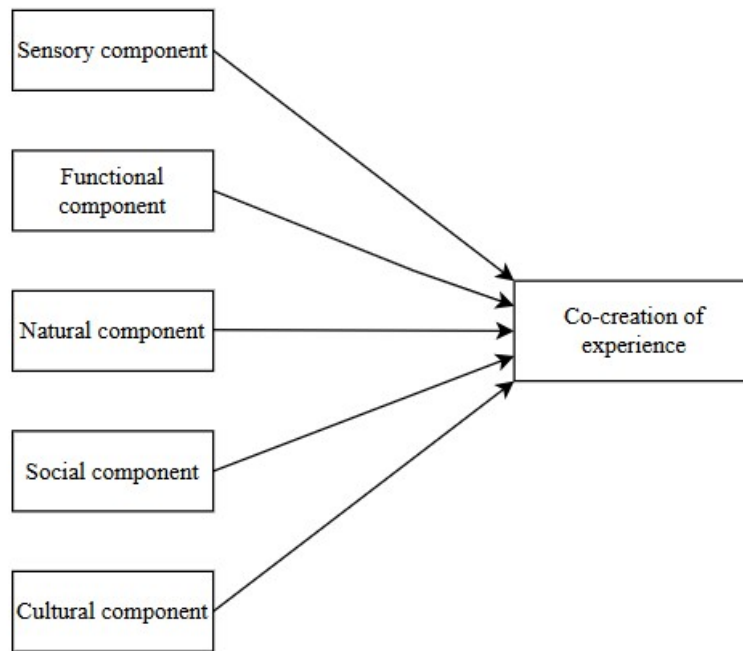
The research was conducted on a random sample of 567 respondents who, after the end of the Covid-19 pandemic, visited at least once one of the hotels in the Republic of Serbia offering wellness spa services. The researchers aimed to examine various components of the user experience of wellness spa services in hotels during the post-pandemic period, considering that the pandemic significantly changed the concept of how wellness spa hotels operate. Today, guests visit these hotels much more for health reasons, and physical and mental well-being, compared to the period before the pandemic.

For the random selection of respondents, a sampling frame containing basic demographic data on guests of luxury hotels in the Republic of Serbia over the past five years was used. Additionally, before the interviews began, each contacted respondent was asked a filter question about whether they had used wellness spa services in hotels at least once after the pandemic. Only respondents who answered this question affirmatively met the criteria for participation in the research.

Looking at the sample structure, women dominate the sample (58.7%), respondents with a university degree make up 39.5%, and in terms of age, the sample predominantly consists of members of Generations Y and Z (60.8%).

The study primarily analyses the concept of guest experience in the context of using hotel wellness spa services. Specifically, the study examines the following components of experience: sensory, functional, social, natural, and hospitality culture components, measuring their impact on the co-creation of guest experience. These experience components were selected based on the structure of the Experienscape model (Pizam and Tasci, 2019). The proposed model represents an adaptation of the original Experienscape model, as it does not include the cultural component, given that the sample consisted of domestic guests. Unlike numerous studies where satisfaction or a specific loyalty component is positioned as the dependent variable, this research focuses on co-creation as a crucial determinant of consumers' willingness to actively engage in the process of improving existing and creating new services, thereby enhancing their overall experience with hotel wellness spa services. The research model is presented in Figure 1.

Respondents expressed their level of agreement with the questionnaire statements using a seven-point Likert scale. Each of the six constructs was measured through at least three statements derived from relevant literature sources. Specifically, the basis for formulating the statements measuring the guest experience components was the study conducted by Pizam and Tasci (2019). The statements measuring the co-creation of experience were taken from the study conducted by Carù and Cova (2007).



Picture 1: Research model
Source: Authors' research

When it comes to the data analysis, in the first step we tested the reliability, validity and model fit. For the purpose of reliability analysis, we calculated Cronbach alpha values for each construct (reliability test). Then we examined the average variance extracted (AVE) for every single latent variable (convergent validity test). In addition, we used following indicies to test the model fit: χ^2/df ; goodness-of-fit index (GFI); normed fit index (NFI); comparative goodness of fit (CFI); Tucker–Lewis Index (TLI); incremental fit index (IFI); relative fit index (RFI); root mean square error of approximation (RMSEA). In the second step, we used structural equation modelling (SEM) to test the effects of five Experiencescape components on the Co-creation of experience.

3. RESEARCH RESULTS

To determine the internal consistency of the statements used to measure the latent variables in the model, Cronbach's alpha coefficients were calculated. The value of this indicator ranges from 0 to 1, and the internal consistency of the statements, i.e., the reliability of the variables, is considered good if Cronbach's alpha exceeds 0.7 (Nunnally, 1978). For all five components of the experience, Cronbach's alpha is above 0.8, with the highest reliability observed in the natural component (0.92). Cronbach's alpha for the co-creation of experience is 0.83.

The results of the model fit testing are presented in Table 1. The model demonstrates a good fit, as the χ^2/df value falls within the desired range of 2–5 (Marsh and Hocevar, 1988). Additionally, the values of GFI, CFI, TLI, IFI, NFI, and RFI indices exceed 0.9. Furthermore, the RMSEA value is below 0.08 (Hair, Black, Babin, Anderson, and Tatham, 2006). It is important to note that the model also meets the criterion for convergent validity, as the average variance extracted (AVE) for each construct exceeds 0.5 (Fornell and Larcker, 1981).

Table 1: The model – fit indicies

Fit indicies	Recommended value	Measurement model
χ^2 / df	between 2 and 5	2.91
GFI	> 0.9	0.91
CFI	> 0.9	0.95
TLI	> 0.9	0.94
IFI	> 0.9	0.95
NFI	> 0.9	0.93
RFI	> 0.9	0.92
RMSEA	< 0.08	0.06

Source: Authors' research.

Table 2: Results of Structural equation modeling

Relationship	Estimate	Significance
Sensor component → Co-creation of experience	0.400	$p < 0.01$
Functional component → Co-creation of experience	0.339	$p < 0.05$
Social component → Co-creation of experience	0.598	$p < 0.01$
Natural component → Co-creation of experience	0.181	$p < 0.1$
Hospitality culture component → Co-creation of experience	0.163	$p > 0.1$

Source: Authors' research.

In the main part of the statistical analysis, structural equation modeling (SEM) was applied to examine the causal relationships between constructs. The coefficient of determination is 0.36, meaning that 36% of the variability of co-creation of experience is explained by the regression model. Of the 5 tested effects, 4 were found to be statistically significant. The results of the SEM analysis are presented in Table 2.

The strongest influence on co-creation of experience comes from the social component. This result suggests that interactions with other guests and hotel staff positively contribute to the respondents' willingness to actively engage in the co-creation process of hotel wellness spa services. The effects of the sensory and functional components are also significantly pronounced. The experience of functional elements such as room design, reception, hotel interior, and equipment in the wellness spa center, as well as the feeling of relaxation provided by various wellness treatments, encourage guests' readiness to participate in service improvement. The influence of the natural component, i.e., the landscape and hotel environment on co-creation of experience, is weaker but still statistically significant. The only component that does not significantly affect co-creation of experience is the hospitality culture component. This result is surprising but likely suggests that guests are primarily willing to offer advice to managers on how to improve their services through interactions with employees and based on their perceptions of hotel rooms, restaurants, wellness center facilities, and external surroundings, but they do not show interest in engaging in the process of improving the overall hospitality strategy of the hotel, which requires a more detailed strategic analysis. In contrast, many elements of the remaining experience components can be improved through appropriate tactical decisions. Additionally, the hospitality culture component, aside from focusing on consumers, also involves relationships with other relevant stakeholders, and in this context, hotel guests may not be sufficiently informed or interested in this aspect of hotel operations.

4. CONCLUSION

Consumer experience analysis is an important activity in contemporary marketing research. In the context of hotel business, it is crucial to identify those factors that allow consumers to undergo a complete individual transformation during their stay, both physically and psychologically. One of the most comprehensive models that allows the measurement of various components of experience, and which adapts very well to the context of hotel business, is the **Experienscape** model. The concept of this model highlights six key components of experience: sensory, functional, natural, social, cultural, and hospitality cultural components. The aim of the conducted study was to identify the component of the **Experienscape** model that most significantly encourages consumers' willingness to actively engage in the process of improving hotel wellness spa services. The results identified the social component as the strongest determinant, but both the sensory and functional components also have a very strong influence on the **co-creation of consumer experience**.

The paper provides several important theoretical implications. The effects of the components of the consumer experience in hotel wellness spa services on the **co-creation of experience** were measured, which gives the paper particular innovativeness. A multi-variable approach was applied in the measurement of experience, where five components of experience were isolated in accordance with the **Experienscape** model. This model has been tested in a very small number of studies in the hospitality industry so far. The scientific contribution of the paper also lies in the fact that in the proposed model, **co-creation of experience** is positioned as the dependent variable. This is a very important variable that reflects consumers' willingness to actively participate in the process of improving services and their own experience, thus providing management with useful input for enhancing existing business strategies.

The study also has several limitations. It was conducted at a single point in time, so successive measurements would contribute to identifying changes in consumer experience. Additionally, the sample included only domestic guests of luxury hotels in the Republic of Serbia, which means that the results do not have a global character. It would be useful for future research to conduct multigroup structural equation modeling to track differences in the strength of variable relationships in the model between observed segments. Finally, future models may include new variables such as affective attachment and behavioral intentions.

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CONSUMER PERCEPTIONS OF AI USE IN RETAIL

Abstract: All supply chain members, from suppliers to retailers, should adjust and synchronize their activities to meet consumer needs. Consumers are not only the final destination in the flow of products and services but also a crucial starting point for many supply chain management (SCM) activities. Various technologies and advancements are continuously developed and implemented to ensure the right value is delivered at the right time and place. Among these technologies, artificial intelligence (AI) has gained increasing attention, influencing nearly all aspects of supply chain management. From a consumer perspective, the application of AI is particularly significant in the retail sector, where both online and offline transactions take place. To effectively integrate AI solutions with consumer preferences, it is essential to analyze their perceptions. Therefore, in addition to discussing supply chain management and the application of AI technology, this research examines consumer perceptions of AI use in retail.

Keywords: Consumer, Artificial Intelligence, Retailer, Supply Chain Management

1. INTRODUCTION

The increased competition within the business environment, along with uncertainty and dynamism, presents challenges that attract significant attention in supply chain management; additionally, a crucial role is played by the need to satisfy increasingly demanding consumer expectations (Sandberg & Jafari, 2018).

These challenges affect all SCM members, especially retailers, due to their supply chain characteristics. According to Ge et al. (2019), the retail supply chain differs from the manufacturing supply chain in three key ways: it involves a large number of partners and end customers, has inventory costs as a major expense, and needs to focus on fulfillment in terms of service quality and delivery speed. Hence, retailers are compelled to operate more efficiently and invest significant effort in understanding consumer requirements.

To achieve this, various technologies and advancements are continuously developed and implemented, with artificial intelligence now playing a crucial role. Therefore, after reviewing several studies on this topic, the research methodology and results regarding consumer perceptions of AI use in retail are presented.

2. LITERATURE REVIEW

Described as „algorithms, programmes, robots, and other systems that mimic intelligent human behaviour“, artificial intelligence has the potential to enhance a product's or service's intelligence and, consequently, impact the retail sector

(Mohanty et al., 2023, p. 1098). According to the Consumer Technology Association, its main benefits in the retail business include cost savings, increased productivity, automated processes and tasks, faster delivery of new products and services, greater innovation, and the ability to identify new revenue stream (Figure 1).

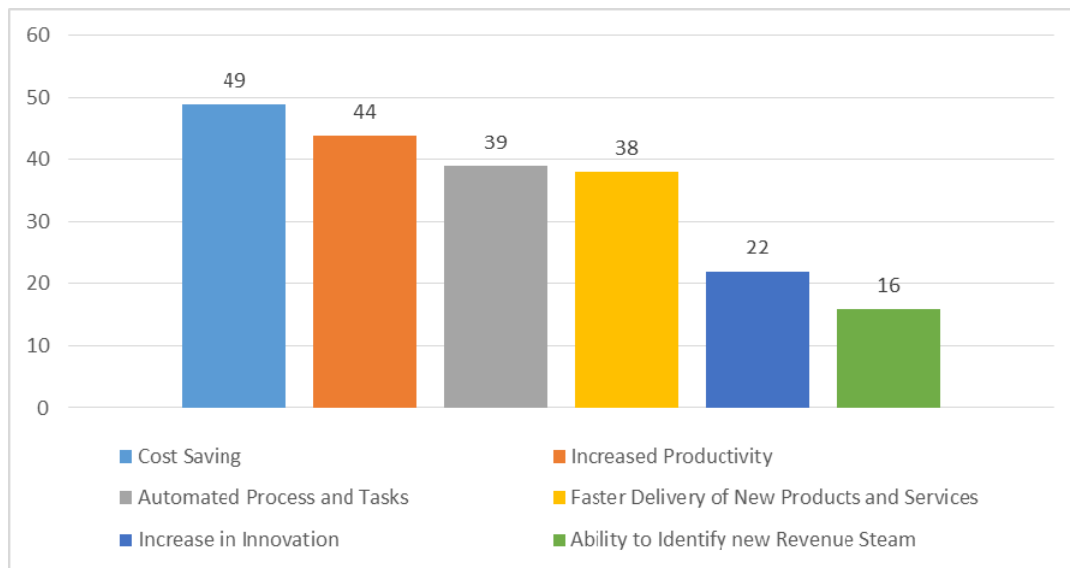


Figure 1: Benefits of Artificial Intelligence for Retail Business, in %, Global, 2018

Source: Mohanty et al. (2023, p. 1101)

The research by Anica-Popa et al. (2021) focused on identifying the practical benefits and risks associated with the implementation of AI in the retail sector. As a result, they developed a conceptual framework, abbreviated as CECoR, where CE stands for customer experience (which can be improved through the use of virtual agents), Co for cost (which can be reduced with the implementation of smart shelves), and R for revenue (which can be increased through product recommendations and the personalization of offers or discounts).

Certain studies emphasize consumers' perceptions of AI in the retail context. For instance, Bunea et al. (2024), based on the TAM model, examined the influence of AI tools on purchase intentions in online settings, focusing on Generation Z. Similarly, Myin and Watchravesringkan (2024) also relied on the TAM model, incorporating behavioral reasoning theory, and developed and tested a conceptual model to examine consumers' intention to use AI chatbots in apparel shopping. On the other hand, Purcărea et al. (2021) explored consumers' perceptions of artificial intelligence regarding its use in retail.

3. RESEARCH METHODOLOGY

This study aimed to conduct an initial assessment of consumers' perceptions of AI-enabled interactions with retailers, and a sample size of 31 was deemed sufficient for this purpose. The majority were female (over 70%), with an average age of 24. The findings provide an early understanding of this topic and serve as a foundation for more extensive future research.

Accordingly, we adapted 14 statements from the study by Purcărea et al. (2021). They were evaluated using a 5-point Likert scale, where 1 represents „totally disagree“ and 5 represents „totally agree“:

1. Interaction with a retailer through artificial intelligence (AI) enables a higher level of personalization (P1).
2. Interaction with a retailer through artificial intelligence (AI) is more reliable (P2).
3. Interaction with a retailer through artificial intelligence (AI) provides better privacy protection and security of personal data (P3).
4. Interaction with a retailer through artificial intelligence (AI) requires less personal effort (P4).
5. Interaction with a retailer through artificial intelligence (AI) allows for faster resolution of customer support issues (e.g., via chatbots or virtual agents) (P5).
6. Interaction with a retailer through artificial intelligence (AI) is available 24/7 (P6).
7. Interaction with a retailer through artificial intelligence (AI) provides greater control over the communication process (P7).
8. There are other aspects of interaction with a retailer through artificial intelligence (AI) that suit me (P8).
9. Interaction with a retailer through artificial intelligence (AI) provides an experience similar to interacting with a human (P9).
10. Interaction with a retailer through artificial intelligence (AI) enables greater empathy (P10).

11. Interaction with a retailer through artificial intelligence (AI) allows for a better understanding of emotions and more appropriate responses to them (P11).
12. Interaction with a retailer through artificial intelligence (AI) demonstrates human-like intellect (P12).
13. Interaction with a retailer through artificial intelligence (AI) is supported by a voice similar to a human voice (P13).
14. Interaction with a retailer through artificial intelligence (AI) has other human-like qualities (e.g., pleasant conversation) (P14).

In addition to descriptive statistics, the ANOVA approach was used to analyze differences among the applied statements. All analyses were conducted using the statistical software SPSS.

4. RESULTS

The overall mean value of all statements was 3.29. The mean values of responses to AI-related statements are detailed in Table 1.

Table 1: Descriptive statistics

Statements	N	Minimum	Maximum	Mean	Std. Deviation
P1	31	2	5	3.77	1.055
P2	31	1	5	2.77	1.055
P3	31	1	5	3.06	1.209
P4	31	2	5	4.32	0.909
P5	31	2	5	4.03	0.836
P6	31	3	5	4.71	0.529
P7	31	2	5	3.39	1.202
P8	31	2	5	3.65	0.798
P9	31	1	5	2.71	1.296
P10	31	1	5	1.90	1.193
P11	31	1	5	2.06	1.237
P12	31	1	5	3.03	1.048
P13	31	1	5	3.26	1.064
P14	31	2	5	3.39	0.919

Source: Authors

As shown, the highest average value (4.71) was recorded for statement P6, referring to 24/7 availability. Statements P4 and P5, related to reduced personal effort and customer support, also recorded average values above 4.

On the other hand, the lowest mean value (1.90) was recorded for statement P10, which is associated with empathy. Other statements with mean values below 3 were P2, P9 and P11, related to reliability, human-like experience and understanding of emotions. All mean values are visually represented in Figure 1.

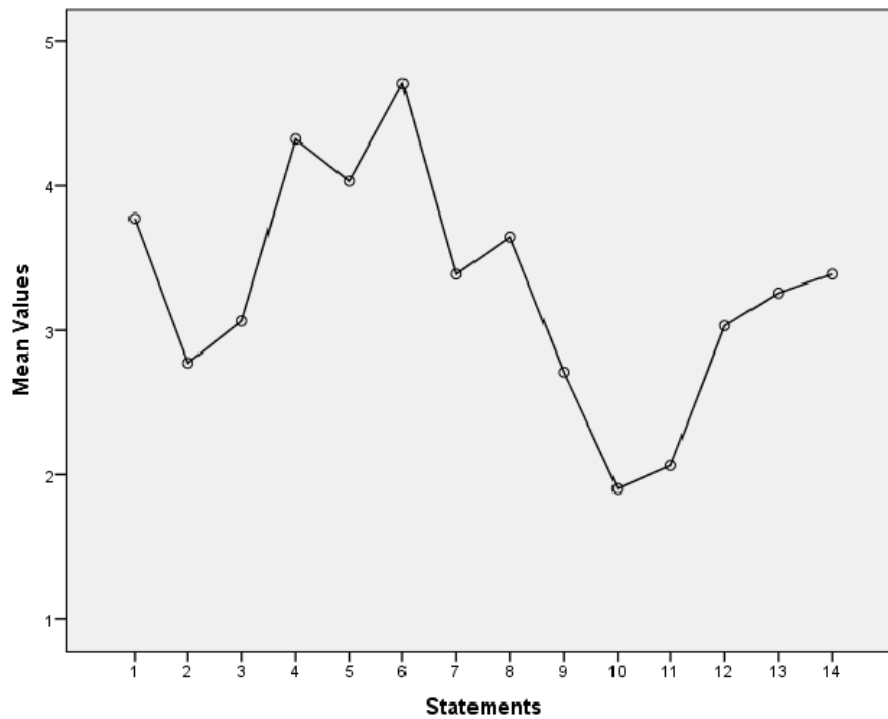


Figure 2: AI perceptions – Statements
Source: Authors

To test the significance of differences among them, the ANOVA method was applied, and the results are presented in Table 2.

Table 2: ANOVA method

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	252.903	13	19.454	17.820	0.000
Within Groups	458.516	420	1.092		
Total	711.419	433			

Source: Authors

Given that the p-value was lower than 0.05 ($p = 0.000$), it can be concluded that there is a statistically significant difference in the mean values of respondents' perceptions across the analyzed statements. To examine individual differences between statements, we applied the Tukey test for pairwise comparisons. The results for statements P6 and P10 are presented in Table 3.

Table 3: Tukey post-hoc test for P6 and P10

(I) P	(J) P	Mean Difference (I-J)	Sig.
6	1	0.935	0.031
	2	1.935	0.000
	3	1.645	0.000
	4	0.387	0.974
	5	0.677	0.375
	7	1.323	0.000
	8	1.065	0.005
	9	2.000	0.000
	10	2.806	0.000
	11	2.645	0.000
	12	1.677	0.000
	13	1.452	0.000
10	14	1.323	0.000
	1	-1.871	0.000
	2	-0.871	0.066
	3	-1.161	0.001
	4	-2.419	0.000

	5	-2.129	0.000
	6	-2.806	0.000
	7	-1.484	0.000
	8	-1.742	0.000
	9	-0.806	0.129
	11	-0.161	1.000
	12	-1.129	0.002
	13	-1.355	0.000
	14	-1.484	0.000

Source: Authors

The mean value of respondents' perception for P6 is statistically significantly higher than all other mean values, except for statements P4 and P5, where no significant difference was recorded. In the case of P10, statistically significant differences were observed compared to all other statements, except for P2, P9, and P11.

5. CONCLUSION

Market uncertainty and increasingly demanding customers compel retailers to modernize their supply chains by adopting new technological solutions. Nowadays, artificial intelligence (AI) is one of the key tools that can provide numerous benefits for both retailers and their partners.

However, before implementing any changes, it is essential to examine consumer perceptions. This study offers an initial assessment of perceptions toward AI use in retail. The overall mean value exceeded 3, indicating a relatively positive perception of AI-enabled interactions with retailers. The highest values were recorded for statements referring to the „technical“ aspects of AI applications, such as 24/7 availability, reduced personal effort, and customer support. Conversely, the lowest mean values were mostly associated with statements linked to „human“ and „emotional“ aspects. Thus, while AI is perceived as a useful tool for enhancing retailer-consumer interactions and improving efficiency, it lacks empathy and emotional sensitivity, which remain primarily associated with human employees.

Given these findings, it would be valuable to expand this research by incorporating a variable related to AI knowledge. Additionally, future studies could include respondent characteristics such as age, education, and other demographic factors to gain deeper insights into how different groups perceive AI in retail.

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RESEARCH OF THE DYNAMICS OF TRADE PERFORMANCE IN SERBIA USING THE PIPRECIA-S AND MARCOS METHODS

Abstract: Abstract text, up to 500 words (Style: SM-Abstract) Abstract: It is of great importance to measure the dynamics of Serbian trade performance using different methods of multi-criteria decision-making. In this way, a more realistic performance picture of trade in Serbia is obtained. Because several criteria are taken into account, the importance of which is determined mathematically. In this study, with this in mind, a study of the dynamics of trade performance in Serbia was carried out using the PIPRECIA-S (Pivot Pairwise Relative Criteria Importance Assessment) and MARCOS (Measurement Alternatives and Ranking according to Compromise Solution) methods. The results of the research show that trade in Serbia achieved the best performance in 2023. Next: 2022, 2021, 2020, 2019, etc. Efficient management of human capital, assets, capital, sales, and profit contributed to this. Also the increasingly favorable macroeconomic trends, as well as the increasing digitization of the entire business.

Keywords: performance, Serbian trade, PIPRECIA-S, MARCOS

1. INTRODUCTION

There is no doubt that the application of multi-criteria decision-making methods in the evaluation of store performance is of great importance (Ersoy, 2017). Using them, the performance of the store can be seen more realistically from different perspectives as alternatives (by individual countries, regions, sales channels, stores, suppliers, etc.). Because they use several criteria to measure store performance. The significance of the criteria is determined mathematically. In this study, the research on the dynamics of trade performance in Serbia is carried out using the PIPRECIA-S and MARCOS methods to improve it in the future. This reflects the goal and the main research hypothesis in this study. Recently, there has been an increasingly rich literature dedicated to the application of multi-criteria decision-making methods in the analysis of various problems in trade (Ersoy, 2017; Lukić, 2023b). In this study, all relevant literature serves as a theoretical, methodological, and empirical basis for a more complex investigation of the treated problem using the PIPRECIA-S and MARCOS methods. The analysis of the results obtained in this study is based on scientific interpretation and verification of validity. This enables their international comparison.

2. METHODOLOGY

The research methodology of the treated problem in this study, following the subject, the goal, and the defined main research hypothesis, is based on the application of multi-criteria decision-making methods, specifically PIPRECIA-S and MARCOS, the characteristics of which are shown below. This method originates from the PIPRECIA (Pivot

Pairwise Relative Criteria Importance Assessment) method (Stanujkić et al., 2017), which improves the computational aspects. Contrary to the PIPRECIA method, the comparison with the simple **PIPRECIA-S** method is made only about the first criterion, thereby facilitating the decision-making process. Like the PIPRECIA method, the simple PIPRECIA-S method does not require prior sorting of criteria according to expected significance, which makes it suitable for application in the case of group decision-making. The Simple PIPRECIA-S method is used to define the weight of criteria and solve decision-making problems in different areas of business (Aytakin, 2022; Sulistiani et al., 2023; Mladenović et al., 2023; Setiawansyah et al., 2024). The calculation procedure of the PIPRECIA-S method takes place through the following steps (Stanujkić et al., 2021; Mirčetić et al., 2024):

Step 1. Defining a set of evaluation criteria.

Step 2. Calculation of the relative importance s_j of each criterion, except the first one, as follows:

$$s_j = \begin{cases} 1 & \text{if } c_j \geq c_1 \\ 1 & \text{if } c_j = 1 \\ 1 & \text{if } c_j < 1 \end{cases} \quad (1)$$

Where $j \neq 1$. Similar to the PIPRECIA method, the value of s_j is equal to 1, while the values of c_j belong to the interval (1, 1.9] when $c_1 \geq c_j$, and to the interval [0.1, 1) when $c_1 < c_j$.

Step 3. Determining the value of the coefficient k_j as follows:

$$k_j = \begin{cases} 1 & \text{if } j = 1 \\ 2 - s_1 & \text{if } j > 1. \end{cases} \quad (2)$$

Step 4. Calculating the weight of the coefficient q_j again as follows:

$$q_j = \begin{cases} 1 & \text{if } j = 1 \\ \frac{1}{k_j} & \text{if } j > 1. \end{cases} \quad (3)$$

Step 5. Defining the relative weight of the criteria as follows:

$$q_j = \frac{q_j}{\sum_{k=1}^n q_k} \quad (4)$$

Step 6: In the case of group decision-making, the total weight coefficient of each criterion is determined using the following equation:

$$GM_j = \left(\prod_{k=1}^K w_j^k \right)^{1/K} \quad (5)$$

$$w_j = GM_j / \sum_{i=1}^n GM_i \quad (6)$$

Where GM_j is the geometric mean of the weighting coefficients obtained by the decision-makers included in the evaluation of criterion j , w_j denotes the weighting coefficient of criterion j , and K is the number of decision-makers.

The **MARCOS** (Measurement Alternatives and Ranking according to Compromise Solution) method is based on defining the relationship between alternatives and reference values (ideal and anti-ideal alternatives) (Đalić, 2020; Kovač, 2021; Miškić, 2021; Nedeljković, 2021; Puška, 2021; Stević, 2020a, b; Stanković, 2020; Trung, 2021). Based on the defined relationships, the utility functions of alternatives are determined and a compromise ranking is made about ideal and anti-ideal solutions. Decision preferences are defined based on a utility function. Utility functions represent the position of the alternative about ideal and anti-ideal solutions. The best alternative is the one that is closest to the ideal and at the same time furthest from the anti-deal reference point. The MARCOS method proceeds through the following steps (Stević, 2020a, b; Lukić, 2022a,b,c, 2023a,b,c):

Step 1: Formation of the initial decision-making matrix. A multi-criteria model involves defining a set of n criteria and m alternatives. In the case of group decision-making, a group of r experts is formed who evaluate the

alternatives in relation to the criteria. In this case, the matrices of expert evaluation are aggregated into initial matrices of group decision-making.

Step 2: Forming the expanded initial matrix. In this step, the expansion initial matrix is defined with ideal (AI) and anti-ideal (AAI) solutions.

$$X = \begin{matrix} & C_1 & C_2 & \dots & C_n \\ \begin{matrix} AAI \\ A_1 \\ A_2 \\ \dots \\ A_m \\ AI \end{matrix} & \begin{bmatrix} x_{aa1} & x_{aa2} & \dots & x_{aan} \\ x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \\ x_{a1} & x_{a2} & \dots & x_{an} \end{bmatrix} \end{matrix} \quad (7)$$

The anti-ideal solution (AAI) is the worst alternative. The ideal solution (AI) is, on the contrary, the alternative with the best characteristics. Depending on the nature of the criteria, AAI and AI are defined using the following equations:

$$AAI = \min x_{ij} \text{ if } j \in B \text{ and } \max x_{ij} \text{ if } j \in C \quad (8)$$

$$AI = \max x_{ij} \text{ if } j \in B \text{ and } \min x_{ij} \text{ if } j \in C \quad (9)$$

Where B represents the benefit and C the cost group of criteria.

Step 3: Normalization of the expanded initial matrix (X). The elements of the normalized matrix $N = [n_{ij}]_{m \times n}$ were obtained by applying the following equations:

$$n_{ij} = \frac{x_{ai}}{x_{ij}} \text{ if } j \in C \quad (10)$$

$$n_{ij} = \frac{x_{ij}}{x_{ai}} \text{ if } j \in B \quad (11)$$

Where the elements x_{ij} and x_{ai} represent the elements of the matrix X.

Step 4: Defining the weighting matrix $V = [v_{ij}]_{m \times n}$. The weighting matrix V is obtained by multiplying the normalized matrix N with the weighting coefficients of the criteria w_j using the following equation:

$$v_{ij} = n_{ij} \times w_j \quad (12)$$

Step 5: Determining the level of usefulness of alternatives K_i . The degree of usefulness of alternatives to anti-ideal and ideal solutions is determined using the following equations:

$$K_i^- = \frac{S_i}{S_{aa1}} \quad (13)$$

$$K_i^+ = \frac{S_i}{S_{a1}} \quad (14)$$

Where S_i ($i=1,2,\dots,m$) represents the sum of the elements of the weight matrix V, shown in the following equation:

$$S_i = \sum_{j=1}^n v_{ij} \quad (15)$$

Step 6: Determining the utility function of alternatives $f(K_i)$. The utility function is the compromise of the observed alternative about ideal and anti-ideal solutions. The utility function of alternatives is defined with the following equation:

$$f(K_i^-) = \frac{K_i^+ + K_i^-}{1 + \frac{1 - f(K_i^+)}{f(K_i^+)} + \frac{1 - f(K_i^-)}{f(K_i^-)}} \quad (16)$$

Where $f(K_i^-)$ represents the utility function of the anti-ideal solution and $f(K_i^+)$ represents the utility function of the ideal solution.

Utility functions about ideal and anti-ideal solutions are determined using the following equations:

$$f(K_i^-) = \frac{K_i^+}{K_i^+ + K_i^-} \quad (17)$$

$$f(K_i^+) = \frac{K_i^-}{K_i^+ + K_i^-} \quad (18)$$

Step 7: Ranking of alternatives. The ranking of alternatives is based on the final value of the utility function. The alternative that has the highest possible value of the utility function is preferred.

3. RESULTS AND DISCUSSION

In this study, the relevant criteria for measuring the performance of the store were chosen, due to their nature. These are number of employees (C1), assets (C2), capital (C3), sales (C4) and net profit (C5). Alternatives were observed from 2002 to 2023 (A1, A2,..., A22). Relevant data for researching the treated problem in this study are presented in Table 1.

Table 1: Initial data, 2002-2023

		(I) Number of employees	(I) Assets	(I) Capital	(O) Sale	(O) Net profit
		C1	C2	C3	C4	C5
A1	2002	159881	408777	155219	538446	7291
A2	2003	173615	511466	176372	678953	12444
A3	2004	173529	739522	214201	956885	23540
A4	2005	179895	1267296	582530	1220051	45310
A5	2006	187028	1440435	676899	1531190	70878
A6	2007	205215	1832673	790197	1971676	90281
A7	2008	215540	2101239	796758	2364978	84995
A8	2009	208595	2206975	803361	2243762	74201
A9	2010	202585	2080584	596110	2495934	80709
A10	2011	199718	2152946	664968	2689107	91637
A11	2012	193954	2354259	716558	2979785	93687
A12	2013	193210	2160474	746992	2891518	89730
A13	2014	191621	2157564	761305	2594602	86955
A14	2015	159621	2197931	805009	2731999	95265
A15	2016	206092	2324843	859749	3009651	105238
A16	2017	208020	2375290	920992	3172393	122727
A17	2018	219373	2524897	1007972	3361094	121816
A18	2019	222049	2682931	1073056	3608329	139409
A19	2020	227618	2837599	1183026	3664505	171010
A20	2021	234727	3166529	1318126	4754169	170703
A21	2022	234011	3490398	1426553	5511864	214917
A22	2023	239429	3882976	1600734	5737589	234843
	Statistics					
	Mean	201605.7273	2131709.2730	812576.6818	2759476.3640	101253.9091
	Median	203900.0000	2179202.5000	793477.5000	2710553.0000	90959.0000
	Std. Deviation	23194.66915	871468.56640	369228.77390	1382857.50700	58423.61117
	Minimum	159621.00	408777.00	155219.00	538446.00	7291.00
	Maximum	239429.00	3882976.00	1600734.00	5737589.00	234843.00
	Friedman Test					
	Mean Rank	2.05	4.05	2.95	4.95	1.0

	Test Statistics ^a					
	Chi-Square	86,473				
	df	4				
	Asymp. Sig.	.000				
	a. Friedman Test					

Note: (I) input, (O) output. The number of employees is expressed in whole numbers. Other data are expressed in millions of dinars.

Author's statistical calculations.

Source: Agency for Economic Registers of the Republic of Serbia

As in the specific case of Asymp. Sig. = 0.000 < 0.05, the hypothesis is rejected that the differences between the variables (measurements) (C1, C2, C3, C4, and C5) are equal to zero, that is, the differences between them are statistically significant. Table 2 shows the correlation of statistical variables.

Table 2: Correlation

Correlations		C1	C2	C3	C4	C5
C1	Pearson Correlation	1	.854 **	.871 **	.837 **	.861 *
	Sig. (2-tailed)		.000	.000	.000	.000
	N	22	22	22	22	22
C2	Pearson Correlation	.854 **	1	.967 **	.975 **	.961 **
	Sig. (2-tailed)	.000		.000	.000	.000
	N	22	22	22	22	22
C3	Pearson Correlation	.871 **	.967 **	1	.954 **	.978 **
	Sig. (2-tailed)	.000	.000		.000	.000
	N	22	22	22	22	22
C4	Pearson Correlation	.837 **	.975 **	.954 **	1	.977 **
	Sig. (2-tailed)	.000	.000	.000		.000
	N	22	22	22	22	22
C5	Pearson Correlation	.861 **	.961 **	.978 **	.977 **	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	22	22	22	22	22

** . Correlation is significant at the 0.01 level (2-tailed).

In this case, there is therefore a strong correlation between the variables at the level of statistical significance.

The weighting coefficients of the criteria calculated using the PIPRECIA-S method are shown in Table 3 and Figure 1.

Table 3: Weighting coefficients of criteria - PIPRECIA-S method

		s _j	k _j	what	w _j
C1	Number of employees		1	1.00	0.10
C2	Assets	1.7	0.3	3.333333	0.33
C3	Capital	1.6	0.4	2.50	0.25
C4	Sale	1.5	0.5	2.00	0.20
C5	Net profit	1.2	0.8	1.25	0.12
				10.08	1.00

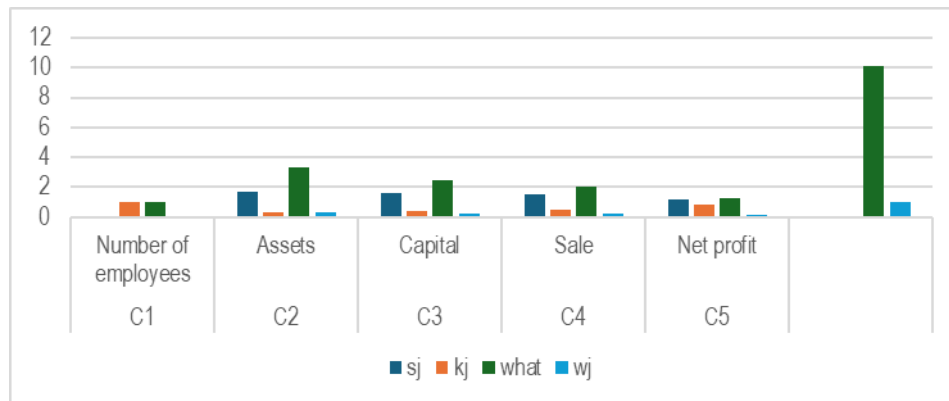


Figure 1: Weighting coefficients of criteria

Source: Author's picture

The most important criterion in the analyzed case is, therefore, assets. Assets in trade represent investment investments. An increase in investment per employee can have a significant impact on the realization of the desired profit in the trade of Serbia. Table 4 shows the process and results of the MARCOS method.

Table 4: Process and results of the MARCOS method

Initial Matrix					
weights of criteria	0.1	0.33	0.25	0.2	0.12
kind of criteria	1	1	1	1	1
	C1	C2	C3	C4	C5
A1	159881	408777	155219	538446	7291
A2	173615	511466	176372	678953	12444
A3	173529	739522	214201	956885	23540
A4	179895	1267296	582530	1220051	45310
A5	187028	1440435	676899	1531190	70878
A6	205215	1832673	790197	1971676	90281
A7	215540	2101239	796758	2364978	84995
A8	208595	2206975	803361	2243762	74201
A9	202585	2080584	596110	2495934	80709
A10	199718	2152946	664968	2689107	91637
A11	193954	2354259	716558	2979785	93687
A12	193210	2160474	746992	2891518	89730
A13	191621	2157564	761305	2594602	86955
A14	159621	2197931	805009	2731999	95265
A15	206092	2324843	859749	3009651	105238
A16	208020	2375290	920992	3172393	122727
A17	219373	2524897	1007972	3361094	121816
A18	222049	2682931	1073056	3608329	139409
A19	227618	2837599	1183026	3664505	171010
A20	234727	3166529	1318126	4754169	170703
A21	234011	3490398	1426553	5511864	214917
A22	239429	3882976	1600734	5737589	234843
MAX	239429	3882976	1600734	5737589	234843
MIN	159621	408777	155219	538446	7291

Extended Initial Matrix					
weights of criteria	0.1	0.33	0.25	0.2	0.12
kind of criteria	1	1	1	1	1
	C1	C2	C3	C4	C5
AAA	159621	408777	155219	538446	7291
A1	159881	408777	155219	538446	7291
A2	173615	511466	176372	678953	12444
A3	173529	739522	214201	956885	23540
A4	179895	1267296	582530	1220051	45310
A5	187028	1440435	676899	1531190	70878

A6	205215	1832673	790197	1971676	90281
A7	215540	2101239	796758	2364978	84995
A8	208595	2206975	803361	2243762	74201
A9	202585	2080584	596110	2495934	80709
A10	199718	2152946	664968	2689107	91637
A11	193954	2354259	716558	2979785	93687
A12	193210	2160474	746992	2891518	89730
A13	191621	2157564	761305	2594602	86955
A14	159621	2197931	805009	2731999	95265
A15	206092	2324843	859749	3009651	105238
A16	208020	2375290	920992	3172393	122727
A17	219373	2524897	1007972	3361094	121816
A18	222049	2682931	1073056	3608329	139409
A19	227618	2837599	1183026	3664505	171010
A20	234727	3166529	1318126	4754169	170703
A21	234011	3490398	1426553	5511864	214917
A22	239429	3882976	1600734	5737589	234843
AI	239429	3882976	1600734	5737589	234843

Normalized Matrix					
weights of criteria	0.1	0.33	0.25	0.2	0.12
kind of criteria	1	1	1	1	1
	C1	C2	C3	C4	C5
AAA	0.666674	0.105274	0.096967	0.093845	0.031046
A1	0.6678	0.1053	0.0970	0.0938	0.0310
A2	0.7251	0.1317	0.1102	0.1183	0.0530
A3	0.7248	0.1905	0.1338	0.1668	0.1002
A4	0.7514	0.3264	0.3639	0.2126	0.1929
A5	0.7811	0.3710	0.4229	0.2669	0.3018
A6	0.8571	0.4720	0.4936	0.3436	0.3844
A7	0.9002	0.5411	0.4977	0.4122	0.3619
A8	0.8712	0.5684	0.5019	0.3911	0.3160
A9	0.8461	0.5358	0.3724	0.4350	0.3437
A10	0.8341	0.5545	0.4154	0.4687	0.3902
A11	0.8101	0.6063	0.4476	0.5193	0.3989
A12	0.8070	0.5564	0.4667	0.5040	0.3821
A13	0.8003	0.5556	0.4756	0.4522	0.3703
A14	0.6667	0.5660	0.5029	0.4762	0.4057
A15	0.8608	0.5987	0.5371	0.5245	0.4481
A16	0.8688	0.6117	0.5754	0.5529	0.5226
A17	0.9162	0.6502	0.6297	0.5858	0.5187
A18	0.9274	0.6909	0.6704	0.6289	0.5936
A19	0.9507	0.7308	0.7391	0.6387	0.7282
A20	0.9804	0.8155	0.8235	0.8286	0.7269
A21	0.9774	0.8989	0.8912	0.9607	0.9152
A22	1.0000	1.0000	1.0000	1.0000	1.0000
AI	1	1	1	1	1

Weighted Normalized Matrix					
	C1	C2	C3	C4	C5
AAA	0.066667	0.03474	0.024242	0.018769	0.003726
A1	0.0668	0.0347	0.0242	0.0188	0.0037
A2	0.0725	0.0435	0.0275	0.0237	0.0064
A3	0.0725	0.0628	0.0335	0.0334	0.0120
A4	0.0751	0.1077	0.0910	0.0425	0.0232
A5	0.0781	0.1224	0.1057	0.0534	0.0362
A6	0.0857	0.1558	0.1234	0.0687	0.0461
A7	0.0900	0.1786	0.1244	0.0824	0.0434

A8	0.0871	0.1876	0.1255	0.0782	0.0379
A9	0.0846	0.1768	0.0931	0.0870	0.0412
A10	0.0834	0.1830	0.1039	0.0937	0.0468
A11	0.0810	0.2001	0.1119	0.1039	0.0479
A12	0.0807	0.1836	0.1167	0.1008	0.0459
A13	0.0800	0.1834	0.1189	0.0904	0.0444
A14	0.0667	0.1868	0.1257	0.0952	0.0487
A15	0.0861	0.1976	0.1343	0.1049	0.0538
A16	0.0869	0.2019	0.1438	0.1106	0.0627
A17	0.0916	0.2146	0.1574	0.1172	0.0622
A18	0.0927	0.2280	0.1676	0.1258	0.0712
A19	0.0951	0.2412	0.1848	0.1277	0.0874
A20	0.0980	0.2691	0.2059	0.1657	0.0872
A21	0.0977	0.2966	0.2228	0.1921	0.1098
A22	0.1000	0.3300	0.2500	0.2000	0.1200
AI	0.1	0.33	0.25	0.2	0.12

Results of the MARCOS Method									
		Si	Ki-	Ki+	f(K-)	f(K+)	f(K)		Ranking
	AAA	0.1481							
2002	A1	0.1483	1.0007	0.1483	0.1290	0.8710	0.1455	0.1455	22
2003	A2	0.1736	1.1715	0.1736	0.1290	0.8710	0.1703	0.1703	21
2004	A3	0.2142	1.4456	0.2142	0.1290	0.8710	0.2101	0.2101	20
2005	A4	0.3395	2.2917	0.3395	0.1290	0.8710	0.3331	0.3331	19
2006	A5	0.3958	2.6720	0.3958	0.1290	0.8710	0.3884	0.3884	18
2007	A6	0.4797	3.2383	0.4797	0.1290	0.8710	0.4707	0.4707	17
2008	A7	0.5189	3.5027	0.5189	0.1290	0.8710	0.5092	0.5092	12
2009	A8	0.5163	3.4850	0.5163	0.1290	0.8710	0.5066	0.5066	14
2010	A9	0.4828	3.2588	0.4828	0.1290	0.8710	0.4737	0.4737	16
2011	A10	0.5108	3.4480	0.5108	0.1290	0.8710	0.5012	0.5012	15
2012	A11	0.5447	3.6771	0.5447	0.1290	0.8710	0.5345	0.5345	9
2013	A12	0.5276	3.5615	0.5276	0.1290	0.8710	0.5177	0.5177	10
2014	A13	0.5172	3.4910	0.5172	0.1290	0.8710	0.5075	0.5075	13
2015	A14	0.5231	3.5310	0.5231	0.1290	0.8710	0.5133	0.5133	11
2016	A15	0.5766	3.8923	0.5766	0.1290	0.8710	0.5658	0.5658	8
2017	A16	0.6059	4.0898	0.6059	0.1290	0.8710	0.5945	0.5945	7
2018	A17	0.6430	4.3406	0.6430	0.1290	0.8710	0.6310	0.6310	6
2019	A18	0.6854	4.6263	0.6854	0.1290	0.8710	0.6725	0.6725	5
2020	A19	0.7361	4.9688	0.7361	0.1290	0.8710	0.7223	0.7223	4
2021	A20	0.8260	5.5754	0.8260	0.1290	0.8710	0.8105	0.8105	3
2022	A21	0.9191	6.2042	0.9191	0.1290	0.8710	0.9019	0.9019	2
2023	A22	1.0000	6.7502	1.0000	0.1290	0.8710	0.9812	0.9812	1
	AI	1.0000							

The conclusion, according to the results of the study, is that trade in Serbia achieved the best performance in 2023. Next: 2022, 2021, 2020, 2019, etc. In 2002, the worst performance of trade in Serbia was achieved. Recently, overall, the performance of trade in Serbia has significantly improved. This was influenced by efficient management of human capital, assets, capital, sales, and profit. The increasingly favorable macroeconomic indicators of Serbia (inflation, interest, exchange rate, foreign direct investments, reduced unemployment rate, and/or increased employment rate, etc.) contributed significantly to this. Digitalization of the entire business certainly plays a significant role in this. Likewise, the application of new business concepts (management of costs, customers, product categories, inventory, private label, sale of organic products, etc.). In the future, to obtain a realistic performance picture of trade in Serbia, as a result of the results of this study, different methods of multi-criteria decision-making should be used as much as possible. There are no restrictions regarding the availability of empirical data.

4. CONCLUSION

In this study, the research results showed that the application of PIPRECIA-S and MARCOS methods provides a realistic performance picture of trade in Serbia. This is also the case with the use of other multi-criteria decision-making methods. Therefore, generally speaking, they should be used as much as possible in the analysis of trade performance in Serbia, using different criteria and alternatives. Recently, it can be said freely according to the results of this study, the performance of trade in Serbia is getting better. The improvement of trade performance in Serbia was the result of the most efficient management of human capital, assets, capital, sales, and profit. Increasingly favorable macroeconomic trends (gross domestic product growth rate, inflation, interest, exchange rate, foreign direct investments, employment, living standards of the population, etc.) also contributed to this. In the context of this, it should be mentioned that the increasing digitization of the entire business and the application of new business models.

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COMPREHENSIVE ANALYSIS OF THE PERFORMANCE OF THE FMCG TRADE CHAINS IN THE REPUBLIC OF SERBIA WITH A FOCUS ON RETAIL PRICES.

Abstract: The business performance of FMCG trade chains in the Republic of Serbia came to the fore after the recently conducted investigation by the Commission for the Protection of Competition at the end of 2024 as well as after the mass boycott of large trade chains by consumers in the Republic of Serbia in February 2025. Do large retail chains in Serbia make extra profit? Are the price margins of large retail chains in Serbia unreasonably high? Are the prices on the domestic market significantly higher compared to the prices of the same products abroad? Is the FMCG trade sector in Serbia liquid, efficient and productive? This scientific work will try to answer these and other questions by analyzing a large number of business indicators of some of the largest trade chains in the Republic of Serbia. Indicators such as ROA, ROE, net profit margin, financial leverage, productivity coefficients, liquidity coefficients, short-term asset turnover rate, inventory turnover rate and others were used in the analysis. Gross margin and gross margin rate were used in order to analyze the size of price margins and the movement trend of those margins in previous years. The retail chains included in the analysis are the largest retail chains in the Republic of Serbia, therefore they are good represent of the entire branch. Analysed chains in this paper will not be mentioned by name, which will not diminish the importance of the analysis, since the subject of the analysis is the entire market. The aim of this work is to determine current situation and trends in the FMCG market, as well as to determine the adequacy and justification of the price policy of large retail chains in the Republic of Serbia.

Keywords: FMCG, Prices, Performance, Trade Chains, Republic of Serbia.

INTRODUCTION

Retail chains as an important element of the distribution system represent an important segment in the lives of consumers and influence the quality of their lives in terms of what they buy and at what price (Marić, Vukmirović, Nuševa, Vučenović, & Macura, 2024). In the Republic of Serbia, there has been a significant increase in FMCG retail prices in recent years. Public pressure has constantly raised the issue of the justification of these price increases.

In the first chapter, the authors analyzed the Serbian retail FMCG market, taking into analysis a sample of 8 large retail chains (some of them are the largest in the Republic of Serbia). These 8 chains were taken as a representative sample for the analysis of the entire retail FMCG market. Authors carried out research of profitability, financial leverage, stock turnover, economy, liquidity, productivity, EBITA, gross margin and other business success indicators of these retail chains. After each partial analysis, the authors commented on the obtained results. The data were taken from the official website of the Agency for Economic Registers.

In the second chapter, the authors analyzed the general rate of inflation, the real growth of FMCG prices and analyzed the comparison of domestic and foreign FMCG prices. The inflation rate was analyzed in order to prove the existence of general price growth, while the comparison was made in order to determine the existence or non-existence of significant difference in prices when it comes to identical products on the foreign market.

The aim of the work was not to judge whether the trade margins were large. The basic idea was to assess how much the retail chains influenced the evident increase in prices, and how much other factors contributed to it on the other hand. In other words, were the price increases that occurred justified or were they the result of the retail chains' pursuit of extra profits.

1. THE ANALYSIS OF FINANCIAL INDICATORS OF FMCG RETAIL CHAINS IN THE REPUBLIC OF SERBIA

Before presenting and interpreting the results of the analysis, the authors emphasize two aspects of retail chains business operations. First, retail chains are the last component of the distribution system, which in practice means that they are also often exposed to the increase in wholesale prices. A huge number of manufacturers, wholesalers, agents, distributors and other actors calculate their margins before the commodities even reach the shelves of retailers. All these manufacturers and wholesalers often raise the prices of their products due to rising costs they are exposed to (labor costs, electricity, etc.). Relationships in marketing channels can often be volatile which also leads to changes in pricing policies by the retailers (Končar, Vučenović, Vukmirović, & Marić, 2020). Second, a retailers' price is composed of several components. Some of those components are wholesale price, transport and inventory costs, margin and value added tax. A change in any of these components will directly affect the change in the final retail price on the shelf (Marić, 2019).

The analysis includes 8 retail chains, 3 of which are officially the largest retail chains in the Republic of Serbia in terms of sales revenue. The financial indicators were calculated on the basis of the balance sheets and income statements of the companies publicly published on the website of the Agency for Economic Registers for the years 2022 and 2023. Business names of the companies will not be revealed in the paper, since the focus of the analysis is on the entire FMCG retail market.

Table 1: Presentation of indicators of profitability, asset turnover ratio and financial leverage of 8 large FMCG retail chains in the Republic of Serbia in 2022.

Retail company	Annual sales revenue (in thousands rsd)	ROA (%)	ROE (%)	Net profit margin (%)	Asset turnover ratio	Fin. Leverage (Equity multiplier= assets/equity)
A	133,722,449	7.37	14.74	4.9	1.5	2
B	92,776,372	2.81	5.84	2.17	1.29	2.09
C	90,019,875	1	20.3	0.61	1.62	20.36
D	31,110,307	3.73	13.88	2.74	1.36	3.71
E	27,635,345	5.89	17.69	3.57	1.65	3
F	22,600,436	2.86	7.04	1.77	1.62	2.46
G	18,841,408	5.04	22.95	2.09	2.41	4.56
H	6,908,731	2.83	23.86	1.39	2.04	8.43
Average	52,951,865	3.94	15.79	2.41	1.69	5.83

Source: Authors on the basis of (Agency for Economic Registers, 2025).

Based on table number 1, the first three leading retail chains in the Republic of Serbia in 2022 achieved a sales revenue of slightly more than 316 billion rsd. All 8 analyzed chains operated profitably in 2022. The largest return on assets was also achieved by the largest retail chain, which amounts to 7.37%, which means that that chain made 0.0737 rsd of net profit per unit of it's assets. The average return on assets of these 8 chains was 3.94%. The highest return on equity (own source of assets) was recorded by the retail chains marked with „H“ and „G“, which are also the chains with the lowest revenue from sales (compared to the 8 analyzed) and amounts to 23.86% and 22.95% respectively, this means that these two chains achieved 0.2386 and 0.2295 rsd of net profit per unit of their equity. The average return on equity

of these 8 chains was 15.79%. The highest net profit margin, similar to the return on assets, was recorded at the largest retailer marked with „A“ and amounted to 4.9%. This means that the retailer managed to turn 4.9% of the total revenue into net profit. The net profit margin is also an indicator of how good the retailer is at managing costs. The average net profit margin was 2.41%. The highest asset turnover ratio was recorded by the retail chains marked with „G“ and „H“, which are also, similarly when it comes to return on equity, the smallest in terms of sales revenue, amounting to 2.41 and 2.04 respectively. In practice, this means that these two chains generated as much as 2.41 and 2.04 rsd of revenue per unit of their assets. The average asset turnover was 1.69, while none of the analyzed chains achieved an asset turnover ratio that was less than 1, which in practice means that not a single chain achieved an annual revenue lower than the size of its reported assets at the end of the business year. This tells us about the sales effectiveness of these retail chains. When it comes to financial leverage, if the equity multiplier is greater than 2, it means that retail chain has more liabilities than equity, which is the case with most of the analyzed retail chains. The retail chain marked with „A“ has the lowest financial leverage and it amounts to 2, which in practice means that the ratio of liabilities and equity of this chain is 1:1. The average leverage was 5.83, the average leverage is raised by the chains marked with „C“ and „H“. Therefore, since these 8 retail chains are also among the largest retail chains in the Republic of Serbia (some of them are largest), we can conclude that the retail market for FMCG in the Republic of Serbia in 2022 was profitable (average ROA 3.94%, ROE 15.79%, NPM 2.41%) and sales effective (average asset turnover ratio was 1.69), it can also be concluded that the chains in this market operate with more borrowed than their own asset sources (average leverage was 5.83).

Table 2: Presentation of indicators of profitability, asset turnover ratio and financial leverage of 8 large FMCG retail chains in the Republic of Serbia in 2023.

Retail company	Annual sales revenue (in thousands rsd)	ROA (%)	ROE (%)	Net profit margin (%)	Asset turnover ratio	Fin. Leverage (Equity multiplier= assets/equity)
A	153,071,396	7.5	15.91	4.88	1.54	2.12
B	103,150,985	2.35	4.89	1.73	1.36	2.08
C	100,796,846	3.1	129.33	1.6	1.94	41.67
D	37,257,327	3.14	12.29	2.19	1.43	3.92
E	29,810,869	4.66	13.28	2.8	1.67	2.85
F	25,192,277	2.93	7.3	1.7	1.72	2.5
G	21,871,061	5.42	22.26	2.35	2.31	4.11
H	8,169,257	4.68	29.91	2.1	2.23	6.39
Average	59,915,002	4.22	29.40	2.42	1.78	8.21

Source: Authors on the basis of (Agency for Economic Registers, 2025).

On the basis of table number 2, the first three leading retail chains in the Republic of Serbia in 2023 achieved sales revenue slightly higher than 357 billion rsd. All 8 analyzed chains operated profitably in 2023. The largest return on assets was also achieved by the largest retail chain marked with „A“, which amounts to 7.5%, which means that it made 0.075 rsd of net profit per unit of its assets. The average return on assets of these 8 chains is 4.22%. The highest return on equity (own source of assets) was recorded by the retail chain marked with „C“ and was 129.33%, this means that this chain achieved 1.29 rsd of net profit per unit of its equity. The average return on equity of these 8 retail chains was 29.4%. The highest net profit margin, similar to the return on assets, was recorded at the largest retailer marked with „A“ and amounted to 4.88%. In practice, this means that the retailer managed to turn 4.88% of the total revenue into a net profit. The average net profit margin was 2.42%. The highest asset turnover ratio was recorded by retail chains marked with „G“ and „H“, which are at the same time the smallest in terms of sales revenue, amounting to 2.31 and 2.23, respectively. In practice, this means that these two chains generated as much as 2.31 and 2.23 rsd of revenue per unit of their assets. The average asset turnover ratio was 1.78, while none of the analyzed chains achieved an asset turnover ratio less than 1, which in practice means that not a single chain achieved an annual revenue lower than the size of its reported assets at the end of the business year. When it comes to financial leverage, if the equity multiplier is greater than 2, it means that retail chain has more liabilities than equity, which is the case with all analyzed retail chains. The retail chain marked with „B“ has the lowest financial leverage and it amounts to 2.08. The average leverage was 8.21, the average leverage is raised by the chains marked with „C“ and „H“.

The state of the FMCG retail market, when it comes to the displayed indicators, is slightly better in 2023 compared to 2022. The chains recorded growth in average return on assets, return on equity, average net profit margin and average asset turnover ratio. The average financial leverage increased to 8.21. However, a higher financial leverage ratio is not necessarily bad if a company with borrowed assets (i.e. debts) can achieve significant returns.

Table 3: Presentation of EBIT values, revenue to costs ratios, commodity stock turnover rates and liquidity indicators of 8 large FMCG retail chains in the Republic of Serbia in 2022.

Retail Company	EBIT (in thousands rsd)	Total revenue to total costs ratio	Financial revenue to financial costs ratio	Commodity stock turnover rate	Total liquidity (current assets – current liabilities)	Liquidity with commodity stocks excluded (accelerated liquidity)
A	9,068,737	1.06	1.37	11.48	0.99	0.69
B	4,907,448	1.03	0.21	6.87	0.9	0.13
C	3,498,953	1.01	0.05	7.89	0.59	0.29
D	1,381,977	1.03	0.24	9.11	0.65	0.26
E	1,595,911	1.04	0.01	10.14	0.79	0.22
F	978,844	1.02	0.06	9.52	0.67	0.27
G	760,830	1.02	0.21	8.72	0.9	0.47
H	285,597	1.01	0.12	6.85	0.69	0.24
Average	2,809,787	1.03	0.28	8.82	0.77	0.32

Source: Authors on the basis of (Agency for Economic Registers, 2025).

On the basis of table number 3, it can be concluded that the total EBIT of the three largest retailers amounted to slightly more than 17 billion rsd in 2022. The largest EBIT was achieved by the largest retail chain in the Republic of Serbia, amounting to 9,068,737,000 rsd. When it comes to total revenue to total costs ratio, all analyzed retail chains operated economically in 2022. The highest ratio was recorded at the largest retail chain marked with "A" and it amounted to 1.06 (i.e. 1.06 rsd of revenue for each 1 rsd of costs). When it comes to financial revenue to financial costs ratio, it compares revenue with costs from financing, such as revenue and costs from interest or revenue and costs generated by changes in the exchange rate, etc. With the exception of the retailer marked with "A" (which is also the largest), all retail chains achieved the ratio values below 1, which means that all retail chains (except the largest) operate with higher costs from financing compared to revenues from financing in 2022. The commodity stock turnover rate is one of the primary indicators of success in retail sector. Only 2 retail chains have a turnover rate greater than 10 and they are the chains marked with "A" and "E" and it is 11.48 and 10.14 respectively. In practice, this means that the largest retail chain in the Republic of Serbia turns over its entire stock of goods in an average of slightly more than 31 days (more precisely, 31 days and about 19 hours). For the sake of comparison, the average commodity stock turnover rate was 8.82, so the time of one turnover lasted a little more than 41 days on average (more precisely, 41 days and about 9 hours). When it comes to the liquidity of these 8 trade chains, which are taken as a representative of the retail sector, the data are a bit concerning. The total liquidity indicator is less than 1 for all analyzed retail chains. The best result was recorded by the chain marked with "A" (also the largest) and it was 0.99. From a strictly formal point of view, none of these 8 chains meets the liquidity requirement, so we could draw the conclusion that the entire retail branch may have problems with illiquidity. When it comes to the indicator of accelerated liquidity (commodity stocks are subtracted from the short-term assets as their least liquid part), the best result is achieved by the chain marked with "A" (also the largest in Serbia) and it was 0.69, the average of 8 chains is 0.32. This result is expected since most of the short-term assets of retail companies are made up of commodity inventories (other inventories such as inventories of materials and parts were excluded from the analysis also).

Therefore, since these 8 retail chains are among the largest (some of them are), we can conclude that the retail market for FMCG products in the Republic of Serbia in 2022 was economical, effective in terms of commodity stock turnover, but the companies operated with less liquidity.

Table 4: Presentation of EBIT values, revenue to costs ratios, commodity stock turnover rates and liquidity indicators of 8 large FMCG retail chains in the Republic of Serbia in 2023.

Retail Company	EBIT (in thousands rsd)	Total revenue to total costs ratio	Financial revenue to financial costs ratio	Commodity stock turnover rate	Total liquidity (current assets – current liabilities)	Liquidity with commodity stocks excluded (accelerated liquidity)
A	11,782,410	1.06	1.8	11.48	1.01	0.75
B	5,244,771	1.02	0.06	6.93	1.05	0.54
C	4,072,625	1.02	0.07	7.95	0.59	0.32
D	1,741,729	1.03	0.19	9.3	0.66	0.32

E	1,591,495	1.03	0.09	10.56	0.78	0.46
F	1,084,179	1.02	0.05	9.46	0.73	0.39
G	925,528	1.03	0.78	7.44	0.92	0.45
H	399,346	1.02	0.05	6.27	0.79	0.25
Average	3,355,260	1.03	0.39	8.67	0.82	0.44

Source: Authors on the basis of (Agency for Economic Registers, 2025).

On the basis of table number 4, it can be concluded that the total EBIT of the three largest retailers amounted to slightly more than 21 billion dinars in 2023. The largest EBIT was achieved by the largest retail chain in the Republic of Serbia, amounting to 11,782,410,000 rsd. When it comes to total revenue to total costs ratio, all analyzed retail chains operated economically in 2023. The highest ratio was recorded at the largest retail chain marked with "A" and it amounted to 1.06. When it comes to financial revenue to financial costs ratio, with the exception of the retailer marked with "A" (which is also the largest), all retail chains achieved ratio values below 1, which means that all retail chains (except the largest) operate with higher costs from financing compared to revenues from financing in 2023. When it comes to the commodity stock turnover rates, same as in 2022, only 2 retail chains achieved a commodity stock turnover rate greater than 10 and those are the chains marked with "A" and "E" and the rates were 11.48 and 10.56 respectively. In practice, this means that the largest retail chain in the Republic of Serbia turns over its entire commodity stocks in an average of slightly more than 31 days (more precisely, 31 days and about 19 hours). For the sake of comparison, the average commodity stock turnover rate was 8.67, so the time of one turnover lasted on average a little more than 42 days (more precisely, 42 days and about 2 hours). When it comes to liquidity in 2023, a slightly better situation was recorded compared to 2022. The first two retail chains marked with "A" and "B" meet the liquidity requirements, and the total liquidity ratios were 1.01 and 1.05 for these chains, respectively. The average liquidity ratio was 0.82, which is an improvement compared to 2022. When it comes to the indicator of accelerated liquidity (commodity stocks were taken from the short-term assets as their least liquid part), the best result is achieved by the chain marked with "A" (also the largest in Serbia) and it amounted 0.75, the average ratio of 8 chains was 0.44.

Therefore, in 2023, a significant increase in EBIT was recorded in all retail chains with the exception of the chain marked with "E". A better condition of the branch was recorded when it comes to financial revenue to financial costs ratios and when it comes to liquidity. However, the total revenue to total costs ratios of the branch did not change significantly, while the average commodity stock turnover rate slightly decreased.

Table 5: Presentation of the number of employees and productivity of 8 large retail chains in the Republic of Serbia.

Retail Company	2022		2023	
	Number of employees	Productivity (sales per employee)	Number of employees	Productivity (sales per employee)
A	11426	11,703,348	12399	12,345,463
B	3562	26,046,146	3415	30,205,266
C	7950	11,323,255	7372	13,672,931
D	2912	10,683,485	3065	12,155,735
E	2935	9,415,790	2858	10,430,675
F	1343	16,828,322	1480	17,021,809
G	2378	7,923,216	2472	8,847,517
H	802	8,614,378	844	9,679,214
Average	4,163.50	12,817,242.50	4,238.13	14,294,826.25

Source: Authors on the basis of (Agency for Economic Registers, 2025).

On the basis of table number 5, it can be concluded that the highest productivity in both observed years was achieved by the retail chain marked with "B", which is also the second largest retail chain in terms of sales revenue. The productivity of all individual retail chains increased in 2023 compared to 2022. Average productivity in 2023 increased to 14,294,826.25 rsd from 12,817,242.50 rsd in 2022. The total number of employees in these 8 retail chains increased to 33,905 in 2023 from 33,308 employees in 2022.

Table 6: Presentation of gross margins and gross margin rates of 8 large retail chains in Serbia for 2021, 2022 and 2023.

Retail Chain	2021		2022		2023	
	Gross Margin (in thousands rsd)	Gross Margin Rate	Gross Margin (in thousands rsd)	Gross Margin Rate	Gross Margin (in thousands rsd)	Gross Margin Rate
A	35,231,862	43.30	40,629,050	43.64	46,954,001	44.25
B	17,760,136	33.26	22,160,243	31.38	24,285,072	30.79
C	20,802,205	34.96	23,804,414	35.95	26,957,306	36.51
D	6,616,399	34.45	8,095,823	35.18	9,899,376	36.18
E	3,720,357	17.52	4,563,976	19.78	5,029,550	20.30
F	2,340,644	13.22	3,037,983	15.53	3,572,355	16.52
G	3,106,502	24.09	3,837,499	25.58	6,347,380	40.89
H	1,650,446	42.58	2,140,535	44.89	2,605,761	46.84
Average	11,403,569	30.42	13,533,690	31.49	15,706,350	34.03

Source: Authors on the basis of (Agency for Economic Registers, 2025).

Based on table number 6, it can be concluded that the three largest retail chains in the Republic of Serbia achieved the highest gross margins in all three observed years. When it comes to the gross margin rates, the highest gross margin rates were recorded by the trade chains marked with "A" and "H", the largest retail chain and the smallest retail chain among the 8 analyzed. The average gross margin and the average gross margin rate tended to increase year by year.

Table 7: Presentation of changes in gross margins and gross margin rates of 8 large retail chains in Serbia in 2022 compared to 2021 and in 2023 compared to 2022.

Retail Chain	2022/21		2023/22	
	Change in gross margin (in thousands rsd)	Change in gross margin rate in percentage	Change in gross margin (in thousands rsd)	Change in gross margin rate in percentage
A	5,397,188	0.35	6,324,951	0.60
B	4,400,107	-1.88	2,124,829	-0.59
C	3,002,209	0.99	3,152,892	0.56
D	1,479,424	0.73	1,803,553	1.01
E	843,619	2.26	465,574	0.51
F	697,339	2.31	534,372	0.99
G	730,997	1.48	2,509,881	15.31
H	490,089	2.31	465,226	1.94
Average	2,130,122	1.07	2,172,660	2.54

Source: Authors on the basis of (Agency for Economic Registers, 2025).

Based on table number 7, it can be concluded that the gross margins of 8 large retail chains in 2022 compared to 2021 increased by an average of 2,130,122,000 rsd. In 2023, compared to 2022, the gross margins of 8 large retail chains increased by an average of 2,172,660,000 rsd. All 8 retail chains recorded growth in gross margin. On the other hand, the gross margin rates increased by an average of 1.07% in 2022 compared to 2021, while they increased by an average of 2.54% in 2023 compared to 2022. As many as 7 retail chains recorded an increase in the gross margin rates, while only the chain marked with "B", also the second largest in terms of sales revenue, recorded a decrease in the gross margin rate of 1.88% in 2022 compared to 2021 and 0.59% in 2023 compared to 2022.

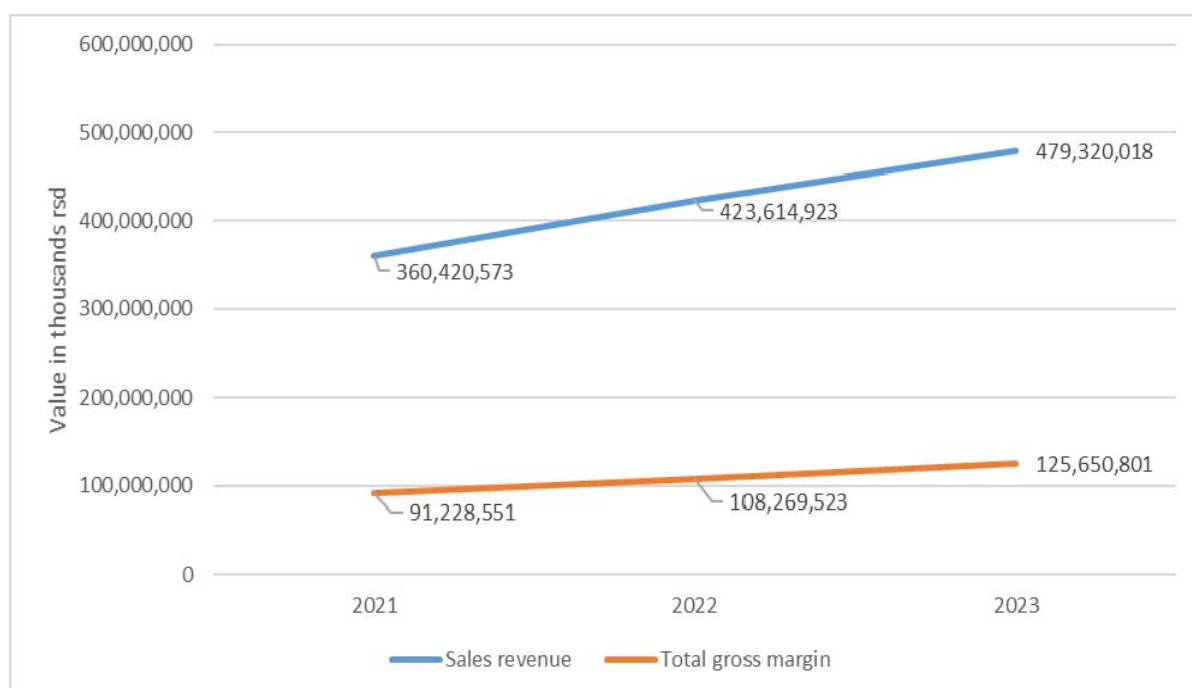


Chart 1: Presentation of trends in total sales revenue and total gross margin for 8 large retail chains in Serbia.

Source: Authors on the basis of (Agency for Economic Registers, 2025).

From chart number 1, it can be seen that the total sales revenue and the total gross margin (collectively for all 8 retailers) from 2021 to 2023 had a constant tendency to grow. The total sales revenue increased by a total of 118,899,445,000 rsd in two years, while the total gross margin increased by a total of 34,422,250,000 rsd in two years. In other words, the total sales revenue increased by a total of 32.99% in two years, while the total gross margin increased by 37.73% in the same period. The total gross margin grew percentageally faster than the total sales revenue.

2. ANALYSIS OF GROWTH OF FMCG RETAIL PRICES IN THE REPUBLIC OF SERBIA

2.1. The general rate of inflation and the rise in food prices

Inflation is a real phenomenon in developing economies, while the inflation rate is one of the most important macroeconomic indicators. „The Executive Board of the National Bank of Serbia, at the meeting of the Executive Board on December 7, 2023, determined the target rate of total inflation for the period from January 2024 to December 2026 at 3%, with a permissible deviation of $\pm 1.5\%$ “ (National Bank of Serbia, 2025).

Table 8: Annual inflation rates in the Republic of Serbia from 2020 to 2024.

Year	Annual inflation rates in % (the growth in prices in current month compared to the same month in last year)											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2020	2.0	1.9	1.3	0.6	0.7	1.6	2.0	1.9	1.8	1.8	1.7	1.3
2021	1.1	1.2	1.8	2.8	3.6	3.3	3.3	4.3	5.7	6.6	7.5	7.9
2022	8.2	8.8	9.1	9.6	10.4	11.9	12.8	13.2	14	15	15.1	15.1
2023	15.8	16.1	16.2	15.1	14.8	13.7	12.5	11.5	10.2	8.5	8	7.6
2024	6.4	5.6	5	5	4.5	3.8	4.3	4.3	4.2	4.5	4.3	4.3

Source: (Republic Institute of Statistics, 2025).

According to the data of the Republic Institute of Statistics, the National Bank of Serbia managed to adjust the actual inflation rate to the target limits in May 2024, while rates were higher than the projected upper limit of 4.5% as of September 2021 (bold rates in the table). When we look at consumer prices indicators related to food (FMCG), the situation is even more unfavorable. For example, the increase in food prices in November 2024 compared to November 2023 amounted to 4.3%, which is in line with the general inflation rate, but in November 2023 compared to November 2022, it was 9.1%, which is higher than the general rate of inflation of 8%. Also, the increase in food prices in November 2022 compared to 2021 amounted to 23.5%, which is also higher than the general inflation rate of 15.1%. Therefore, food prices grew faster compared to the general annual inflation rate. When looking at individual food categories, the biggest price increase in November 2024 compared to November 2023 was in the category "sugar, jam, honey and chocolate" and it amounted to 14.5% and in the category "fruit" 10.2%. Also, in November 2023, compared to November 2022, the category "vegetables" had the highest price growth of 16.5% and the category "coffee, tea and cocoa" 12.8%. Then, in November 2022, compared to November 2021, the category "milk, cheese and eggs" had the highest price increase, amounting to 43.1% and the category "fish" 25.9%. This situation is caused by a large number of different factors, some of which we will discuss below (Republic Institute of Statistics, 2025).

Therefore, inflation as a macroeconomic phenomenon was present especially in 2022 and 2023. The causes of inflation can be different. The term „imported inflation“ is increasingly being used to describe the rise in the prices of imported products. Since Serbia is a net importer, this may be one of the factors. Of course, the rise in prices is often caused by the rise in the prices of raw materials and energy products such as fuel. Also, many macroeconomists believe that the primary source of inflation is excessive money printing by governments in order to finance budget deficits. However, there is another obvious cause, the "greed" of retailers and their hunger for extra profits. We will consider last one in next paragraphs.

2.2. Restrictive agreement and comparison of domestic and foreign prices

On 10th of October in 2024 the Commission for the Protection of Competition made an unannounced raid on the headquarters of 4 large retail chains in order to prove the existence or non-existence of forbidden restrictive agreement on retail prices. Together, these 4 retail chains have over 50% of the FMCG market share in the Republic of Serbia. The Commission was determining whether the chains concluded a restrictive agreement and thereby violated Article 10 of the law on competition protection. According to Article 10 of the law on the protection of competition, "restrictive agreements are agreements between market participants that have the aim or effect of significantly limiting, distorting or preventing competition on the territory of the Republic of Serbia." Restrictive agreements are considered prohibited and void by the same article of law, except in special cases“ (Law on Protection of Competition, 2025).

In order to prove the existence of a restrictive agreement, the Commission for the Protection of Competition monitored the price changes of 35 products in the period of several months before October 10th and determined that the prices were identical for all 4 retail chains. After that, the Commission expanded the analysis to 45 more products during August 2024 and included in the analysis another retail chain of the same format for the purpose of comparison. The results of the investigation showed that the retail market in Serbia achieved value sales growth from April 2023 to March 2024 with a simultaneous decrease in volume sales. Also, it was established that in this period the price increase in FMCG retail chains was almost twice as high as the official inflation rates, and that in the period from 2016 to 2023, an unusual growth of sales revenues and gross margins were recorded in these retail chains (Commission for the Protection of Competition, 2025).

The commission further proved that the prices of basic foodstuffs such as milk, yogurt, oil, flour, sugar, eggs, coffee and bananas in the period from April to September 2024 were the same or similar with different procurement conditions of these 4 retail chains. The value of the consumer basket composed of 45 products is similar between the observed 4 retail chains, while this value is significantly lower in the fifth retail chain that has the most unfavorable procurement conditions and which was taken for the purpose of comparison.

The Commission further stated that the value of the consumer basket for the analyzed 45 products ranged from 35,161 rsd to 38,830 rsd, which is significantly higher than the value of the same basket in the fifth retail chain that was taken for the purpose of comparison, where the value of the basket was 30,523 rsd. This difference is even more highlighted since the fifth retail chain had the worst commercial procurement conditions compared to the 4 chains that were under the supervision of the Commission. Taking all of the above into account, the Commission "reasonably assumed that the indicators found on the retail market are the result of the absence of mutual competitive pressure of the observed retailers and that the listed companies concluded a restrictive agreement from Article 10 of the Law on the Protection of the Competition." This situation resulted in multi-day boycotts of large retail chains by consumers at the beginning of 2025 (Commission for the Protection of Competition, 2025).

A topic that is becoming more and more relevant after the scandal in Serbia regarding the price fixing of retail chains is the comparison of domestic and foreign prices of FMCG, especially when it comes to food. It is not a rare case that on social networks citizens from abroad take pictures of prices in foreign retail chains in order to show much lower prices compared to those on the shelves of domestic retail chains. However, the answer to the question of whether this is really the case was given by the Republic Institute of Statistics in its publication "Trends". Based on data from the publication "Trends" from the first quarter of 2024, the prices of "food and non-alcoholic beverages" and the prices of "alcoholic

beverages and tobacco" in the Republic of Serbia were lower compared to the prices of the same categories in most European countries.

European Union countries have higher food prices compared to Serbia by an average of 9%. Switzerland is more expensive than Serbia in the category of "food and non-alcoholic beverages" by 81%, Iceland by 51%, Norway by 39%, Luxembourg by 30%, Malta by 29%, Finland by 23%, Denmark by 30%, France by 16%, Germany by 15%, Sweden by 15%, Slovakia by 13%, etc. While Serbia was more expensive in this category compared to Turkey by 45%, Romania by 19%, Poland by 15% and Bulgaria by 3% (Republic Institute of Statistics, 2025).

European Union countries have higher prices of „alcoholic beverages and tobacco“ compared to Serbia by an average of 37%. Iceland by 197%, Ireland by 187%, Norway by 180%, Finland by 133%, Denmark by 83%, France by 80%, Belgium by 65%, Latvia by 35%, Portugal by 31%, Greece by 31%, Croatia by 23%, Cyprus by 22%, Austria by 20%, Slovenia by 19%, Slovakia for 19%, etc. While Serbia was more expensive in this category compared to North Macedonia by 18%, Turkey by 17% and Bulgaria by 11% (Republic Institute of Statistics, 2025).

Therefore, Serbia, in relation to European countries, with the exception of certain countries such as Turkey or Bulgaria, has nominally lower prices for "food and non-alcoholic beverages" and "alcoholic beverages and tobacco." But the most realistic picture can only be obtained if other factors such as average or medial salaries are compared.

CONCLUSION

Although FMCG prices in the Republic of Serbia, at least officially, are not nominally higher than the prices of most European countries, there is certainly a significant price increase in previous years (see table 8). The reasons for these price increases are numerous. So, although most of the public blames the big retail chains for the price increases, the reality is that they are not the only ones who have contributed to this. In the years when the real (official) inflation rate was the highest in 2022 and 2023, the average gross margin rate for the 8 analyzed chains increased by 1.07 percentage points and 2.54 percentage points respectively, while the average gross margin of these chains for those two years increased from 11.4 billion to over 15.7 billion (by 37.7%). This increase in the average gross margin is not only caused by the increase in the margin rates of retail chains, but most probably also by the increase in wholesale prices of commodities. In other words, higher wholesale prices of commodities increased the basis for calculating the trading margins, which resulted in higher gross margins and, of course, higher retail prices. Retail chains, especially large ones, are responsible for the rise in prices, especially when we consider the price agreements proven by the Commission for the Protection of Competition, but they are not the only factor. A whole range of manufacturers, distributors and wholesalers also significantly influenced the growth of retail prices. Some retailers have recently announced to their suppliers that they will no longer accept further increases in wholesale prices, while many retailers have complained that they are having to raise retail prices as wholesale prices are also rising. In the paper, the authors did not comment on the justification of the trade margins of these 8 retailers (whether they are large or not), but only proved to what extent the chains were responsible for the retail price increase in previous years.

FMCG price increases mainly affect the poorer segments of the population (Paul & Sharma, 2019). Fortunately, there are many ways in which society and governments can help detect and suppress unjustified price increases. The intervention of society (boycotts of chains, highlighting price increases, etc.) and the government (inspections by the Commission for the Protection of Competition, etc.) are of crucial importance in this regard.

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Participation (direct/virtual):

JEL:

GREEN SUPPLY CHAIN MANAGEMENT AND ARTIFICIAL INTELLIGENCE: A REVIEW AND BIBLIOMETRIC ANALYSIS

Abstract: Green Supply Chain Management (GSCM) has emerged as a crucial approach for enhancing environmental sustainability in supply chain operations. In parallel, Artificial Intelligence (AI) technologies are revolutionizing decision-making processes, optimization strategies, and overall supply chain efficiency. This paper presents a comprehensive review and bibliometric analysis of the relationship between GSCM and AI, highlighting key research trends, influential authors, and major thematic areas. Using the Bibliometrics R package, relevant publications from the Web of Science Core Collection are analyzed to identify new patterns, collaboration networks, and technological advances that drive sustainability in supply chains. The findings provide valuable insights into how AI-powered solutions, such as machine learning, predictive analytics, and blockchain, contribute to greener and more efficient supply chain practices. This study also outlines future research directions, emphasizing the role of AI in advancing circular economy principles and reducing the environmental impact of supply chain operations.

Keywords: green supply chain, management, artificial intelligence, bibliometric analysis.

1. INTRODUCTION

In recent years, growing concerns over environmental sustainability have driven industries to adopt more eco-friendly practices in their supply chain operations. Green Supply Chain Management (GSCM) integrates sustainability principles into traditional supply chain processes, aiming to minimize environmental impact while maintaining economic efficiency. This approach encompasses various strategies, including green procurement, eco-design, sustainable logistics, and waste reduction, all of which contribute to a more circular and responsible economy. The GSCM is based on the philosophy of "reduce, reuse, recycle" with the aim of adapting supply chain activities to the environment. It all starts from the selection of environmentally friendly suppliers to the selection of raw materials and materials that can be recycled. While in the past, the main motive for the work of numerous companies around the world was profit, today it is sustainability and corporate social responsibility.

Simultaneously, artificial intelligence (AI) has emerged as a transformative force, revolutionizing supply chain management through data-driven decision-making, predictive analytics, and process automation. AI-powered technologies, such as machine learning, deep learning, blockchain, and the Internet of Things (IoT), are increasingly being leveraged to enhance the efficiency and sustainability of supply chain operations. By optimizing resource allocation, reducing waste, and improving forecasting accuracy, AI plays a crucial role in advancing GSCM objectives.

Despite the growing body of research on GSCM and AI, a comprehensive bibliometric analysis of their intersection remains limited. Understanding the key research trends, influential publications, and emerging themes in this domain is essential for both academics and practitioners seeking to drive innovation and sustainability in supply chain management. This study aims to fill this gap by conducting a bibliometric analysis of the literature on GSCM and AI, utilizing the Bibliometrix R package to examine research trends, co-authorship networks, and keyword co-occurrence patterns. The findings will provide valuable insights into how AI contributes to the advancement of green supply chains and identify potential areas for future research.

The structure of the paper is divided into five sections. After the introduction, an overview of the concept of green supply chain and the application of AI technology is provided, while the next section describes the methodology of the bibliometric analysis. The fourth section presents the results and discussion, and the fifth section presents key conclusions and directions for future research.

2. THEORETICAL BACKGROUND

Since the late 1980s and early 1990s, the concepts of supply chain management and environmental management have become key strategic approaches for achieving competitive advantage (Sarkis et al., 2011). However, their foundations can be traced back to the end of the 1960s, when the first ecological management systems began to be developed. Only in the mid-1990s did this research field become formalized and gain importance (Seuring & Müller, 2008). Since then, the number of scientific publications on this topic has grown exponentially, which indicates its increasing importance both for researchers and for business practice. This part of the paper will briefly present the theoretical background of papers on the topic of AI and GSCM in the period from 2020 to 2025.

Sustainable supply chain management has become a key area of research as companies strive to balance profitability with social responsibility and environmental protection. AI-based technologies offer the potential to optimize processes, reduce environmental impact and improve sustainability through tools such as predictive analytics, blockchain and IoT. AI enables companies to improve supply chain resilience and make better strategic decisions, while sustainability is gradually integrated into all phases of business (Zejjari & Benhayoun, 2024).

An article by Bag, Gupta, Kumar, and Sivarajah (2021) explores the role of technological dimensions of GSCM on firm performance. The authors analyze how technological innovations, such as automation technologies, digitization and advanced IT infrastructures, influence the implementation of GSCM practices and how these practices improve enterprise performance. Through detailed analysis, the paper shows that the integration of advanced technologies into green supply chain operations enables firms to reduce environmental impacts, improve efficiency, reduce costs, and improve product quality. The technological dimensions of GSCM are considered key to achieving competitive advantages and sustainable business growth. Research results indicate that technological innovations in GSCM practice are not only useful for sustainability, but also for increasing the profitability and competitiveness of companies in the market.

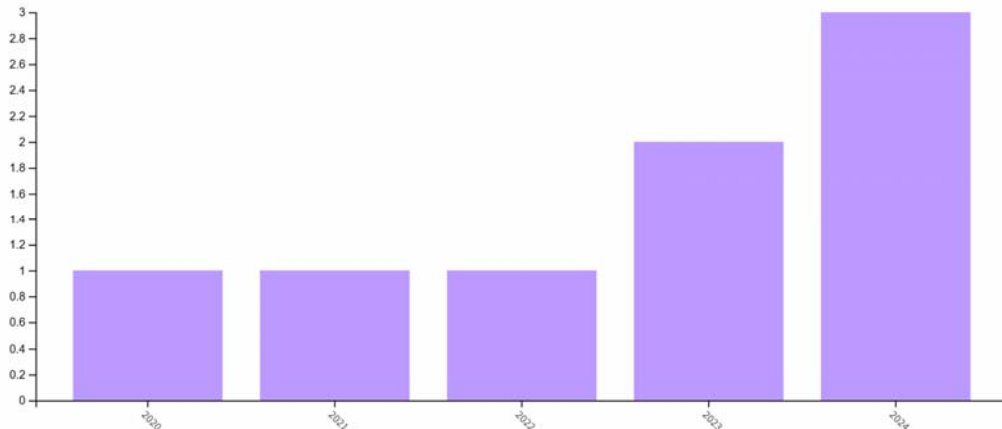
Furthermore, Zhang, Gao, and Luqman (2022) explore how GSCM contributes to corporate competitiveness during the COVID-19 pandemic, with a particular focus on the role of big data analytics. The authors state that companies that implemented GSCM practices were able to maintain competitive advantages during the challenging times of the pandemic. The use of big data analytics enabled the optimization of operations, improved predictive analysis, and resource management, allowing firms to remain flexible and resilient to market changes. The article concludes that the integration of sustainable practices and big data technologies helps businesses enhance their competitiveness even in uncertain conditions.

The study by Susithra, Vasantha, and Subramanian (2023) demonstrates that AI enables the optimization of key supply chain processes, including resource management, waste reduction, energy efficiency improvement, and real-time monitoring of environmental indicators. Technologies such as machine learning, big data analytics, and IoT facilitate informed decision-making that reduces negative environmental impacts. The study concludes that the integration of AI and GSCM practices not only contributes to environmental sustainability but also enhances companies' operational efficiency and competitiveness. Aljoghaiman and Mirzaliev (2024) emphasize that green supply chain processes play a crucial role in linking AI technologies with improved business performance, such as cost reduction, resource optimization, and lower environmental pressure. The findings show that the adoption of AI and digital technologies is directly linked to enhanced supply chain performance, while green processes enable these technologies to further contribute to sustainability and corporate competitiveness.

The latest research by Rashid et al. (2025) shows that the combination of big data analytics and AI technologies allows businesses to optimize their operations, improve efficiency, reduce costs, and enhance resource utilization. This is particularly important for companies in developing countries, where sustainability is becoming key to achieving competitive advantages in the global market. The use of green supply chain practices, such as carbon emission reduction, energy efficiency, and the use of renewable energy sources, enables firms not only to meet environmental standards but also to achieve greater profitability and social goals. Through the integration of IoT devices and sensors, smart monitoring and real-time product flow management are facilitated, increasing efficiency and reducing warehouse storage times (Raziq, El Khaili & Zamma, 2025).

Chang and Zhang (2024) analyze the application of AI and decision support systems (DSS) in green supply chain management. Their study highlights how AI-driven DSS can improve decision-making processes by optimizing resource allocation, reducing waste, and enhancing environmental sustainability throughout the supply chain. The authors emphasize the role of machine learning, big data analytics, and industrial IoT in enabling real-time monitoring and predictive analytics for supply chain operations. The findings suggest that integrating AI and DSS into GSCM increases efficiency, reduces costs, and improves compliance with sustainability regulations. The study concludes that AI-powered decision support systems are essential for fostering sustainable supply chain practices and achieving long-term environmental and economic benefits.

When it comes to a comprehensive literature review, the review of 191 articles by authors Seuring and Muller (2008) from 1994 to 2007, and Fahimnia, Sarkis, and Davarzani (2015) from 2014, are particularly noteworthy. However, a gap was observed in the bibliometric review of the literature on this topic in the period from 2020 to 2025. Regarding the bibliometric analysis on the topic of GSCM and AI, there are only a few papers recognized on the Web of Science Core Collection (WOS CC) scientific base in the period from 2020 to 2025 (Picture 1).



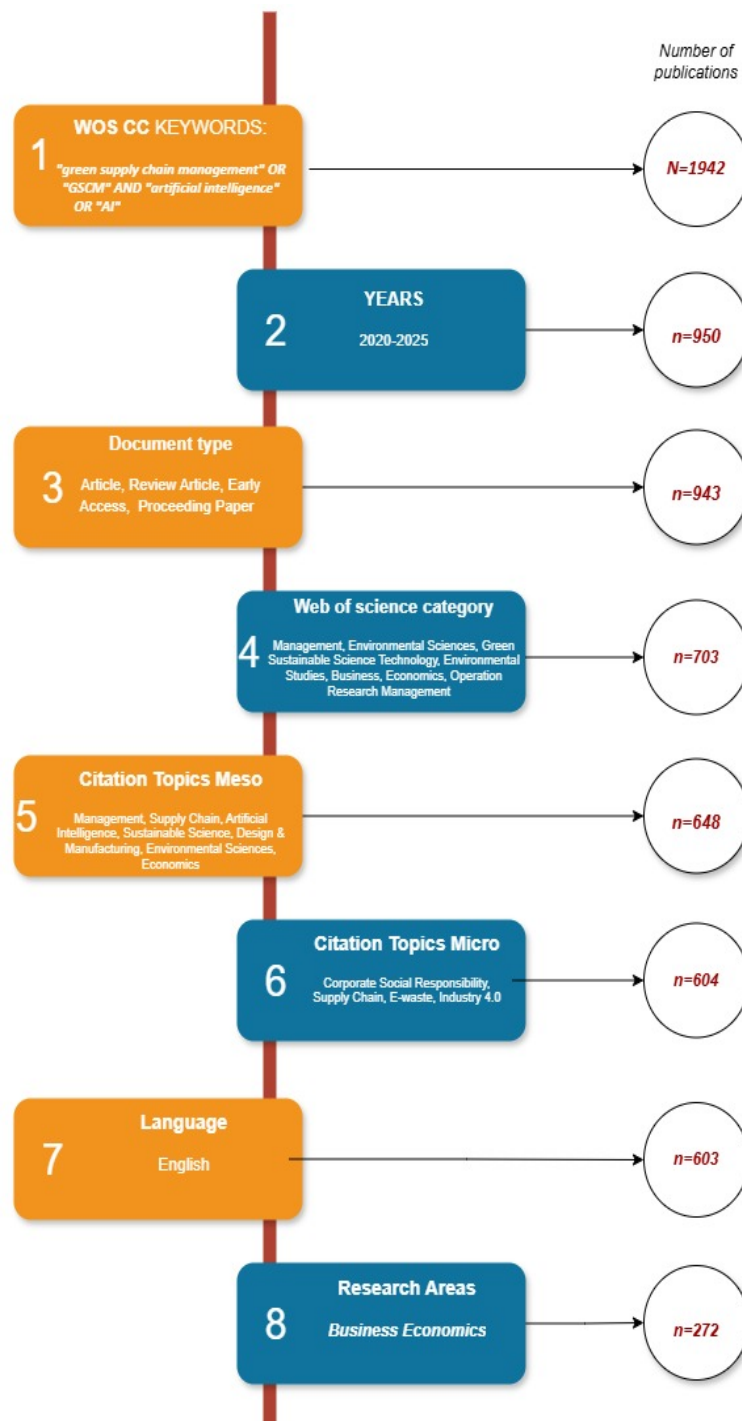
Picture 1: Search results analysis - bibliometric analysis GSCM and AI
Source: the author

These data represent the temporal distribution of scientific papers on the topic of GSCM and AI, analyzed by the bibliometric method. The largest number of papers was published in 2024 (3 papers, 33.33%), which indicates an increase in research focus on this topic. This trend may indicate the increasing application of AI in GSCM and the topicality of the topic in academic circles. With this in mind, this research conducted a bibliometric analysis to identify key trends, authors, publications and topic areas at the intersection of *Green Supply Chain Management (GSCM)* and *Artificial Intelligence (AI)*. The analysis was performed using the Bibliometrix package in the R programming language, which enables quantitative examination of scientific literature and network visualization of research data.

3. RESEARCH METHODOLOGY

This research uses bibliometric analysis to study the relationship between GSCM and AI. The aim of the methodology is to provide a quantitative overview of existing scientific works, identify key trends, authors, citation networks and research directions in this area. The software tool Bibliometrix (R package) is used, which enables systematic analysis of large amounts of bibliographic data, network analysis and visualization of results (Derviş, 2019). Bibliometrix is a tool widely used in scientific studies to obtain quantitative insights into scientific publications and the connections between different subject areas. Aria and Cuccurullo (2017) present Bibliometrix, an R tool that enables complete scientific map analysis and provides a detailed overview of bibliometric data. The tool is designed to support researchers in the analysis and visualization of large bibliographic collections, as well as in the mapping of scientific flows and connections between different research areas. Through this analysis, users can identify key authors, papers, institutions, and subject areas, and can also explore citation networks and interrelationships between different research streams.

In order to get a comprehensive overview of the relationship between AI and GSCM, the WOS CC database was searched for the following keywords: "**green supply chain management**" OR "**GSCM**" AND "**artificial intelligence**" OR "**AI**". As part of the search, adequate filters were selected to make the research as representative as possible. These keywords enabled a search for relevant papers investigating the connection between sustainable supply chain management and the application of artificial intelligence. By using the OR operator, it is possible to search for works related to both terms, which expands the criteria for including all relevant research in this area (Picture 2).



Picture 2: Research framework
Source: the author

These filters were selected to ensure the high quality and relevance of the collected data, as well as to provide the most complete and accurate overview of existing research in this area. In this way, the collected works provide a solid basis for further bibliometric analysis, enabling a detailed analysis of thematic trends, main authors and institutions, as well as the identification of research gaps in connecting AI and GSCM. The total number of articles included in the bibliometric analysis in this paper is 272, in the period from 2020 to 2025.

This study aims to address the following research questions:

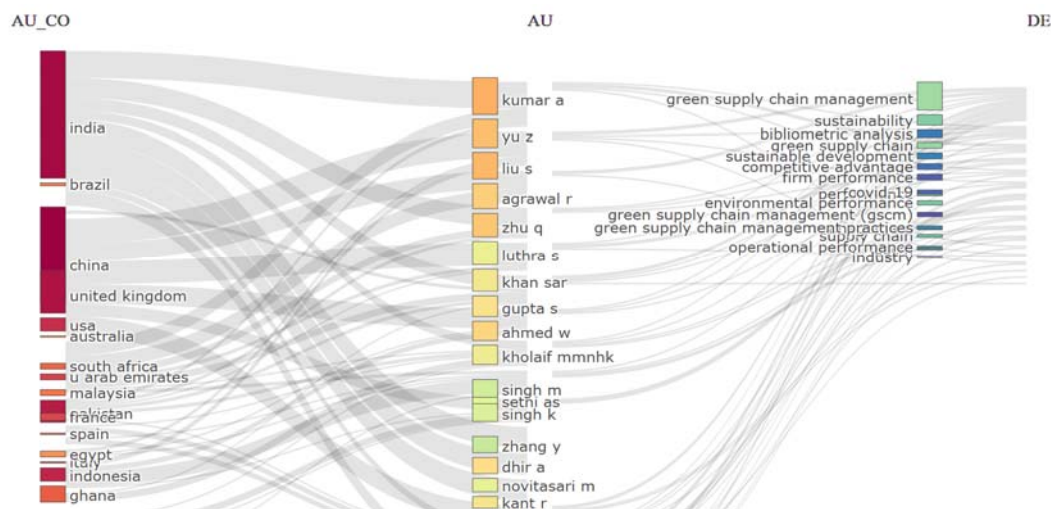
- What are the key thematic areas in AI and GSCM research in the period from 2020 to 2025?
- What is the future direction of research on AI and GSCM?

4. DISCUSSION OF FINDINGS

The completeness analysis of metadata for 272 documents indicates a high quality of available information. All key attributes, including author affiliation, authors, cited references, corresponding author, document type, journal, language, publication year, title, and total citations, have 0% missing data, categorizing them as "Excellent". Minor data gaps are observed in abstracts (0.37%), keywords (1.47%), DOI identifiers (3.31%), and Keywords Plus (4.04%), which are rated as "Good". These results suggest a high reliability of the dataset, with minimal deficiencies that should not significantly impact the accuracy of the bibliometric analysis.

4.1. Analysis of the authors

A Three-Field Plot is a bibliometric visualization technique that analyzes and displays the relationships between three different fields within a data set. In the context of this research on Artificial Intelligence (AI) and Green Supply Chain Management (GSCM), this chart identifies key relationships between: author, author country, and keywords the authors wrote about the most.



Picture 3: Three-Field Plot

Source: the author

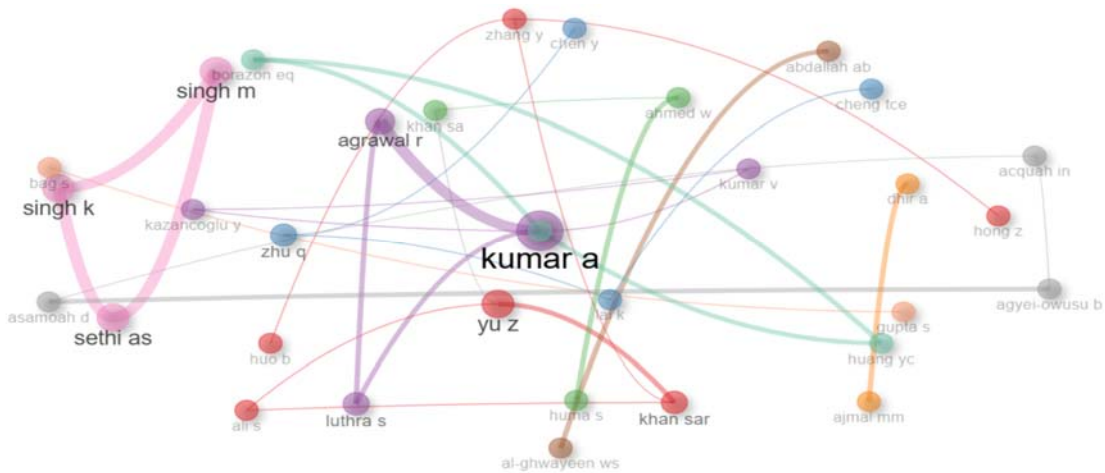
The Three-Field Plot is a visualization that illustrates the connections between three key elements: authors, their countries of origin, and the main topics they focus on in research related to AI and GSCM. The analysis results indicate that **India, China, the UK, and the USA** are the dominant countries where authors actively explore this subject. Their research focuses on **GSCM, sustainability, sustainable development, business and operational performance**, as well as the **impact of COVID-19** on supply chains. A particular emphasis is placed on the **application of AI in the industry**, with practical examples of GSCM implementation being analyzed. These findings highlight the global significance of the topic and the regional distribution of research.

The analysis of the most relevant authors in the field of artificial intelligence (AI) and green supply chain management (GSCM) research shows that **Kumar, Liu, Yu, and Zhu** are among the most productive, with the highest number of published papers. Their research covers various aspects of sustainable supply chain management, the application of AI technologies, and the optimization of business performance. In addition to them, significant contributions come from authors such as **Agrawal, Ahmed, Dhir, Gupta, and Kant**. Furthermore, there is a wide range of other researchers who have published two papers, indicating a growing interest in this topic within academic circles and an increasing diversity in geographic and institutional contributions.

One of the most cited papers in this sample is the work of Wang, Zhang, and Zhang (2020), which has been cited 197 times in the WOS database. This paper explores the relationship between corporate social responsibility (CSR), green supply chain management (GSCM), and firm performance, with the moderating role of big-data analytics capability. The research shows how CSR and GSCM can enhance business performance, and how the use of big-data analytics further amplifies this effect by enabling better optimization and decision-making. The paper by Lerman et al. (2022) explores how digital transformation affects green supply chain management (GSCM) performance through a smart GSCM approach. Analyzing data from 473 manufacturing companies, the authors examine both external (partner relationships) and internal (operations within the organization) GSCM activities. The results show that digital transformation directly influences green performance, particularly through activities such as green purchasing. However, the paper emphasizes that digital transformation alone is not sufficient to achieve the desired outcomes without an appropriate GSCM configuration that integrates both internal and external dimensions. This approach

highlights that managers need to combine digital transformation strategies, ecological relationships, and green operations to achieve better green performance in the supply chain. The authors' collaboration network (Picture 4) provides insight into the relationships and centrality of authors based on their collaborative interactions. In this analysis, we observe the following:

- Central authors: Authors such as Yu, Khan, and Zhang are in Cluster 1 and have high values in the betweenness (15.000) and closeness (0.063) metrics, indicating that they play a central role in connecting other authors in the network. Their positions suggest they are key intermediaries, facilitating the flow of information between different parts of the network.
- Clusters and groupings: Authors are grouped into clusters based on their collaborative ties, and the high betweenness values of some authors indicate that they play an important role in linking other authors together. For example, authors in Cluster 1 have the highest betweenness values, while authors in Clusters 6, 7, 8, and 9 have lower values, suggesting less centrality in the collaboration network.
- Specific values: Authors like Dhir, Ajmal, and Abdallah in Clusters 5 and 6 have closeness and PageRank values of 1.000, meaning they are highly connected and have a significant impact within the context of their collaborations. However, their role as central intermediaries is not as prominent as that of authors in Clusters 1 and 4.

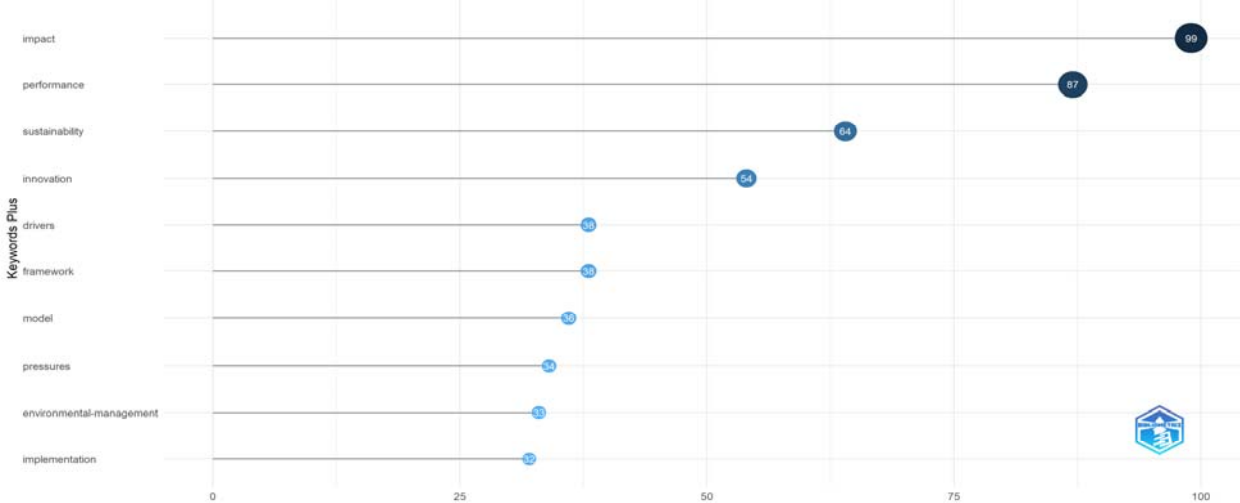


Picture 4: Collaboration Network
Source: the author

This network provides a detailed insight into the collaboration structure among authors, showing which authors play a key role in connecting and facilitating the exchange of information in their field of study.

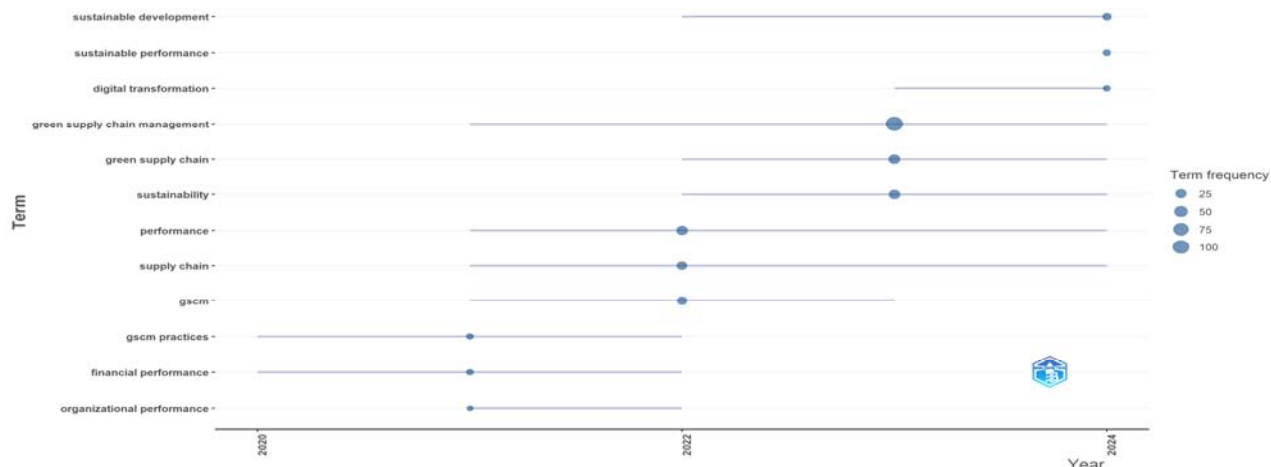
4.2. Keyword analysis

The analysis of the most frequent words in the dataset reveals key themes and areas of focus in the research related to green supply chain management (GSCM) and its relationship with sustainability (Picture 5).



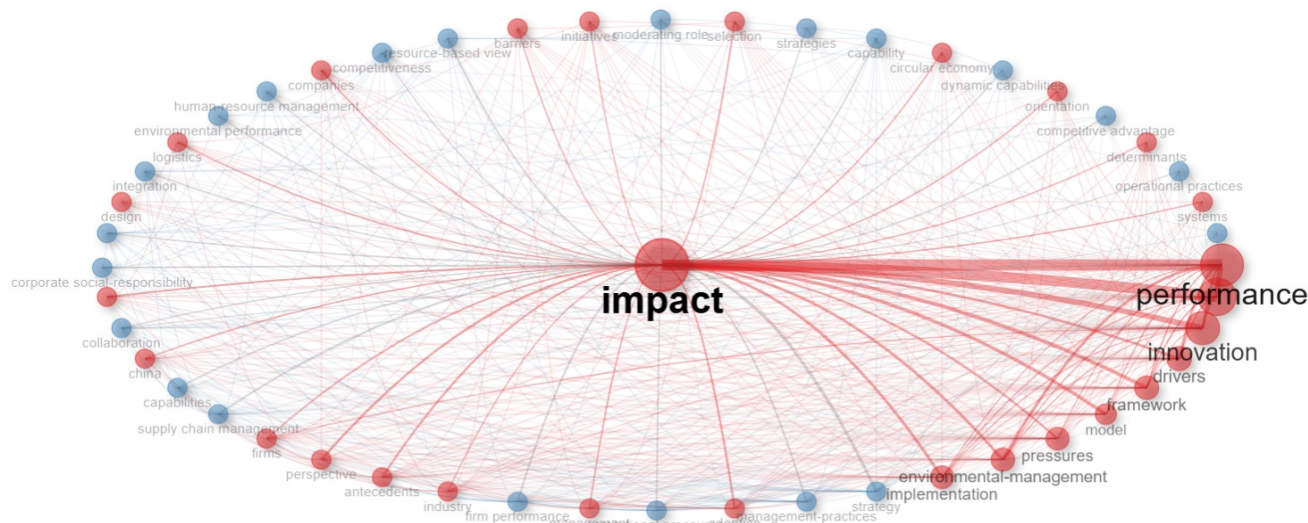
Picture 5: Most Frequent Words
Source: the author

Terms like "impact," "performance," and "sustainability" appear frequently, indicating that the primary concern of the research is evaluating the effects of GSCM practices on organizational outcomes and their role in driving sustainable business practices. Words such as "innovation," "drivers," and "framework" highlight the search for innovative solutions and theoretical models to guide the adoption of GSCM. The presence of terms like "environmental management," "adoption," and "institutional pressures" suggests that the implementation of GSCM is influenced by both internal organizational factors and external regulatory or market pressures. Furthermore, "collaboration" and "supply chain management" indicate the importance of partnerships and integrated strategies in achieving green objectives. Overall, the frequent words demonstrate a focus on the practical and strategic aspects of implementing green supply chain management in a sustainable and performance-driven manner.



Picture 6: Trend topics
Source: the author

The trend topics analysis reveals significant insights into the evolving focus of research in the field of green supply chain management (GSCM) and its related areas (Picture 6). The term **"green supply chain management"** stands out with the highest frequency of 111 occurrences, indicating its central role in contemporary research, especially from 2021 to 2024. Additionally, topics like **"financial performance," "organizational performance,"** and **"supply chain"** show a steady rise in their frequency from 2020 to 2024, reflecting the growing interest in understanding how GSCM practices impact overall business and supply chain performance. The consistent mentions of **"sustainability"** and **"sustainable performance"** suggest an increasing focus on achieving long-term environmental goals while maintaining operational effectiveness. Terms like **"digital transformation"** and **"sustainable development"** emerging in recent years (2023 and 2024) highlight the integration of modern technological advancements and sustainability efforts within the GSCM framework. The shift in focus from **"gscm practices"** and **"gscm"** to broader concepts like **"green supply chain"** and **"sustainability"** illustrates the expanding scope of research, transitioning from specific practices to overarching systems that encompass environmental, financial, and operational considerations. This shift underscores the increasing importance of sustainability-driven performance, especially in the context of digital transformation and sustainable development in supply chains.



Picture 7: Co-occurrence Network

Source: the author

The **Co-occurrence Network** is a visualization technique used to analyze relationships between terms that frequently appear together in a dataset. This particular network measures how often specific words (nodes) occur together and the significance of their connections based on various metrics (Picture 7). Analysis of the terms in the network reveals that key terms such as "impact," "performance," and "sustainability" are most strongly connected, with high values in the betweenness and PageRank metrics, indicating that they play a central role in linking other terms within the network. These terms have a strong influence on the breadth and depth of the research, especially "impact" and "performance," which are crucial for understanding the interconnection between various aspects of green supply chain management. On the other hand, terms such as "drivers" and "framework" have lower values compared to these key terms, suggesting that they are not as central but still significant for certain aspects of the research. Additionally, the closeness values indicate that the interactions between the terms are relatively evenly distributed, meaning that there is a high level of interconnectedness within the topic of green logistics.

4.3. Countries' Collaboration

The Countries' Collaboration World Map provides an overview of international collaborations between authors or researchers based on their affiliations with different countries. This dataset reveals the frequency and patterns of collaboration between countries, with a focus on how often collaborations occur. For instance, China has the highest frequency of collaborations with the United Kingdom (12 times), the USA (9 times), and Pakistan (5 times), indicating strong academic or research ties between these nations. Other notable collaborations include India with South Africa (6 times), and Pakistan with Malaysia (3 times). Some countries, such as the United States, the United Kingdom, and China, appear frequently across the dataset, suggesting their prominent role in global research collaborations. On the other hand, smaller collaborations between countries like Azerbaijan and Belarus are also present, showcasing the diversity of global academic partnerships. These collaboration patterns can help identify countries that are central to international research networks (Picture 8).



*The red lines represent the connection line between the two countries.

Picture 8: Countries' Collaboration World Map

Source: the author

CONCLUSION

Managing green supply chains (GSCM) would be significantly less effective without the assistance of AI. AI enables optimization and efficiency, planning all activities, starting from production flow down to product distribution and return. AI helps reduce waste by optimizing inventory levels, thereby minimizing the need for overproduction and transportation, which in turn reduces the environmental impact. AI is also used to optimize transport routes, reducing transportation time, CO₂ emissions, and fuel consumption by analyzing traffic data and weather conditions, as well as implementing more eco-friendly transportation methods, such as electric trucks. Furthermore, AI facilitates life cycle assessment (LCA), which helps organizations identify the environmental consequences of all production and distribution stages, allowing better decisions regarding sustainable materials and processes. Automation and robotic processes also play a significant role by improving efficiency in warehouses and production facilities, reducing unnecessary resource consumption and operational costs. Additionally, AI contributes to optimizing energy efficiency by analyzing real-time energy consumption and automatically adjusting systems to reduce usage. Through eco-design and innovations, AI aids in the development of more sustainable products, identifying ways to reduce the ecological footprint across all stages of their life cycle. Finally, AI supports strategic planning and decision-making by analyzing

vast amounts of data and providing recommendations for improving supply chain sustainability, enabling better management of environmental and economic challenges in business. Through all these processes, AI contributes not only to increased business efficiency but also to reducing the negative environmental impact, which is the key goal of green logistics and sustainable supply chain management.

The conclusion of this research paper is based on the analysis of various networks related to green supply chain management, author collaboration, and international cooperation among countries. Through the application of network analysis methods, the interconnection of key terms, the role of authors in collaboration, and international links between countries were explored. The analysis of term co-occurrence networks highlighted central terms such as "impact," "performance," and "sustainability," which play a key role in connecting other terms and spreading knowledge about green logistics. On the other hand, terms like "drivers" and "framework," though less central, still represent significant components of the research. The author collaboration network analysis revealed that authors such as Yu, Khan and Zhang play a central role in connecting other authors, while authors in different clusters had varying roles in the network. Some authors had a high influence through the betweenness metric, while others, although highly connected, had less influence on information dissemination. This analysis emphasizes the importance of collaboration and mutual connections among authors in the field of green logistics, as well as the significance of exchanging knowledge and experiences. Finally, the analysis of international collaboration among countries showed that countries like China, the United States, and the United Kingdom are key players in global cooperation, with numerous collaborative links enabling the spread and application of new ideas in green logistics. Through these analyses, it is clear that international and interdisciplinary collaboration plays a crucial role in accelerating innovation, knowledge exchange, and the implementation of sustainable solutions in a global environment.

The future direction of research on AI and GSCM will focus on integrating digital transformation with sustainability goals, leveraging AI to drive green supply chain optimization while minimizing environmental impacts. Research will shift towards creating holistic systems that encompass environmental, financial, and operational aspects, moving beyond specific practices to more comprehensive approaches to sustainable supply chains. AI will play a key role in enhancing performance metrics, automating processes, and enabling data-driven decision-making to achieve long-term sustainability. Additionally, AI will support innovation in circular supply chains, predictive analytics for risk management, and improving resilience in the face of global challenges, ultimately contributing to more efficient, adaptive, and sustainable supply chains.

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