Strategic management

International Journal of Strategic Management and Decision Support Systems in Strategic Management

Vol. 30, No. 4
2025
ISSN 2334-6191 (Online)
UDC 005.21
University of Novi Sad
Faculty of Economics in Subotica

Strategic Management

International Journal of Strategic Management and
Decision Support Systems in Strategic Management

ISSN 1821-3448, UDC 005.21

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Strategic Management

International Journal of Strategic Management and
Decision Support Systems in Strategic Management

www.smjournal.rs

Publisher

University of Novi Sad, Faculty of Economics in Subotica

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http://www.ef.uns.ac.rs

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Print
DONAT GRAF

Circulation
100

The Journal is published quarterly.

Strategic Management

International Journal of Strategic Management and
Decision Support Systems in Strategic Management

www.smjournal.rs

ISSN 1821-3448
UDC 005.21
2025, Vol. 30, No. 4

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STRATEGIC MANAGEMENT, Vol. 30 (2025), No. 4, pp. 005-020

DOI: 10.5937/StraMan2500004C

Received: January 15, 2025
Revised: May 30, 2025
June 02, 2025
Accepted: July 01, 2025
Published online: July 21, 2025

Linking Decision-Making Styles and Entrepreneurial Competences: Insights from the EntreComp Framework

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Abstract

Background: The increasing entrepreneurial activity among young people highlights the importance of understanding the competences and decision-making styles that influence their success. The European Union emphasizes the development of entrepreneurial competences, as outlined in the EntreComp framework, which comprises Ideas and Opportunities, Resources, and Into Action. Decision-making in entrepreneurship occurs under conditions of uncertainty, requiring adaptive cognitive approaches.

Purpose: This study examines the relationship between entrepreneurial competences and decision-making styles among university students, aiming to identify patterns that contribute to effective entrepreneurial behaviour.

Study design/methodology/approach: The research involved 245 university students (aged 19–25) who completed questionnaires assessing their perceived entrepreneurial competences and decision-making styles. EntreComp competences were measured using a validated scale, while decision-making styles were categorized as rational, intuitive, dependent, avoidant, or spontaneous. Statistical analyses included Spearman correlations and multiple linear regression to explore associations and predictive relationships.

Findings/conclusions: The results demonstrate that rational and intuitive decision-making styles positively predict higher self-perceived entrepreneurial competencies. These styles align with analytical and adaptive approaches essential for recognizing opportunities and managing uncertainty. In contrast, avoidant and spontaneous decision-making styles are negatively associated with entrepreneurial competences, reflecting tendencies toward impulsivity or inaction that hinder effective entrepreneurship. Dependent styles show weaker, positive relationships with some competences.

Limitations/future research: The study relies on self-reported data, which may be influenced by social desirability or subjective biases. Future research should explore objective measures of entrepreneurial competences and investigate the role of cognitive factors, such as time orientation and perfectionism, in decision-making and entrepreneurial success.

Keywords

Entrepreneurship, entrepreneurial competence, youth entrepreneurship, decision-making style, European Union

Introduction

According to reports by the Global Entrepreneurship Monitor, the average age of entrepreneurs is decreasing by approximately one year annually, with an increasing number of young people choosing to start their entrepreneurial journeys (Barrientos-Báez et al., 2022). Some sources even suggest that generations born in the 21st century are the most entrepreneurial in history. According to the Global Entrepreneurship Monitor report published in 2015, which analysed data from 2012 to 2014, young people aged 18–34 showed higher levels of entrepreneurial intention than adults. During the period between 2012 and 2016, 4.9% of young people in the European Union were actively involved in starting a business, while this proportion was 6.6% in OECD countries. Notably, one in five young entrepreneurs during this timeframe began their business in collaboration with others, exceeding the average rate for the adult population (OECD/European Union, 2017b, p. 58).

The most recent estimates indicate a high level of entrepreneurial interest among young people, with 39% of individuals aged 15–30 in the European Union preferring self-employment over traditional employment (OECD/European Commission, 2023, p. 42). However, data from 2018–2022 reveal that only 5% of young people aged 18–30 in the European Union reported working on a start-up, and an additional 4% were running their own business (OECD/European Commission, 2023, p. 23). In OECD countries, young people displayed slightly higher entrepreneurial activity, with 9% involved in start-ups and another 5% managing their own businesses. From the perspective of the European Union and OECD, this level of engagement remains insufficient and is seen as an underutilization of the potential of young people. It is estimated that if young individuals were as entrepreneurial as the core generation (those aged 30–49), this could translate into approximately 812,000 "missing" young entrepreneurs in the European Union and 3.6 million in the OECD (OECD, 2023, p. 102).

A key priority for the European Union has thus become the development of entrepreneurial competences among young people, enabling them to make critical decisions in uncertain, stressful, and interpersonally challenging environments. The present study focuses on exploring the relationships between entrepreneurial competences and various decision-making styles.

In the present study, the term *youth* refers specifically to individuals aged 19 to 25 years. While the European Union defines youth as persons aged 18 to 30 (European Union, 2018) and the OECD often uses a broader range, such as 15 to 29 years (OECD, 2022), this study adopts a narrower definition. The focus on university students reflects both a practical and a conceptual rationale. From a developmental perspective, the age group 19–25 represents a period of emerging adulthood, in which individuals actively engage in decisions related to education, identity, and career (Murphy et al., 2010)—factors closely linked to entrepreneurial development.

1. Entrepreneurial competence

In the context of the European Union, entrepreneurship is recognized as one of the eight key competences for lifelong learning (European Union, 2018). Entrepreneurial competence refers to the ability to identify and utilize opportunities and ideas, transforming them into value for others. It is grounded in creativity, critical thinking, problem-solving, initiative, perseverance, and the capacity for collaborative work aimed at planning and managing projects that generate cultural, social, or financial value (European Union, 2019, p. 13).

The development of entrepreneurial competences among young people is a key priority for the European Union (2018), as it directly aligns with broader goals of economic growth, social inclusion, and political stability. In 2015, the concept of entrepreneurial competence was formalized into the EntreComp framework (McCallum et al., 2018), designed to systematize the support for developing entrepreneurial competences across the European population. This framework not only defines entrepreneurship as a lifelong learning competence but also provides universal guidelines for implementing its development in various contexts, including formal education, non-formal learning, and workplace training. It was developed as a potential common reference framework intended to guide all types of educational and training programs, equipping citizens with competencies considered applicable across all areas of life (Armuña et al., 2020). The framework outlines and explains the specific knowledge, skills, and attitudes that need to be cultivated to enable individuals to recognize opportunities in their surroundings, identify resources, and take action to create value. Importantly, this value is not limited to business contexts; it may also encompass social, cultural, or environmental contributions (Komarkova et al., 2015; McCallum et al., 2018).

Within the EntreComp framework, entrepreneurship is regarded as a key transversal competence, applicable to individuals and groups across various areas of life. It is defined as the ability to transform opportunities and ideas into value for others, with this value being financial, cultural, or social (Vestergaard et al., 2012). This definition emphasizes value creation irrespective of its type or context, encompassing activities across all sectors and value chains—whether in the private, public, or third sector, or combinations thereof. As such, it includes diverse forms of entrepreneurship, such as intrapreneurship, social entrepreneurship, green entrepreneurship, and digital entrepreneurship.

The EntreComp framework is built on the premise that entrepreneurship can be applied in every sphere of life. This enables individuals to foster their personal development, actively contribute to societal progress, enter the labour

market as employees or self-employed professionals, and establish or grow businesses with cultural, social, or commercial orientations.

The EntreComp framework consists of three core competence areas: Ideas and Opportunities, Resources, and Into Action. Each of these stages in the process is characterized by five specific competencies, resulting in a total of 15 competencies (Bacigalupo et al., 2016, p. 10):

1. Ideas and Opportunities – spotting opportunities, creativity, vision, valuing idea, ethical & sustainable thinking
2. Resources – mobilising others, financial & economical literacy, mobilising resources, motivation & perseverance, self-awareness & self-efficacy
3. Into Action – taking initiative, planning & management, coping with ambiguity, uncertainty & risk, working with others, learning through experience

Each of these 15 competencies is further enriched by two to six sub-competencies, resulting in a total of 60 sub-competencies, referred to as threads. It is important to note that these competencies do not operate in isolation but are interconnected. They are also considered equally significant, meaning no single competency dominates as more critical to entrepreneurship than the others. Additionally, the framework does not aim for individuals to develop all competencies equally or to their maximum potential, as every entrepreneurial activity and individual requires a unique combination of skills (McCallum et al., 2018).

2. Youth entrepreneurship

By supporting young entrepreneurs, the European Union can stimulate the creation of new businesses, which naturally leads to job creation, increased productivity, and economic diversification. Young people often spearhead innovative industries that enhance the EU's competitiveness in the global market. Their openness to innovation fosters the development of new products, services, and business models, which can disrupt traditional sectors and generate new opportunities for sustained economic growth. Furthermore, promoting entrepreneurship among young people plays a pivotal role in addressing unemployment, which remains a significant challenge in many EU member states (Ghazy et al. 2022). Since young entrepreneurs create jobs not only for themselves but also for others, their activities contribute to broader economic stability and social cohesion (Halabisky, 2012). Moreover, fostering an entrepreneurial culture among young people encourages initiative, innovation, and the courage to pursue their goals. These entrepreneurs are more adaptable to change and resilient during crises, as they can identify and implement novel solutions to emerging challenges. Equally significant is the role of young entrepreneurs in promoting social inclusion and reducing inequalities. By supporting entrepreneurship in economically less developed regions, the EU can stimulate local economies and help reduce regional disparities (Kim et al., 2020).

In recent years, the traditional approach to business has been challenged by the need for greater environmental and social responsibility (Krstić, et al., 2025). The EU also aims to inspire young people to engage in social entrepreneurship, which provides not only financial but also social and environmental benefits, particularly in areas such as sustainability (economic, environmental, social; Milenković et al., 2025), social justice, and community development. The socio-psychological traits of Generation Z (1996–2010) align with these goals, as this generation is particularly attuned to issues of sustainability and social responsibility (Bresler et al., 2020). Supporting youth entrepreneurship is therefore not only a means to address current economic challenges but also a strategy to secure a prosperous, inclusive, and sustainable future for Europe.

The European Union has developed several policies addressing the promotion of youth entrepreneurship. One of these is the EU Youth Strategy, which sets the following objectives: (1) addressing youth concerns in employment strategies; (2) investing in skills sought by employers; (3) enhancing career guidance and advisory services; (4) supporting opportunities for work and education abroad; (5) promoting quality internships; (6) improving childcare and shared family responsibilities; and (7) fostering entrepreneurship. The prioritization of youth entrepreneurship within the EU's political agenda is evident, positioning it as a tool to combat youth unemployment and social exclusion while fostering innovation among young people. For example, promoting youth entrepreneurship is one of the objectives of the Europe 2020 strategy ("Youth on the Move"). Employment and entrepreneurship are also among the eight areas of action supported by the EU Youth Strategy (2010–2018). Additionally, entrepreneurship is identified

as a key competence within the European Reference Framework of Key Competences for Lifelong Learning (European Union, 2018).

Youth work and non-formal education play a crucial role in developing the creative and innovative potential of young people, including their entrepreneurial competencies. Training programs in entrepreneurship, coaching, and mentoring initiatives are among the most common types of support offered by governments to foster youth entrepreneurship (OECD, 2021). This underscores the fact that education at all levels is vital for the development of entrepreneurial competencies (OECD/European Commission, 2020).

The European Higher Education Area (EHEA) has placed the concept of competence at the centre of the educational process (Ferreras-Garcia et al., 2021). As noted by Barrientos-Báez et al. (2022), universities are uniquely positioned to quickly adapt to societal changes and implement improvements to optimize educational activities. Universities therefore play a pivotal role in developing entrepreneurial competencies by providing students with essential education, resources, and support systems to enhance their entrepreneurial skills (Stephens et al., 2021).

Through specialized courses, workshops, and experiential learning opportunities, universities help students acquire critical entrepreneurial knowledge and practical skills such as financial management, marketing, and innovation (OECD, 2019). Additionally, many universities host incubators, accelerators, and entrepreneurship competitions, offering students mentorship, funding opportunities, and real-world experience in launching and managing a business (OECD/European Union, 2017a).

Universities also foster an entrepreneurial culture by encouraging interdisciplinary collaboration, where students from diverse fields come together to develop innovative solutions to complex problems (Hintikka et al., 2022; Ligonenko et al., 2023). This environment not only promotes creativity and problem-solving but also instils a proactive mindset in students, motivating them to take initiative and engage in entrepreneurial activities.

By providing a supportive ecosystem, universities enable students to explore and test their entrepreneurial ideas in a safe and resource-rich environment, which is crucial for the growth and development of young entrepreneurs. College and university graduates are more likely to establish new businesses compared to non-graduates, employ more people, and make significantly greater investments in their companies than entrepreneurs without academic education (Huang et al., 2021; Huňady et al., 2018).

The development of entrepreneurial competencies is particularly crucial for university students, who, compared to high school students, are at a more advanced stage of personal and academic development. This enables them to better understand and engage with complex entrepreneurial concepts. University students often possess more specialized knowledge in their chosen fields, allowing them to identify specific markets and innovative opportunities within these areas. This deeper academic foundation equips them with analytical and critical thinking skills essential for addressing the challenges of starting and managing a business (Crespí et al., 2022). The university environment typically offers a greater array of resources and entrepreneurship-focused opportunities, such as access to business incubators, accelerators, mentoring programs, and professional networks (OECD, 2019). These resources provide university students with practical experience and support, which are vital for launching and sustaining a business.

3. Entrepreneurial competence and decision-making

The entrepreneurial environment is inherently unpredictable, characterized by rapidly changing markets, shifting customer preferences, and technological advancements. Entrepreneurs must constantly make decisions with incomplete information, manage risks, and adapt to new challenges. They are frequently under pressure to make quick decisions that can have significant long-term consequences, whether it involves launching a product, entering a new market, or responding to a crisis (Shepherd et al., 2015). The ability to make sound decisions under pressure is therefore critical. Entrepreneurial decision-making often takes place in contexts of high uncertainty and complexity. Entrepreneurs must navigate environments where information is incomplete, outcomes are unpredictable, and the stakes are high. Such uncertainty demands decision-making approaches that are both adaptive and resilient. Entrepreneurial decision-making often takes place in contexts of high uncertainty and complexity. In the context of entrepreneurship education, Ilonen, Heinonen, and Stenholm (2018) identified four

decision-making logics—causal, effectual, hybrid, and coping—among university students participating in business creation projects. Their study revealed that students often shift between these logics depending on situational factors such as uncertainty, team dynamics, and perceived failure. Although some student teams did not establish viable ventures, the process itself led to a deeper understanding of entrepreneurship and self-perception as potential entrepreneurs.

Cohen and Wirtz (2022) identify two decision-making styles in the context of entrepreneurship. The control-oriented decision-making style is based on the belief that entrepreneurs can shape their future through their actions. Rather than attempting to predict the future, these individuals focus on controlling variables and creating opportunities by leveraging their resources and networks. Entrepreneurs who adopt a control-oriented approach are more likely to employ innovative and flexible financial strategies. However, this decision-making style involves higher risks, as it often entails acting without extensive forecasting or planning. Entrepreneurs who adopt a predictive decision-making style heavily rely on forecasting, planning, and analysing market trends to guide their financial decisions. This style operates on the assumption that the future can be predicted with reasonable accuracy based on available data and trends. Predictive approaches are often associated with more structured financial planning and cautious growth strategies. Entrepreneurs using this style tend to seek stability and are more likely to follow traditional financing paths, such as bank loans or equity investments. However, this approach may limit their ability to quickly adapt to unforeseen changes or seize unexpected opportunities.

The study by De Winnaar and Scholtz (2020) highlights the interplay between cognitive (rational) and emotional (irrational) factors in entrepreneurial decision-making. According to the authors, entrepreneurs often rely on a combination of logic, intuition, and emotional intelligence when making decisions (De Winnaar & Scholtz, 2020; Sanda & Sallama, 2023).

Several studies have demonstrated a positive relationship between the rational decision-making style and entrepreneurial intentions. The emphasis of this style on thorough analysis and planning aligns with calculated risk-taking and strategic thinking, which are often essential in entrepreneurship (Krasniqi et al., 2019). Entrepreneurs with a rational decision-making style excel at recognizing opportunities due to their meticulous analysis of market data, trends, and potential risks. This cautious approach enables them to identify viable opportunities that others might overlook. The rational decision-making style is closely linked to effective risk management. Entrepreneurs who adopt this style are typically more diligent in assessing potential risks before making decisions, leading to more calculated and less risky entrepreneurial activities. While rational decision-makers can also be innovative, their innovations tend to be more structured and methodical, focusing on incremental improvements rather than radical changes (Yener, 2020). Moreover, individuals who employ a rational approach are more likely to engage in social entrepreneurship. They systematically identify social problems, analyse potential solutions, and implement innovative projects to address these challenges (Cohen & Wirtz, 2022).

The rational decision-making style is often closely associated with the analytical decision-making style, which is characterized by a focus on data, systematic analysis, and structured approaches. Entrepreneurs with an analytical cognitive style tend to delve deeply into research and information gathering, using detailed data analysis to inform their decisions (Sassetti et al., 2022). This style is marked by thorough research, careful consideration of various options, and a strong emphasis on minimizing risks. Wang, Liu, and Wang (2019) identified key cognitive dimensions—such as task division, monitoring ability, and consensus-building—that significantly influence the speed and effectiveness of decision-making among student entrepreneurs. Their findings suggest that structured cognitive strategies, especially professional task allocation and monitoring, enhance decision quality, which aligns with the core characteristics of rational and analytical styles. Research shows that students who self-select into entrepreneurship programs tend to exhibit higher risk tolerance and specific cognitive patterns that influence their entrepreneurial decision-making. These characteristics should be considered when interpreting their intentions and designing effective training (Zichella & Reichstein, 2023).

Entrepreneurs employing an analytical decision-making style are more likely to engage in detailed financial planning. They tend to create comprehensive business plans, seek external sources of funding, and carefully manage cash flows. This approach often results in more stable

financial management; however, it may also slow down decision-making processes in rapidly changing environments.

Entrepreneurs who adopt an analytical decision-making style often achieve sustainable and stable growth. Their emphasis on meticulous planning and aversion to risk helps them avoid major financial setbacks, contributing to long-term success. However, the same cautious approach may also slow down growth, as decisions are made more conservatively (Cohen & Wirtz, 2022).

Interestingly, this conservative profile contrasts with recent findings by Ma, Fiet, and Dubofsky (2023), who compared entrepreneurs and non-entrepreneurs under risk conditions. They observed that entrepreneurs tend to rely more on intuition and are less influenced by how opportunities are framed, while non-entrepreneurs display more caution and are more affected by cognitive biases. These results suggest that intuitive decision-making may offer a competitive edge in environments characterized by uncertainty and rapid change.

Indeed, individuals with an intuitive decision-making style typically draw upon their instincts, past experiences, and situational alertness, rather than engaging in extensive data collection. This approach enables quicker decisions, though sometimes at the expense of thoroughness (Sassetti et al., 2022). Nevertheless, intuitive decision-makers are often highly adept at spotting entrepreneurial opportunities, particularly in volatile or ambiguous contexts (Yener, 2020).

Intuitive decision-making is also a strong predictor of entrepreneurial intentions. Individuals who trust their instincts and experiences are more likely to engage in entrepreneurial activities, as this style supports opportunity recognition and decision-making in uncertain and dynamic settings. Their ability to quickly perceive and react to emerging opportunities, coupled with their willingness to trust their instincts and explore unconventional ideas, allows them to innovate rapidly and adapt to changing market conditions, giving them a competitive advantage in fast-moving markets (Yener, 2020).

However, this style is often less structured, with decisions made quickly based on perceived opportunities or threats rather than detailed analysis (Cohen & Wirtz, 2022).

Intuitive decision-making is also strongly associated with social entrepreneurship. Individuals who rely on intuition excel at recognizing social needs and opportunities for innovation, often making quick decisions that lead to the realization of social entrepreneurial initiatives (Akdeniz & Korkmaz, 2023). Intuitive decision-makers tend to be more flexible and adaptive in their financial strategies, enabling them to seize new opportunities, adjust when necessary, and make rapid decisions aligned with emerging market trends. However, this style can also lead to higher financial risks if decisions are made without sufficient data or planning (Cohen & Wirtz, 2022). While both spontaneous and intuitive decision-makers may be more willing to take risks, and their ability to quickly adapt and capitalize on opportunities can result in significant short-term gains, this approach has a dual edge. The lack of thorough analysis can expose them to unforeseen risks, yet it also allows them to pursue high-risk, high-reward opportunities (Yener, 2020). Additionally, the absence of detailed financial planning can lead to instability and potential challenges if market conditions change unexpectedly (Cohen & Wirtz, 2022).

Some entrepreneurs adopt a heuristic decision-making style, where they apply rules of thumb, shortcuts, or past experiences to make financial decisions. This style combines analytical and intuitive approaches, aiming to simplify complex decisions in uncertain environments. Entrepreneurs using heuristics rely on practical, experience-based guidelines to inform their financial choices, which can be particularly effective when quick decision-making is essential. This style fosters agility while maintaining a degree of risk management. Entrepreneurs employing heuristics tend to achieve growth that is both adaptive and resilient. By leveraging practical rules, they navigate uncertain environments effectively, balancing the need for speed with the necessity of managing risks (Cohen & Wirtz, 2022). Students with higher entrepreneurial tendencies may prefer faster and less analytical decision-making, while those with lower entrepreneurial inclinations are more likely to rely on a systematic approach and thorough analysis (Deprez et al., 2021; Kolvereid & Moen, 1997).

The relationship between the spontaneous decision-making style and entrepreneurial intentions is mixed. While the ability to make quick decisions can be advantageous in rapidly changing entrepreneurial environments, a lack of thorough consideration can result in impulsive and high-risk decisions that may not be sustainable in the long term (Krasniqi et al., 2019). Spontaneous decision-makers can be effective leaders in situations

requiring quick decisions and immediate responses. Their decisiveness can inspire confidence within their teams; however, it may also lead to impulsive choices if not balanced with careful deliberation (Yener, 2020). Individuals with a dependent decision-making style are less likely to exhibit entrepreneurial intentions (Krasniqi et al., 2019). Entrepreneurs displaying this style tend to seek advice, reassurance, and input from others before making decisions. This reliance may present challenges in leadership, as they often depend on others for guidance. However, this style can be beneficial in team-oriented environments where collaboration is essential (Yener, 2020). Dependence on others' input during decision-making can hinder independence and proactive thinking, which are typically associated with entrepreneurial behaviour (Krasniqi et al., 2019). The dependent decision-making style also shows weaker correlations with social entrepreneurship. While such individuals may engage in social entrepreneurial activities, their reliance on others can limit their ability to act independently and take the initiative required for driving social innovation (Akdeniz & Korkmaz, 2023).

The avoidant decision-making style is negatively associated with entrepreneurial intentions. Individuals who tend to procrastinate or avoid making decisions are less likely to engage in entrepreneurship, which often requires decisive action and a willingness to confront risks and uncertainties head-on (Krasniqi et al., 2019). This decision-making style is also negatively linked to social entrepreneurship, as avoidance behaviour conflicts with the proactive and solution-oriented mindset necessary for addressing social challenges (Akdeniz & Korkmaz, 2023).

4. Present study

Decision-making styles play a crucial role in how individuals identify opportunities, mobilize resources, and execute entrepreneurial activities. Given the entrepreneurial environment's inherent dynamism, uncertainty, and information asymmetry, decision-making strategies become critical determinants of entrepreneurial competence (Cohen & Wirtz, 2022).

Identifying entrepreneurial opportunities requires strategic thinking, responsiveness, and openness to new approaches. The rational decision-making style supports systematic evaluation of information (Krasniqi et al., 2019; Yener, 2020), the intuitive style facilitates swift adaptation in dynamic contexts (Sassetti et al., 2022), and the dependent style may enhance idea generation through consultation and feedback (Yener, 2020).

Hypothesis 1: Rational, intuitive, and dependent decision-making styles positively predict the level of competence in the Ideas and Opportunities dimension.

In contrast, decision-making styles marked by avoidance or impulsivity may hinder opportunity recognition and development. Avoidant decision-makers show reduced initiative and decisiveness (Akdeniz & Korkmaz, 2023), while spontaneous decision-makers may engage in uncoordinated or ethically questionable decision-making (Cohen & Wirtz, 2022).

Hypothesis 2: Avoidant and spontaneous decision-making styles negatively predict the level of competence in the Ideas and Opportunities dimension.

Effective use of personal, material, and social resources is central to entrepreneurial performance. The rational style supports planning and organizational efficiency (Sassetti et al., 2022), while the intuitive style is associated with flexibility and self-confidence (Yener, 2020).

Hypothesis 3: Rational and intuitive decision-making styles positively predict the level of competence in the Resources dimension.

Conversely, avoidant decision-making, characterized by procrastination and low motivation, may undermine one's ability to manage resources effectively (Akdeniz & Korkmaz, 2023).

Hypothesis 4: The avoidant decision-making style negatively predicts the level of competence in the Resources dimension.

The translation of ideas into action requires initiative, planning, risk management, teamwork, and learning from experience. The rational style supports structured decision-making and risk tolerance (Cohen & Wirtz, 2022), the intuitive style enhances adaptability and responsiveness (Yener, 2020), and the dependent style may facilitate collaboration and organization (Yener, 2020).

Hypothesis 5: Rational, intuitive, and dependent decision-making styles positively predict the level of competence in the Into Action dimension.

In contrast, avoidant tendencies may act as barriers to entrepreneurial initiative, particularly under conditions of ambiguity and risk (Krasniqi et al., 2019; Akdeniz & Korkmaz, 2023).

Hypothesis 6: The avoidant decision-making style negatively predicts the level of competence in the Into Action dimension.

5. Methodology

5.1. Sample

The study involved 245 university students aged 19–25 years (M = 21.82 years; SD = 1.71). The sample comprised 145 females (59.20 %) aged 19–25 years (M = 21.77 years; SD = 1.65) and 100 males (40.80 %) aged 19–25 years (M = 21.90 years; SD = 1.80). Most participants were enrolled in bachelor's degree programs (N = 174, 71.0%), while the remaining 29.0 % (N = 71) were pursuing master's or engineering degrees. Regarding fields of study, 42.4 % of respondents (N = 104) were studying economics or related disciplines, while 57.6 % (N = 141) were enrolled in non-economics programs.

5.2. Measures

Sociodemographic Questionnaire. The first section of the questionnaire focused on basic demographic information, including age, gender, nationality, level of study, field of study, and place of origin. The second section was dedicated to the respondents' social background, specifically addressing: family structure ("complete/incomplete"), parental entrepreneurial experience ("at least one parent was an entrepreneur in the past but is no longer active/parents are non-entrepreneurs/neither parent has ever been an entrepreneur/at least one parent is currently an active entrepreneur"), perceived socioeconomic status of parents ("lower/middle/upper"), respondent's future entrepreneurial intentions ("I haven't thought about it yet/yes/no").

The EntreComp questionnaire (Čopková et al., 2023) consists of 60 items that measure three dimensions of entrepreneurial competence: Ideas and Opportunities *("I can identify ways in which I could be useful to others."*), Resources *("I am determined and persistent in achieving my own goal or my team's goal."*), and Into Action *("I can clarify what my goals are when creating a simple value."*). Each of the three dimensions is further divided into five subdimensions, with the number of items per subdimension ranging from two to six. Respondents assess their competencies on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). The internal consistency of the scales was as follows: Ideas and Opportunities ω = 0.858, Resources ω = 0.872, and Into Action ω = 0.897.

General Decision-Making Styles Questionnaire (Scott & Bruce, 1995; Bavoľár & Orosová, 2015). The questionnaire consists of 25 items divided into five subscales, each representing a specific decision-making style and containing five items. The authors identified the following five decision-making styles: Rational (*"I make decisions in a logical and systematic way."*), Intuitive (*"When making decisions, I tend to rely on my intuition."*), Dependent (*"I rarely make important decisions without consulting other people."*), Avoidant (*"I often consciously delay making important decisions.*"), Spontaneous (*"I often make impulsive decisions."*). Respondents rate their agreement on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The sum of scores for each subscale indicates the preference for a specific decision-making style. The internal consistency (McDonald's omega) for the scales was as follows: Rational ω = 0.769, Intuitive ω = 0.552, Dependent ω = 0.586, Avoidant ω = 0.843, and Spontaneous ω = 0.697.

5.3. Procedure

Data collection took place in the spring of 2024. The questionnaire sets were distributed to respondents exclusively in electronic form via Google Docs-Form. Participants were informed about the anonymity and voluntary nature of the research, as well as their right to withdraw at any time by simply closing the application. They were also assured that the data collected would be used solely for research purposes.

The collected data were analysed using Jamovi 2.4.11 statistical software. The reliability of the applied instruments was estimated using McDonald's omega. A test of normality using the Shapiro-Wilk test revealed that the data did not follow a normal distribution across all datasets ($p < 0.05$). Consequently, non-parametric statistical methods were applied where necessary.

The datasets contained no missing data. Descriptive analysis was conducted across all parts of the study using basic statistical measures, including arithmetic mean, standard deviation, median, minimum, maximum.

The nature and significance of relationships between variables were examined using

Spearman's correlation coefficient (Spearman ρ). To test the predictive models, multiple linear regression analysis was applied. Before conducting the regression analysis, the necessary assumptions were verified: a sufficient number of cases based on the formula (8/f2) + (m−1)(8/f^2) + (m-1)(8/f2) + (m−1), the linearity of relationships using scatterplots, the absence of outliers assessed through Cook's distance, the multicollinearity checked with Variance Inflation Factor (VIF), normality, linearity, and homoscedasticity of residuals evaluated using scatterplots (Bavoľár et al., 2021).

6. Results

The aim of the study was to explore the relationships between entrepreneurial competences and decision-making styles. The following section of the results presentation includes the descriptive analysis of the variables (Table 1).

Table 1 Descriptive analysis of decision-making styles and entrepreneurial competence according to EntreComp (N = 245)

	M	Me	SD	Min	Max
DECISION-MAKING STYLES					
rational	17.13	17.00	3.14	8.00	25.00
intuitive	16.50	16.00	2.47	9.00	24.00
dependent	16.14	16.00	2.76	7.00	24.00
avoidant	15.65	17.00	3.86	5.00	25.00
spontaneous	16.00	17.00	2.99	6.00	23.00
IDEAS & OPPORTUNITIES	73.95	73.00	11.19	43.00	117.00
spotting opportunities	15.69	16.00	2.90	4.00	24.00
creativity	20.38	20.00	3.76	11.00	34.00
vision	12.79	13.00	2.59	7.00	21.00
valuing ideas	8.18	8.00	1.75	4.00	14.00
ethical & sustainable thinking	16.91	17.00	3.34	9.00	28.00
RESOURCES	88.75	87.00	13.53	50.00	139.00
self-awareness & self-efficacy	16.67	16.00	3.54	9.00	28.00
motivation & perseverance	21.15	20.00	4.34	5.00	35.00
mobilising resources	17.25	17.00	3.49	8.00	28.00
financial & economic literacy	16.91	17.00	3.21	9.00	28.00
mobilising others	16.77	17.00	3.00	9.00	27.00
INTO ACTION	87.50	85.00	14.20	55.00	146.00
taking initiative	12.69	12.00	2.76	3.00	21.00
planning & management	24.83	25.00	4.54	8.00	42.00
coping with ambiguity, uncertainty & risk	12.45	12.00	2.59	6.00	21.00
working with others	25.06	25.00	4.97	12.00	42.00
learning through experience	12.47	12.00	2.71	3.00	21.00

Note: M = mean; SD = standard deviation; Me = median; Min = minimum; Max = maximum

Source: the author

To identify significant associations between decision-making styles and the entrepreneurial competence factor Ideas and Opportunities, we conducted a correlation analysis using the non-parametric Spearman's correlation coefficient. This analysis revealed several statistically significant relationships between the subdimensions of entrepreneurial competence and specific decision-making styles. Based on the results presented in Table 2, individuals exhibiting rational and intuitive decision-making styles perceive themselves as more capable in recognizing opportunities, identifying needs, defining problems, demonstrating innovativeness, envisioning the future, sharing and protecting ideas, ethical behaviour, and sustainable thinking. The dependent decision-making style was also positively associated with recognizing

opportunities, creativity, and vision. In contrast, individuals with an avoidant decision-making style tend to lack initiative in seeking opportunities, curiosity, openness, strategic thinking, and ethical and sustainable thinking. Similarly, individuals with a spontaneous decision-making style demonstrated negative associations, indicating lower initiative in addressing challenges, identifying opportunities, recognizing the value of ideas, and engaging in ethical and sustainable thinking.

Table 2 Spearman's correlation (**ρ**) of decision-making styles and entrepreneurial competence Ideas & Opportunities (N = 245)

	rational	intuitive	dependent	avoidant	spontaneous
IDEAS & OPPORTUNITIES	0.377***	0.264***	0.217***	-0.172**	-0.175**
spotting opportunities	0.354***	0.152*	0.177**	-0.166**	-0.148**
creativity	0.342***	0.247***	0.150*	-0.186**	-0.105
vision	0.217***	0.244***	0.138*	-0.129*	-0.111
valuing ideas	0.192***	0.182**	0.060	-0.037	-0.173**

Note: *p < 0,05; **p < 0,01; ***p < 0,001

Source: the author

In the domain of Resources, numerous significant associations with specific decision-making styles were identified (Table 3). The rational decision-making style was positively correlated with all subdimensions of Resources. Individuals employing a rational style perceive their competencies in managing internal, personnel, and material resources positively. A similar pattern was observed for the intuitive decision-making style, except for mobilizing human resources through effective communication, inspiration, or persuasion, where the correlation coefficient did not reach statistical significance. In this subdimension, along with motivation and perseverance, no significant relationships were identified for the dependent decision-making style. However, the dependent style was positively associated with the management of internal resources, such as self-confidence and the recognition of strengths and weaknesses, as well as the management of material, non-material, and financial resources. On the other hand, individuals with avoidant and spontaneous decision-making styles perceive themselves as less competent in self-awareness, belief in their abilities, motivation, and determination to persist despite obstacles. They also report lower competency in managing both material and non-material resources.

Table 3 Spearman's correlation (**ρ**) of decision-making styles and entrepreneurial competence Resources (N = 245)

	rational	intuitive	dependent	avoidant	spontaneous
RESOURCES	0.398***	0.228***	0.172**	-0.205**	-0.176**
self-awareness & self-efficacy	0.351***	0.243***	0.154*	-0.233***	-0.207**
motivation & perseverance	0.279***	0.195**	0.081	-0.243***	-0.160*
mobilising resources	0.402***	0.265***	0.177**	-0.157*	-0.217***
financial & economic literacy	0.245***	0.157*	0.147*	-0.039	-0.105

Note: *p < 0,05; **p < 0,01; ***p < 0,001

Source: the author

Decision-making styles were significantly correlated with the Into Action factor (Table 4). Like the previous two factors, individuals with a rational decision-making style perceived themselves as more competent in taking initiative, working independently, managing uncertainty and risk, embracing diversity within a team, and learning from experience.

However, while individuals with an intuitive decision-making style were also associated with competencies under the Into Action factor, they did not exhibit significant associations with goal setting, planning, and organization. The dependent decision-making style showed positive correlations with only two subdimensions: planning and organizing, including goal and priority setting, and collaboration with others.

In contrast, individuals with avoidant and spontaneous decision-making styles perceived themselves as less competent in taking

responsibility, planning and organizing, collaborating with others, and learning from experience. The key difference between these two styles lies in the subdimension of managing uncertainty, ambiguity, and risk. This subdimension was negatively associated with the avoidant style, while no significant relationship was observed for the spontaneous style.

Table 4 Spearman's correlation (**ρ**) of decision-making styles and entrepreneurial competence Into Action (N = 245)

	rational	**intuitive**	**dependent**	**avoidant**	**spontaneous**
INTO ACTION	0.410***	0.132*	0.148*	-0.279***	-0.170**
taking initiative	0.330***	0.192**	0.074	-0.138*	-0.150*
planning & management	0.375***	0.069	0.128*	-0.271***	-0.185**
coping with ambiguity, uncertainty & risk	0.304***	0.160*	0.022	-0.202**	-0.095
working with others	0.236***	0.192**	0.201**	-0.234***	-0.145*

Note: *p < 0,05; **p < 0,01; ***p < 0,001

Source: the author

We also analysed more complex relationships between entrepreneurial factors and decision-making styles using multiple linear regression analysis. Three models were developed and described. On the predictor side, all five decision-making styles were included, while the dependent variables were represented by the individual entrepreneurial factors.

The first model (Table 5) significantly explained 45.0% of the variance in Ideas and Opportunities ($F(5,239) = 39.164$, $p<0.001$). In this model, all decision-making styles significantly predicted the dependent variable. The rational decision-making style ($\beta = 0.280$), the intuitive decision-making style ($\beta = 0.244$), and the dependent decision-making style ($\beta = 0.135$) were positive predictors. Conversely, the avoidant decision-making style ($\beta = -0.325$) and the spontaneous decision-making style ($\beta = -0.174$) were negative predictors.

Table 5 Multiple linear regression of decision-making styles and entrepreneurial competence Ideas & Opportunities (N = 245)

	IDEAS & OPPORTUNITIES				
	b	**SE**	**β**	**t**	**p**
rational	0.998	0.200	0.280	4.984	<0.001***
intuitive	1.104	0.241	0.244	4.585	<0.001***
dependent	0.548	0.213	0.135	2.570	0.011*
avoidant	-0.942	0.172	-0.325	-5.488	<0.001***
spontaneous	-0.653	0.237	-0.174	-2.755	0.006**
R^2	0.450				
F	39.164				
p	<0 .001***				

Note: *p < 0,05; **p < 0,01; ***p < 0,001

Source: the author

The second model was also significant ($F(5,239) = 38.786$; $p<0.001$) and explained 44.8 % of the variance in Resources (Table 6). In this case, only three decision-making styles emerged as significant predictors: the rational decision-making style ($\beta = 0.354$) and the spontaneous decision-making style ($\beta = 0.249$) were positive predictors, while the avoidant decision-making style ($\beta = -0.316$) was a negative predictor.

Table 6 Multiple linear regression of decision-making styles and entrepreneurial competence Resources (N = 245)

	RESOURCES				
	b	**SE**	**β**	**t**	**p**
rational	1.524	0.243	0.354	6.281	<0 .001***
intuitive	1.362	0.292	0.249	4.671	<0 .001***
dependent	0.376	0.258	0.077	1.456	0.147
avoidant	-1.110	0.208	-0.316	-5.338	< 0.001***
spontaneous	-0.367	0.287	-0.081	-1.281	0.202
R^2	0.448				
F	38.786				
p	< 0.001***				

Note: *p < 0,05; **p < 0,01; ***p < 0,001

Source: the author

In the final model (Table 7), Into Action was significantly explained by decision-making styles ($F(5,239) = 43.247$; $p<0.001$), accounting for 47.5 % of the variance. Into Action was significantly and positively predicted by the rational decision-making style (β = 0.309), the intuitive decision-making style (β = 0.185), and the dependent decision-making style (β = 0.135). It was negatively predicted by the avoidant decision-making style (β = −0.446).

Table 7 Multiple linear regression of decision-making styles and entrepreneurial competence Into Action (N = 245)

	INTO ACTION				
	b	**SE**	**β**	**t**	**p**
rational	1.397	0.248	0.309	5.626	< 0.001***
intuitive	1.065	0.299	0.185	3.565	<0 .001***
dependent	0.693	0.264	0.135	2.620	0.009**
avoidant	-1.642	0.213	-0.446	-7.714	< 0.001***
spontaneous	-0.180	0.294	-0.038	-0.614	0.540
R^2	0.475				
F	43.247				
p	<0.001***				

Note: *p < 0,05; **p < 0,01; ***p < 0,001

Source: the author

Conclusion

Young entrepreneurs play a vital role in driving innovation, job creation, and economic growth, which are particularly significant for the European Union. The EU emphasizes fostering entrepreneurship among young people as part of its broader goals to enhance competitiveness, reduce unemployment, and promote social cohesion. According to the EU's strategies, supporting young entrepreneurs not only addresses current economic challenges but also contributes to a sustainable and inclusive future.

University students, as potential future entrepreneurs, are often at the forefront of innovative industries, and their openness to new ideas positions them as key contributors to economic and social development. By understanding how their decision-making styles interact with entrepreneurial competencies, educators and policymakers can better design programs that nurture entrepreneurial intentions and prepare students to successfully launch and manage their ventures.

The central aim of this study was to examine how university students' decision-making styles relate to their self-perceived entrepreneurial competences. This focus stems from the recognition that the entrepreneurial environment is inherently uncertain, complex, and risk-laden—conditions that require individuals to rely on distinct cognitive strategies when making decisions. Our findings indicate that among the decision-making styles assessed, rational and intuitive styles were the most positively associated with higher self-assessments of entrepreneurial competences, while dependent, spontaneous, and avoidant styles were either weakly or negatively related.

The strong association between the rational decision-making style and entrepreneurial competence suggests that structured, analytical thinking supports students' confidence in their entrepreneurial abilities. This is consistent with existing literature, which links rationality with strategic thinking, risk assessment, and goal-oriented planning—all of which are foundational to entrepreneurial success (Krasniqi et al., 2019; Cohen & Wirtz, 2022; Yener, 2020). Rational thinkers are more likely to evaluate opportunities thoroughly and respond with deliberate, informed action, which in turn may enhance their perceived readiness to engage in entrepreneurial tasks.

Similarly, the intuitive decision-making style was positively related to students' perceived entrepreneurial competences. This style is especially advantageous in dynamic and fast-paced environments, where swift, experience-based judgments are often necessary. The ability to act on instinct, grounded in prior knowledge and tacit learning, may give intuitive individuals a sense of confidence and adaptability in navigating complex entrepreneurial challenges (Yener, 2020).

In contrast, the dependent decision-making style showed only weak associations with entrepreneurial competence. This suggests that reliance on external validation or guidance may undermine self-confidence in one's ability to act independently—an essential trait for entrepreneurs (Krasniqi et al., 2019). While collaboration and feedback are valuable, excessive dependence may signal a lack of autonomy, which could impede entrepreneurial initiative.

Finally, spontaneous and avoidant decision-making styles were negatively associated with perceived entrepreneurial competences. Individuals with a spontaneous style may make impulsive, poorly considered decisions, increasing the likelihood of mistakes and reducing perceived effectiveness (Yener, 2020). Those with an avoidant style tend to procrastinate or withdraw from decision-making altogether—traits fundamentally incompatible with the proactive and decisive nature of entrepreneurial activity (Shepherd & Patzelt, 2017; Gans et al., 2019). These findings highlight that not all decision-making styles equally support entrepreneurial development, and some may actively hinder it.

This study contributes to the growing body of literature on entrepreneurship by exploring how distinct decision-making styles predict the self-perception of entrepreneurial competences among university students. While previous research has often focused on entrepreneurial intentions or behaviours in isolation (Djordjevic et al., 2021), our findings emphasize the psychological mechanisms that may underpin the acquisition of entrepreneurial skills—particularly during the formative years of early adulthood.

From a theoretical perspective, the study supports the relevance of cognitive and affective styles in entrepreneurship research and illustrates how are decision-making tendencies such as rationality, intuition, or avoidance associated with self-perceived competences within the EntreComp framework. These insights expand our understanding of the psychological foundations of entrepreneurship and offer new directions for future research, particularly in investigating how these styles evolve over time or vary across cultural and educational contexts.

Practically, the results can inform educators and curriculum designers about the importance of tailoring entrepreneurship education to individual cognitive profiles. For example, students with a rational decision-making style may benefit from strategy-based training, while those with intuitive tendencies might excel in dynamic, real-world simulations. Integrating such psychological considerations into educational practice may enhance the effectiveness of entrepreneurship programs and better prepare young adults for decision-making in complex and uncertain environments.

There are several limitations in our study. Although the participants in this study were not entrepreneurs at the time of data collection, the sample is appropriate for investigating the relationship between decision-making styles and entrepreneurial competences for several reasons. The EntreComp framework is designed not only to assess entrepreneurial performance but also to support the development of entrepreneurial potential in individuals, particularly in educational contexts (Bacigalupo et al., 2016). The framework explicitly targets learners and aspiring entrepreneurs, making students a highly relevant population for early-stage assessment of entrepreneurial competences. Numerous studies have shown that entrepreneurial competences and intentions are often shaped before the actual launch of a business, especially during late adolescence and early adulthood (Kolvereid & Moen, 1997; Nabi et al., 2017). University students are typically in a developmental phase characterized by increased autonomy, decision-making responsibility, and exploration of career

pathways—all of which are strongly related to entrepreneurial thinking. Decision-making styles are relatively stable cognitive tendencies that can influence how individuals perceive, evaluate, and act upon opportunities—regardless of their current entrepreneurial status (Scott & Bruce, 1995). Examining these styles in students enables us to better understand how individual predispositions may facilitate or hinder the future development of entrepreneurial behaviour.

It is important to note that we did not assess the objective level of entrepreneurial competencies but rather their subjective perception by the respondents. This introduces potential biases, such as socially desirable responses, answers influenced by current mood, perception, or memories (Rabbitt & Abson, 1990). While this is a natural limitation of self-report methodologies, other experts have emphasized that self-report tools in this context can promote self-awareness, which is essential for further personal development (London et al., 2022). Therefore, when interpreting the results, it is crucial to keep in mind that they reflect perceived, rather than actual, competency levels.

In the future, examining irrational work-related beliefs, such as perfectionism, and time perspectives (whether entrepreneurs are more future- or present-oriented) could reveal how these cognitive frameworks influence decision-making and strategic planning.

Declarations

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Funding

This research received a financial grant from the Cultural and Educational Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic, during the project "Targeted acquisition of skills and competences at universities through microcredentials and European digital credits" (KEGA 072TUKE-4/2024)

Acknowledgements

Not applicable.

References

Akdeniz, A., & Korkmaz, M. (2023). The relationship between the decision-making styles and social entrepreneurship of science and art center principals. *Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi, 55*, 231–249. https://doi.org/10.53444/deubefd.1221022

Armuña, C., Ramos, S., Juan, J., Feijóo, C., & Arenal, A. (2020). From stand-up to start-up: Exploring entrepreneurship competences and STEM women's intention. *International Entrepreneurship and Management Journal, 16*(1), 69–92. https://doi.org/10.1007/s11365-019-00627-z

Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande, G. (2016). *EntreComp: The entrepreneurship competence framework*. Joint Research Centre, European Commission. https://publications.jrc.ec.europa.eu/repository/handle/JRC101581

Barrientos-Báez, A., Martínez-González, J. A., García-Rodríguez, F. J., & Gómez-Galán, J. (2022). Entrepreneurial competence perceived by university students: Quantitative and descriptive analysis. *Journal of International Studies, 15*(2), 40-49. https://doi.org/10.14254/2071-8330.2022/15-2/3

Bavoľár, J., & Orosová, O. (2015). Decision-making styles and their associations with decision-making competencies and mental health. *Judgment and Decision Making, 10*(1), 115-122. https://doi.org/10.1017/s1930297500003223

Bavoľár, J., Ferjenčík, J., & Kačmár, P. (2021). *Pokročilé štatistické metódy v behaviorálnych a sociálnych vedách* [Advanced statistical methods in behavioral and social sciences]. Košice, Slovakia: Univerzita Pavla Jozefa Šafárika v Košiciach.

Bresler, M., Galiullina, S., & Gerasimova, D. (2020). Transformation of the values of Generation Z - residents of the digital society of sustainable development. *E3S Web of Conferences, 208,* 09043. https://doi.org/10.1051/e3sconf/202020809043

Cohen, L., & Wirtz, P. (2022). Decision-making style in entrepreneurial finance and growth. *Small Business Economics*, *59*(1), 1–28. https://doi.org/10.1007/s11187-021-00528-y

Crespí, P., Queiruga-Dios, M., & Queiruga-Dios, A. (2022). The challenge of developing entrepreneurial competence in the university using the project-oriented learning methodology. *Frontiers in Psychology, 13,* 966064, 1-9. https://doi.org/10.3389/fpsyg.2022.966064

Čopková, R., Gróf, M., Zausinová, J., & Siničáková, M. (2023). Adaptation of the entrepreneurship competences questionnaire - when entrepreneurship is more than just business. *Strategic management, (28)*4, 53 – 65. https://doi.org/10.5937/StraMan2300046C

De Winnaar, K., & Scholtz, F. (2020). Entrepreneurial decision-making: New conceptual perspectives. *Management Decision, 58*(7), 1283–1300. https://doi.org/10.1108/MD-11-2017-1152

Deprez, J., Leroy, H., Manigart, S., & Meuleman, M. (2021). Cognitive styles and entrepreneurial intentions: The mediating role of entrepreneurial attitudes and perceived behavioral control. *European Research on Management and Business Economics*, *27*(1), 100134. https://doi.org/10.1515/erj-2019-0003

Djordjevic, D., Cockalo, D., Bogetic, S., & Bakator, M. (2021). Modelling youth entrepreneurship intentions: A ten-year research. *Journal of East European Management Studies*, *26*(4), 617–638. https://doi.org/10.5771/0949-6181-2021-4-617

European Union. (2018). EU youth strategy: Employment and entrepreneurship. https://youth.europa.eu/strategy/employment-entrepreneurship_en

European Union. (2019). *Key competences for lifelong learning*. Publications Office of the European Union. https://doi.org/10.2766/569540

Ferreras-Garcia, R., Sales-Zaguirre, J., & Serradell-Lopez, E. (2021). Developing entrepreneurial competencies in higher education: A structural model approach. *Education + Training, 63*(5), 720–743. https://doi.org/10.1108/ET-09-2020-0257

Gans, J. S., Stern, S., & Wu, J. (2019). Foundations of entrepreneurial strategy. *Strategic Management Journal, 40*(5), 736-756. https://doi.org/10.1002/smj.3010

Ghazy, N., Ghoneim, H., & Lang, G. (2022). Entrepreneurship, productivity and digitalization: Evidence from the EU. *Technology in Society, 17,* 102052, 1-15. https://doi.org/10.1016/j.techsoc.2022.102052.

Global Entrepreneurship Monitor. (2015). APS global individual level survey data. *Young Meaning: 15–24 Years of Age*. https://www.gemconsortium.org/report/gem-2015-2016-global-report

Halabisky, D. (2012). Entrepreneurial activities in Europe - youth entrepreneurship. *OECD Employment Policy Papers, 1*. https://doi.org/10.1787/5jxrcmlf2f27-en

Hintikka, J., Taipale-Erävala, K., Lehtinen, U., & Eskola, L. (2022). Let's be entrepreneurs – Finnish youth's attitudes toward entrepreneurship. *Journal of Enterprising Communities: People and Places in the Global Economy*, *17*(4), 856–874. https://doi.org/10.1108/JEC-07-2021-0099

Huang, B., Tani, M., & Zhu, Y. (2021). Does higher education make you more entrepreneurial? Causal evidence from China. *Journal of Business Research, 135*, 543–558. https://doi.org/10.1016/j.jbusres.2021.06.044

Huňady, J., Orviská, M., & Pisár, P. (2018). The effect of higher education on entrepreneurial activities and starting up successful businesses. *The Engineering Economics, 29*, 226–235. https://doi.org/10.5755/J01.EE.29.2.19069

Ilonen, S., Heinonen, J., & Stenholm, P. (2018). Identifying and understanding entrepreneurial decision-making logics in entrepreneurship education. *International Journal of Entrepreneurial Behavior & Research*, *24*(1), 59–80. https://doi.org/10.1108/IJEBR-05-2017-0163

Kim, G., Kim, D., Lee, W., & Joung, S. (2020). The Effect of Youth Entrepreneurship Education Programs: Two Large-Scale Experimental Studies. *SAGE Open, 10*(3). https://doi.org/10.1177/2158244020956976.

Kolvereid, L., & Moen, Ø. (1997). Entrepreneurship among business graduates: Does a major in entrepreneurship make a difference? *Journal of European Industrial Training, 21*(4), 154–160. https://doi.org/10.1108/03090599710171404

Komarkova, I., Gagliardi, D., Conrads, J., & Collado, A. (2015). *Entrepreneurship Competence: An Overview of Existing Concepts, Policies and Initiatives - Final Report*. Publications Office of the European Union. JRC96531. https://publications.jrc.ec.europa.eu/repository/handle/JRC96531

Krasniqi, B. A., Berisha, G., & Pula, J. S. (2019). Does decision-making style predict managers' entrepreneurial intentions? *Journal of Global Entrepreneurship Research, 9*(1), 68. https://doi.org/10.1186/s40497-019-0200-4

Krstić, B., Bonić, L., Jovanović-Vujatović, M., & Rađenović, T. (2025). Key aspects and determinants of business performance management process in regenerative enterprises. *Economics of Sustainable Development, (9)*1, 51-74. https://doi.org/10.5937/esd2501051k.

Ligonenko, L., Riepina, I., Nykyforuk, O., Berezhnytska, U., & Fursa, V. (2023). Prospects for the development of entrepreneurship: The role of universities. *Science and Innovation*, *19*(3), 15–37. https://doi.org/10.15407/scine19.03.015

London, M., Sessa, V., & Shelley, L. (2022). Developing Self-Awareness: Learning Processes for Self- and Interpersonal Growth. *Annual Review of Organizational Psychology and Organizational, 10*, 261-288. *Behavior*. https://doi.org/10.1146/annurev-orgpsych-120920-044531

Ma, D., Fiet, J. O., & Dubofsky, D. A. (2023). Entrepreneurial Decision-Making Under Risk. *Entrepreneurship Research Journal*, *13*(2), 221–249. https://doi.org/10.1515/erj-2020-0051

McCallum, E., Weicht, R., McMullan, L., & Price, A. (2018). *EntreComp into action – Get inspired, make it happen: A user guide to the European entrepreneurship competence framework*. Publications Office of the European Union. https://doi.org/10.2760/574864

Milenković, A., Janjić, I., & Marković, M. (2025). Interdependence of sustainability and value creation. *Economics of Sustainable Development, (9)2*, 41-51. https://doi.org/10.5937/ESD2502041M

Murphy, K., Blustein, D., Bohlig, A., & Platt, M. (2010). The College-to-Career Transition: An Exploration of Emerging Adulthood. *Journal of Counseling and Development*, *88*(2), 174 181. https://doi.org/10.1002/J.1556-6678.2010.TB00006.X.

Nabi, G., Walmsley, A., Liñán, F., Akhtar, I., & Neame, C. (2017). Does entrepreneurship education in the first year of higher education develop entrepreneurial intentions? *Studies in Higher Education, 43*(3), 452–467. https://doi.org/10.1080/03075079.2016.1177716

OECD (2019). *Strengthening SMEs and entrepreneurship for productivity and inclusive growth: OECD 2018 ministerial conference on SMEs*. OECD Publishing. https://www.oecd.org/en/publications/strengthening-smes-and-entrepreneurship-for-productivity-and-inclusive-growth_c19b6f97-en.html

OECD (2021). *Missing entrepreneurs 2021: Policies for inclusive entrepreneurship and self-employment*. OECD Publishing. https://www.oecd-ilibrary.org/docserver/71b7a9bb-en.pdf?expires=1732364414&id=id&accname=guest&checksum=DF3C452A8DB8609A63442CE7ABF47F13

OECD (2022). *Recommendation of the Council on Creating Better Opportunities for Young People*. OECD Legal Instruments. https://pjp-eu.coe.int/documents/42128013/116339195/Recommendation+on+Creating+Better+Opportunities+for+Young+People.pdf/27239911-3332-6be3-0115-e68893a20f18

OECD/European Commission. (2023). *The Missing Entrepreneurs 2023: Policies for Inclusive Entrepreneurship and Self-Employment*. OECD Publishing. https://doi.org/10.1787/230efc78-en

OECD/European Union. (2017a). *Supporting entrepreneurship and innovation in higher education in Ireland*. OECD Publishing. https://doi.org/10.1787/9789264270893-en

OECD/European Union. (2017b). *The Missing Entrepreneurs 2017: Policies for Inclusive Entrepreneurship*. OECD Publishing. https://doi.org/10.1787/9789264283602-en

OECD/European Commission. (2020). *Policy brief on recent developments in youth entrepreneurship*. OECD Publishing. https://www.oecd.org/en/publications/policy-brief-on-recent-developments-in-youth-entrepreneurship_5f5c9b4e-en.html

Rabbitt, P., & Abson, V. (1990). „Lost and found": some logical and methodological limitations of self-report questionnaires as tools to study cognitive ageing.. *British journal of psychology*, *81*(1), 1-16 . https://doi.org/10.1111/J.2044-8295.1990.TB02342.X

Sanda, M.-A., & Sallama, M.-N. (2023). Mediation effect of emotions on relational dynamics between entrepreneurs' thinking processes and their entrepreneurial decision-making. *Journal of the International Council for Small Business*, *4*(4), 337–350. https://doi.org/10.1080/26437015.2022.2156312

Sassetti, S., Cavaliere, V., & Lombardi, S. (2022). The rhythm of effective entrepreneurs' decision-making process: The pathways of alertness, scanning and search, and cognitive style. A mediation model. *International Entrepreneurship and Management Journal, 18*(2), 555–578. https://doi.org/10.1007/s11365-021-00759-1

Scott, S. G., & Bruce, R. A. (1995). Decision-making style: The development and assessment of a new measure. *Educational and Psychological Measurement, 55*(5), 818–831. https://doi.org/10.1177/0013164495055005017

Shepherd, D., & Patzelt, H. (2017). *Entrepreneurial cognition: Exploring the mindset of entrepreneurs*. Springer. https://doi.org/10.1007/978-3-319-48701-4_8

Shepherd, D., Williams, T., & Patzelt, H. (2015). Thinking About Entrepreneurial Decision Making. *Journal of Management, 41*(1), 11 - 46. https://doi.org/10.1177/0149206314541153.

Stephens, S., Lyons, R., & Cunningham, I. (2021). The decision-making environment for the entrepreneurial student. *Journal of Enterprising Culture*, *29*(1), 65–78. https://doi.org/10.1142/S0218495821500047

Vestergaard, L., Moberg, K., & Jørgensen, C. (2012). *Impact of entrepreneurship education in Denmark–2011.* Odense: The Danish Foundation for Entrepreneurship-Young Enterprise. https://eng.ffe-ye.dk/media/202248/impact_of_entrepreneurship_education_in_denmark_2011.pdf

Wang, S., Liu, L., & Wang, S. (2019). Influence of the Cognition of Student Entrepreneurs on Decision Making Based on Factor Analysis. *International Journal of Emerging Technologies in Learning (iJET)*, *14*(12), 158–168. https://doi.org/10.3991/ijet.v14i12.10358

Yener, H. (2020). Effects of decision-making styles on entrepreneurship skills. *Technium Social Sciences Journal, 8*, 569–576. https://doi.org/10.47577/tssj.v8i1.693

Zichella, G., & Reichstein, T. (2023). Students of entrepreneurship: Sorting, risk behaviour and implications for entrepreneurship programmes. *Management Learning*, *54*(5), 727-752. https://doi.org/10.1177/13505076221101516

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STRATEGIC MANAGEMENT, Vol. 30 (2025), No. 4, pp. 021-031

DOI: 10.5937/StraMan2400017H

Received: December 19, 2023
Revised: July 15, 2024
October 15, 2024
Accepted: December 09, 2024
Published online: February 18, 2025

Team effectiveness in a virtual environment: the role of trust and knowledge sharing

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Abstract

Background: In recent years, research efforts have focused on understanding virtual environments and the importance of collaboration in such environments. The spread of remote working, exacerbated by the global pandemic and changing workforce dynamics, has meant that organizations are increasingly reliant on dispersed teams. Building trust in virtual teams is paramount to fostering effective collaboration, and achieving common goals. Trust reduces uncertainty, promotes collaboration and facilitates open communication between team members. Building trust in virtual contexts is challenging due to limited face-to-face interactions. In addition, knowledge sharing plays a crucial role in improving team effectiveness by enabling information sharing and problem solving. The lack of physical proximity in virtual environments is a barrier to spontaneous knowledge sharing and highlights the critical need for a culture that encourages knowledge sharing.

Methodology:

This study highlights the importance of cultivating a supportive virtual environment, ensuring psychological safety and utilizing technical platforms to facilitate information sharing. Quantitative data and survey methods are used to explore the integral impact of trust, knowledge sharing, collaboration, and team effectiveness.

Findings and Conclusions:

The results of this study contribute to the existing literature on virtual teamwork by highlighting techniques and practices that improve team performance. The finding that trust and information sharing play a central role in virtual teams can help organizations develop effective virtual work policies, design appropriate training programs, and select suitable collaboration platforms.

Limitations and Future Research:

While the study provides valuable insights, the generalizability of the findings to other contexts is limited by the restriction to a single sample. Replicating the study in different organizational contexts would improve the robustness of the results. Furthermore, the cross-sectional nature of the study limits the possibility of proving causality. Future research efforts could use longitudinal studies to examine the complex relationships between trust, teamwork, collaboration, and knowledge sharing over time.

Keywords

Virtual team, knowledge sharing, team effectiveness, remote work, collaboration, trust

Introduction

In a world where the business environment is already rapidly changing, COVID-19 pandemic brought new challenges for businesses worldwide. The pandemic fastened the process of migrating work to the virtual environment, affecting not just existing remote work practices but also forcing individuals and teams, with no previous experience of working this way, to work remotely (Kniffin, et

al., 2021; Gibson & Grushina 2021). Before the pandemic there were several names for remote work arrangements, including telecommuting, telework, distant work and distance work (Wyld, 2022). Chiu, et al., 2007 defined virtual communities as "online social networks in which people with common interests, goals, or practices interact to share information and knowledge, and engage in social interactions". Remote work as a broader term includes the "Work from Anywhere" concept, meaning working from different locations, not necessarily from home (Allen, et al., 2014). The definition of a remote team is also relatively new to the discipline of project management and collaboration. A virtual team is a collection of individuals who work together in cooperative projects to accomplish shared goals and objectives (Al Samman & Muttar, 2022). People in virtual teams perform tasks in a virtual work environment which is maintained by information technology. These teams use communication technologies to share information and collaborate in real-time. For many employees and employers, the combination of the COVID-19 pandemic and remote work caused numerous changes in daily business routines and activities. Managing teams in the new environment was one of the biggest impediments for organizations, especially if they had arranged their work face-to-face before the pandemic. Global Workplace Analytics published results from the largest global post-COVID employee survey, including 2865 employees from the United States of America, which concluded that 67% of surveyed participants worked from home for the first time (Newman, S. A., & Ford, R. C., 2021). This is not just the case with the USA. Working remotely was unfamiliar to the majority of information workers worldwide. In the UK, only 6% of workers had such prior experience (ONS - Office for National Statistics, 2020; Mark, et al., 2022).

One of the most affected segments of businesses worldwide is knowledge sharing. With the rapid growth of virtual teams and enterprises, controlling knowledge in organizations has become even more challenging (Huysman & Wulf, 2006; Davidavičienė et al., 2020). However, new conditions in the global market, supported by information technology development, raised the popularity of knowledge sharing. As a set up by a company to communicate information and experience, knowledge sharing was a part of business development from an agricultural society to the market as we are familiar with today (Reid, 2003). Many factors are a base for functional knowledge-sharing systems, from education, technological infrastructure, the culture of knowledge-sharing, availability of resources, etc. (Muqadas et al., 2016; Ng, et al., 2022). According to Eshak, et al., (2022), knowledge is not considered valuable, until it can be shared. Knowledge sharing includes not just sharing existing knowledge but also bringing new knowledge to the team. Establishing systems that facilitate information exchange, permit efficient operations, high-performance standards, and staff innovation is essential to achieving teams' objectives (Rosen, et al., 2007).

The knowledge-sharing process can be done through various contexts such as documenting, and organizing, in the way of written form or social context (Eshak, et al., 2022). To build up effective communication and knowledge-sharing practices at individual, group, community, and business levels, based on IT support, different tools can be used for knowledge sharing, such as blogs, social media, collaborative tools, podcasts, etc. (Panahi, et al., 2013). Knowledge-sharing systems should make sure the proper data and information are available at the right moment, taking into account the many resources that businesses have at their disposal. The role of business leaders in encouraging and rewarding knowledge-sharing behaviors is crucial for these systems to work.

1. Development of Conceptual Model and Hypotheses

1.1. Knowledge Sharing, Team Effectiveness, and Trust

Knowledge sharing is performed through "capturing, organizing, reusing, and transferring the vast and unique knowledge that resides within the organization and making that knowledge available to others in the business" (Reid, 2003). The word "sharing" implies the act of communicating one's information to others in a way that they may require some deliberate effort on the side of the knowledge bearer. Additionally, sharing suggests that the sender and the recipient share ownership of the knowledge rather than the sender giving up it entirely.

Over the past decades, an increasing amount of research has included the notion that knowledge sharing improves team performance. In 1996, Cohen, et al., proposed an approach for understanding group behavior and analyzing team effectiveness. This normative method concentrated

on the team's capacity for collaboration and the effects of group experiences on individuals. Additionally, team empowerment, which includes elements of shared experiences, and meaningful connections related to work, is significantly related to team effectiveness (Hu & Liden, 2011). Another piece of evidence that can be taken into consideration comes from the social exchange theory which presents how perceived team support was expected to predict team commitment, which results in higher job performance (Cropanzan & Mitchell, 2005).

However, to achieve knowledge management, trust is the main component for success (Ford, 2004; Castelfranchi, 2004). Forming and maintaining relationships between team members is directly impacted by trust in the team (Jarvenpaa et al., 1998; Zaheer et al., 1998; Jarvenpaa et al., 2004; Powell et al., 2004; Brahm & Kunze, 2012). In virtual teams, organizational and/or team leaders play the main role in defining and building team culture which also includes trustworthiness. As remote work has faced new challenges in recent years, building trust has become crucial in the uncertain times of the global pandemic (Aitken-Fox, 2020; Newman, & Ford, 2021). There is a lot of research that examines the positive influence of trust on knowledge sharing among team members (Kuo 2013; Chen, et al., 2014; Ouakouak & Ouedraogo, 2017). Although some of these studies included analysis of various additional factors, they showed that professional trust within the workplace has a mediating effect on knowledge-sharing in organizations. In organizations in which team members tend to share knowledge, people have built trust between each other and the organization (Hinds & Pfeffer, 2003). As one of the suggested approaches in empirical studies for differentiating trust, Cook and Wall (1980) emphasized the importance of creating situations in which trust is developed to support task performance, which can be related to the level of team effectiveness. It is important to distinguish the type of trust that is a significant predictor when it comes to team effectiveness in virtual environment settings, and that is a cognitive-based trust (Kanawattanachai & Yoo, 2007). However, there is a lack of studies that examine the inverse link that exists between trust, knowledge sharing, and team performance. Hence, it is one of the topics we aimed to address in this study. For virtual team members to collaborate effectively, team members have to establish open communication and work on effective knowledge management in the team. Since those who work remotely often miss the regular social interactions that foster team cohesion, we think that knowledge-sharing activities can have a positive effect on trust and the efficacy of virtual teams. Therefore, we hypothesize as follows:

H1. Knowledge sharing positively influences team effectiveness in a virtual environment.
H2. Knowledge sharing positively influences trust in teams working in a virtual environment.
H3. Trust positively influences team effectiveness in a virtual environment.

1.2. The Impact of Collaboration on Knowledge Sharing, Team Effectiveness, and Trust

To build organizational knowledge, employees have to be willing to share and contribute with individual knowledge (Alavi & Leidner 2001; Bock et al., 2005). When this isn't the case and staff members are reluctant to share their expertise, collaboration will suffer and goals will be missed (Van den Bosch et al., 1999). Collaboration "enables teams to effectively leverage their team knowledge, skills, abilities, and resources towards the pursuit and completion of team goals" (Behfar et al. 2008; DeChurch et al., 2013).

Knowledge exchange can be better understood through Social Exchange Theory, as in this theory human behavior takes place in a social exchange (Blau, 1964; Alsharo et al., 2017). If we consider social exchange as a form of collaboration, it can have an impact on knowledge sharing in a virtual environment too. Additionally, Social Exchange Theory explains how people will behave in a certain way if they believe it will maximize their benefits, which can have the potential to positively influence the team's effectiveness too. Another theory supports this view: according to the Interdependence theory, team members will collaborate to achieve set goals, and that will affect team effectiveness too (DeOrtentiis et al., 2013, Alsharo et al., 2017). Virtual teams can face different challenges related to the lack of face-to-face interaction, working in different time zones, common understanding of specific topics due to speaking different languages, etc. Although teams working in a virtual environment sometimes need more time to set the common ground and make their collaboration effective, once they do, the benefits of collaboration take place (DeOrtentiis et al., 2013; Alsharo et al. 2017). What helps in this process is the willingness of team members to

share their thoughts, and discuss openly, hence they will naturally come to the process of collaboration.

Kanawattanachai and Yoo (2007) emphasized that task-knowledge coordination is the most important variable that influences the performance and effectiveness of virtual teams. Additionally, communication that is task-oriented is especially important for building trust in the team (Kanawattanachai & Yoo, 2007, Pangil & Moi Chan, 2014). In order to be effective, teams must be formed of individuals who will be able to work together and share their knowledge. Through collaboration, teams can build their own knowledge base and information resources that can become necessary for completing assigned tasks on their work. After analyzing previous research findings, we present the following hypotheses:

H4. Collaboration positively influences knowledge sharing within teams in a virtual environment.
H5. Collaboration positively influences team effectiveness in a virtual environment.
H6. Collaboration positively influences trust among teams in a virtual environment.

When members of a team trust each other, they are more likely to find knowledge-sharing trustworthy and valuable, which leads to increased use of shared knowledge and improved team performance. This is why knowledge sharing has a higher impact on team effectiveness (Alsharo et al., 2017). When trust is low, team members may be hesitant to freely share their knowledge for fear of exploitation, loss of recognition, or reputational damage. This lack of information sharing might reduce team effectiveness since essential ideas and skills may not be exploited or integrated into team processes and decision-making. As a result, trust acts as a moderator, changing the strength and direction of the association between knowledge sharing and team success, as expected. When trust is strong, information sharing is more likely to benefit team effectiveness; when trust is low, information sharing is less likely to benefit team effectiveness.

H7. Trust moderates the relationship between knowledge sharing and team effectiveness.

Figure 1 shows the conceptual research model in accordance with the stated and described research hypotheses:

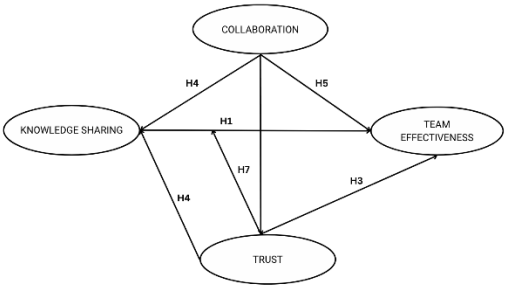

Figure 1 The conceptual research model
Source: the authors

2. Methodology

2.1. Sample Characteristics

The study's goal is to investigate how trust and expertise contribute to virtual teams' success. Professionals with jobs who resided in Bosnia and Herzegovina were given the questionnaire. The questionnaire consisted of 40 questions. The respondent characteristics—sex, age, education level, industry of the company they work for, and length of employment—are listed in the first section. The second section includes questions related to the employees' role in the virtual team and characteristics of the team, while the third section consists of questions about knowledge sharing and trust in virtual teams. The survey questions came from previously released studies. Knowledge sharing, trust, cooperation, and team effectiveness are the relevant variables. Appendix A contains the survey questions.

Table 1 Demographic characteristics of respondents

Characteristics	n	%
Gender		
Female	112	45%
Male	139	55%
Age		
18-29	130	52%
30-39	103	41%
40-49	12	5%
50-59	3	1%
60+	3	1%
Level of education		
Secondary education	22	9%
College education	111	44%
Bachelor	19	8%
Master	91	36%
PhD	8	3%
Industry		
Finance	21	8%
IT	120	48%
Marketing and Sales	33	13%
NGO	50	20%
Education	10	4%
Other	17	7%

Source: the authors

2.2. Measures

The majority of the indicators used in measuring scales come from earlier publications. The proposed research model was based on a total of 15 indicators. These indicators made an effort to quantify collaboration, trust, team effectiveness, and knowledge sharing. The questions were scored using a seven-point Likert scale with anchors that went from 1 for "strongly disagree" to 7 for "strongly agree." The indications were translated from their original English to the native language for better understanding. The questionnaire adaptation method involved two academic specialists. The construct collaboration that contains five indicators was adopted from Aram and Morgan (1976) and Alsharo et al., (2017).

Construct trust was measured by Mayer et al., (1995). In order to achieve knowledge management, trust is the main component for success (Ford, 2004; Castelfranchi, 2004). Trust is defined as "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer, et al., 1995; Ford, 2004). Forming and maintaining relationships between team members is directly impacted by trust in the team (Zaheer et al., 1998; Jarvenpaa et al., 2004; Powell et al., 2004; Brahm & Kunze, 2012). In virtual teams, organizational and/or team leaders are playing the main role in defining and building team culture which also includes trustworthiness. As remote work brought new challenges, building trust became crucial in the uncertain times of the global pandemic (Newman & Ford, 2021; Aitken-Fox et al., 2020). Mayer et al., (1995), a frequently quoted and referenced study on the subject, provided the measures for trust (e.g. Jarvenpaa & Leidner 1998; Jarvenpaa et al. 1998; Dirks & Ferrin, 2001; Alsharo et al., 2017). The measures for knowledge sharing are adopted by Phang et al., (2009) and Alsharo et al. (2017).

Ipe (2003) defines knowledge sharing as "the process by which knowledge held by individuals, teams or organizations is converted into a form that can be understood, absorbed, and used by others." When the word "sharing" is employed, it is implied that the knowledge-holder must consciously take some action to offer their information to others in a way that they can use. Additionally, sharing suggests that the sender and the recipient share ownership of the knowledge rather than the sender giving up it entirely. The knowledge-sharing policies are derived from Phang et al., (2009) and Alsharo et al., (2017).

Team effectiveness is the capacity of the group or organization to produce goods and services that meet quality standards (Lindsjørn et al., 2016; Zaimovic et al., 2021). Achieving the expected level of quality obviously cannot be done without the effort of people who are part of the organization. Members of a virtual team must develop open lines of communication and focus on efficient knowledge management to collaborate well. The efficacy of a team is directly impacted by its various phases of development (Wheelan, 2005). The measures used to assess team effectiveness were taken from Alsharo et al., (2017) and Lurey and Raisinghani (2001).

Table 2 Constructs

Construct	Item	Source
Collaboration	Team members were asked for their suggestions when the team was originally formed.	Aram & Morgan (1976); Alsharo, et al. (2017).
	Careful consideration was given to the team's objectives during the design of this team.	
	I received sufficient information to understand the team's purpose when I was notified that I will be part of this team.	
	My role in the team was clearly explained to me.	
	I have received training focused on becoming more effective in the virtual team setting.	
Trust	If I had my way, I wouldn't let the other team members have any influence over issues that are important to the project.	Mayer et al., (1995)
	I really wish I had a good way to oversee the work of the other team members on the project.	
Team effectiveness	My team has been effective in reaching its goals.	Lurey & Raisinghani (2001); Alsharo, et al. (2017).
	My team is meeting its business objectives.	
	My input is valued by my team members.	
	My team members and I respect each other.	
	In my team, members' morale is high.	
Knowledge sharing	I routinely share my knowledge with my team members.	Phang et al., (2009); Alsharo, et al. (2017).
	I routinely seek out knowledge from other team members.	
	When several team members are discussing an issue, I can ask questions about anything I do not understand.	

Source: the authors

3. Data Analysis

3.1. Measurement Model

3.1.1. Validity and Reliability

The method of data analysis proposed by Anderson and Gerbing (1988), involving a two-step process, was employed. The first phase involved assessing the reliability, convergent validity, and discriminant validity of the measurement models. The procedure of adopting items from the available literature while taking the definitions of constructs into consideration validated the content validity. In addition, by checking standardized factor loadings we confirmed convergent validity. Hair et al., (2010) stated that the value of the Cronbach's Alpha coefficient, a common parameter used in reliability testing, should be greater than 0.5 (>0.5) (Bollen & Long, 2003; Garson, 2015). In our case, factor loading values ranging from 0.808 to 0.946, which are shown in Table 3, demonstrate the internal consistency and reliability of the measures as they exceed the 0.70 cut-off point. After confirmatory factor analysis, the final results are displayed in Table 3. In addition, the table below also demonstrate the results of internal consistency and reliability.

Table 3 Loadings reliability and validity

Item	st. loadings	Cronbach's Alpha	CR	AVE
COL1	0.870	0.868	0.905	0.656
COL2	0.870			
COL3	0.868			
COL4	0.885			
COL5	0.808			
TRUST1	0.867	0.721	0.877	0.781
TRUST2	0.900			
KS1	0.817	0.786	0.872	0.695
KS2	0.854			
KS3	0.830			
TEAMEF1	0.870	0.912	0.935	0.741
TEAMEF2	0.870			
TEAMEF3	0.868			
TEAMEF4	0.885			
TEAMEF5	0.808			

Source: the authors

A composite reliability (CR) measure is used to quantify reliability, and values above 0.7 are considered to be satisfactory. The CR measure's value ought to exceed 0.6. (Hair et al., 2010). The fact that all measurement model CR values are more than 0.8, as shown in the table above, attests to the measurement model's dependability. In addition, the examination of convergent and discriminant validity was conducted concerning the validity of measurement models.

Convergent validity examines the connection between a latent construct and the manifest variables. The average derived variance (AVE) and factor loadings as the most popular indicators of convergent validity were used in the testing. An AVE exceeding 0.5 and standardized factor loadings greater than 0.50 (Hair et al., 2010) indicate adequate convergence. As a result, we can observe in the table above that all the average variance extracted (AVE) values and all standardized factor loadings are more than 0.50. This confirms that model convergent validity meets the recommended threshold.

The measure of discriminant validity assesses the variety of constructs contained within a model. The comparison of the square root of the AVE value and the correlation coefficients between that construct and other constructs serves as the verification method in this study. According to Fornell and Larcker (1981), the square root of the average variance extracted should exceed the correlations between constructs. Table 4 displays the square root AVE values on the diagonal and the correlation matrix below the diagonal. The aforementioned indicates that all conceptions satisfy the requirement of discriminatory validity.

Table 4 Correlation matrix for discriminant validity

	KS	TEAMEF	COL	TRUST
Knowledge sharing	0.834			
Team effectiveness	0.698	0.861		
Collaboration	0.660	0.708	0.810	
Trust	0.391	0.476	0.428	0.884

Note: Bold values represent Square-root of AVE **Source:** the authors

Heterotrait-monotrait ratio (HTMT ratio) correlations were additionally employed to assess discriminant validity. Henseler et al., (2015) state that all values must fall within the 0.9 acceptable criterion. This further demonstrates that we have no issues with discriminant validity (Table 5).

Table 5 HTMT Ratio

	KS	TEAMEF	COL	TRUST
Knowledge sharing				
Team effectiveness	0.796			
Collaboration	0.780	0.788		
Trust	0.487	0.584	0.533	

Source: the authors

3.2. Structural Model

The Structural Equation Modeling (SEM) approach was used to test the structural model that was utilized in this paper. This multivariate method simultaneously examines the links between manifest variables and latent constructs as well as among different latent constructs by combining factor analysis and multiple regression. Its key

characteristic is the ability to evaluate several interdependent interactions simultaneously (Hair et al., 2010). Before to anything else, the model's constituent constructs and their relationships are specified. After doing the research and gathering enough data, the reliability and validity of the measurement models were examined.

Based on the findings and recommendations of prior research and studies, a structural research model has been established. Based on R^2 and Q^2 as well as the importance of the pathways, the structural model is evaluated. R^2 should be equal to or exceed 0.1 (Falk & Miller, 1992). The findings in Table 5 show that all R^2 values are over 0.1, confirming the validity of the demonstrated predictive capability. Additionally, the fact that the values of Q^2 are above zero further supports the significance of construct prediction.

Table 6 Hypothesis testing

	Hypothesis	β	ST DEV	T Stat.	P Values	f²
H1	Knowledge sharing -> Team effectiveness	0.906	0.210	4.324	0.000	0.141
H2	Knowledge sharing -> Trust	0.193	0.083	2.325	0.020	0.026
H3	Trust -> Team effectiveness	0.898	0.269	3.338	0.001	0.077
H7	Moderating effect -> Trust	-0.089	0.031	2.891	0.004	0.054
H4	Collaboration -> Knowledge Sharing	0.660	0.051	12.918	0.000	0.772
H5	Collaboration -> Team effectiveness	0.358	0.069	5.213	0.000	0.182
H6	Collaboration -> Trust	0.300	0.090	3.337	0.001	0.064
		R²	Q²			
	Knowledge sharing	0.433	0.292			
	Team effectiveness	0.628	0.449			
	Trust	0.196	0.148			

Source: the authors

In this part of the paper, an analysis of the relationships presented by the hypotheses is performed. Table 5 presents a standardized rating parameter that illustrates how the dependent variable changes concerning the standard deviation change in the independent variable. Additionally, it includes a t-value indicating whether a specific parameter significantly deviates from zero in a population. According to the data analysis, knowledge sharing has a positive significant impact on team effectiveness ($\beta = 0.906$, $t = 4.324$, $p = 0.000$). Knowledge sharing has a positive impact on trust ($\beta = 0193$, $t = 4.727$, $p = 0.020$). Trust as a moderator variable has a negative impact on knowledge sharing and team effectiveness ($\beta = -0.089$, $t = 12.918$, $p = 0.000$). Additionally, collaboration has a positive significant effect on knowledge sharing ($\beta = 0.660$, $t = 5.213$, $p = 0.000$). Collaboration has a positive effect on team effectiveness ($\beta = 0.358$, $t = 6.690$, $p = 0.000$). Collaboration has positive effect on trust ($\beta = 0.300$, $t = 3.337$, $p = 0.001$). Trust has a significant and positive effect on team effectiveness ($\beta = 0.898$, $t = 3.338$, $p = 0.001$).

4. Discussion and Conclusion

The results of this study suggest that knowledge sharing positively and significantly impacts the team's effectiveness and trust. Knowledge sharing, team effectiveness, and trust were all found to be positively correlated with collaboration. The study also indicates that trust has a negative moderating effect on the relationship between knowledge sharing and team effectiveness. Therefore, the research emphasizes the need for efforts in processes of building trust in virtual teams, that can be supported through clear communication, openness, and regular feedback.

To support collective learning, it is crucial for knowledge management initiatives to recognize that knowledge is embedded within social contexts and cannot be uncoupled from the social community (Huysman & Wulf, 2006).

Given that COVID-19 has expedited the growth of virtual teams, it will be beneficial for researchers to monitor and investigate innovations that could enable such teams to function optimally and reach their full potential (Kniffin et al., 2021).

The result that collaboration is positively correlated with knowledge sharing, team effectiveness, and trust emphasizes the significance of creating a supportive and cooperative team environment. Team effectiveness and trust may increase when members are motivated and engaged, which increases their propensity to work together and share knowledge. To reach these goals, it is important to establish processes and tools that will support the knowledge-sharing process. Organizations, process facilitators, and leaders have to be open when it comes to ways and tools that can be used for knowledge sharing so this practice can become engaging to their teams and different individuals.

Regardless of processes and tools, the main element that determines success in this kind of process is trust, and this is crucial to acknowledge when it comes to remote work settings. These results imply that team leaders ought to place a high priority on developing a team culture that encourages participation and knowledge sharing to improve team performance.

This study's conclusions have significant ramifications for organizations looking to boost trust and team success. There are numerous ways this study can be beneficial to organizations and leaders. Organizations may foster a more supportive and collaborative team environment that improves performance and fosters trust among team members by encouraging knowledge sharing and team involvement. Understanding how trust and knowledge sharing impact team effectiveness in virtual environments can provide valuable insights into how to structure and manage virtual teams for optimal performance. Also, organizations can use information from this study as a basis for creating strategic plans related to building activities that will enable a collaborative team environment that will be organized around knowledge-sharing efforts. Following that, research in this area can lead to the development of targeted training programs for both virtual team members and leaders. Training can focus on developing trust-building skills, effective communication strategies, and techniques for sharing knowledge across geographical boundaries. This can result in more competent virtual teams capable of navigating the unique challenges of remote work. The study's findings can influence the development of new or better usage of existing virtual collaboration tools and platforms that emphasize trust-building features and seamless knowledge-sharing mechanisms. As effective decision-making is crucial in virtual teams, understanding the role of trust and knowledge sharing can lead to the development of frameworks that guide decision-making processes in remote settings. Also, it is expected that traditional performance evaluation metrics might not fully capture the nuances of virtual team performance. Our study could contribute to the development of new metrics that account for factors such as trust-building efforts and knowledge-sharing contributions. This can lead to fairer and more accurate performance evaluations for virtual team members. Overall, this study can help in initiating discussions around practical implementation related to leading virtual teams in a way that can improve overall organization performance in the ever-evolving landscape of remote work.

The results of this study align with previous research emphasizing the importance of information sharing in enhancing team performance. Sharing knowledge allows team members to benefit from one another's knowledge and experiences, which can ultimately result in better decision-making and problem-solving. Since the sharing of knowledge is positively correlated with trust, it is anticipated that team members who share their knowledge will create stronger connections based on trust and respect. Some organizations have successfully built a knowledge-sharing culture that became their crucial business imperative even before the global pandemic hit. Similarly, those businesses that adjusted their knowledge-sharing mechanisms during the pandemic and transformed challenges into opportunities will achieve their organization's visions and navigate future changes in the market. For successful knowledge management, the initiative must be advantageous for both the organization and the knowledge worker (Huysman & Wulf, 2006).

4.1. Limitations and Future Research

Although this study offers many insightful conclusions, there are several limitations that need to be acknowledged. First, the fact that the study was carried out on one sample restricts the applicability of the findings to other situations. This study could be repeated in different organizational contexts in future research to see how generalizable the results are. Additionally, the study's cross-sectional design hinders our capacity to prove causality. Future studies could employ longitudinal designs to investigate the links between trust, teamwork, collaboration, and knowledge sharing.

Future research could delve into the influence of leadership on promoting knowledge sharing and teamwork. Studies could focus on the leadership styles and behaviors that promote knowledge sharing and collaboration in the work environments. Second, future research might investigate the effect of various forms of knowledge on team effectiveness and trust. For example, studies could assess the effects of tacit knowledge (hard to articulate knowledge) versus explicit knowledge (easy to articulate knowledge) on team effectiveness and trust. Finally, future

study might look into how cultural characteristics affect knowledge sharing, team involvement, team performance, and trust. Studies could explore how cultural differences in attitudes toward knowledge sharing and teamwork affect team performance and trust in various contexts.

Declarations

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding

Not applicable

Acknowledgements

Not applicable.

References

Aitken-Fox, E., Coffey, J., Dayaram, K., Fitzgerald, S., Gupta, C., McKenna, S., et al., (2020). The impact of Covid-19 on human resource management: avoiding generalisations. *LSE Business Review*. https://eprints.lse.ac.uk/104792/1/businessreview_2020_05_22_the_impact_of_covid_19_on_human_resource.pdf

Al Samman, A. M., & Muttar, A. K. (2022). Surviving the Pandemic through Virtual Leadership to Remote Work Teams. *In 2022 ASU International Conference in Emerging Technologies for Sustainability and Intelligent Systems (ICETSIS)* (pp. 402-408). IEEE. https://doi.org/10.1109/ICETSIS55481.2022.9888938

Alavi, M. & Leidner, D.E. (2001). Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. *MIS Quarterly*, *25*, 107-136. https://doi.org/10.2307/3250961

Allen, T. D., Cho, E., & Meier, L. L. (2014). Work–Family boundary dynamics. Annual Review of Organizational *Psychology and Organizational Behavior*, *1*, 99–121. https://doi.org/10.1146/annurev-orgpsych-031413-091330

Alsharo M., Gregg, D.G. & Ramirez, R.. (2017). Virtual team effectiveness: The role of knowledge sharing and trust. *Information & Management*. *54*(4), 479-490. https://doi.org/10.1016/j.im.2016.10.005

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411–423. https://doi.org/10.1037/0033-2909.103.3.411

Aram, J. D., & Morgan, C. P. (1976) The Role of Project Team Collaboration in R&D Performance. *Management Science 22*(10),1127-1137. https://doi.org/10.1287/mnsc.22.10.1127

Behfar, K. J., Peterson, R. S., Mannix, E. A., & Trochim, W. M. K. (2008). "The critical role of conflict resolution in teams: A close look at the links between conflict type, conflict management strategies, and team outcomes": Correction. *Journal of Applied Psychology*, *93*(2), 462. https://doi.org/10.1037/0021-9010.93.1.170

Blau, P.M. (1964) Justice in Social Exchange. *Sociological Inquiry*, *34*, 193-206. https://doi.org/10.1111/j.1475-682X.1964.tb00583.x

Bock, G. W., Zmud, R. W., Kim, Y. G., & Lee, J. N. (2005). Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS quarterly*, 87-111. https://doi.org/10.2307/25148669

Bollen, K. A., & Long, J. S. (Eds.). (1993). *Testing structural equation models* (Vol. 154). Sage.

Brahm, T., & Kunze, F. (2012). The role of trust climate in virtual teams. *Journal of Managerial Psychology*, *27*(6), 595-614. https://doi.org/10.1108/02683941211252446

Castelfranchi, C. (2004). Trust Mediation in Knowledge Management and Sharing. In: Jensen, C., Poslad, S.,& Dimitrakos, T. (Eds) *Trust Management. iTrust 2004. Lecture Notes in Computer Science*, 2995. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-24747-0_23

Chen, Y. H., Lin, T. P., & Yen, D. C. (2014). How to facilitate inter-organizational knowledge sharing: The impact of trust. *Information & management*, *51*(5), 568-578. https://doi.org/10.1016/j.im.2014.03.007

Cohen, S. G., Ledford Jr., G. E. & Spreitzer, G. M., (1996). A Predictive Model of SelfManaging Work Team Effectiveness. *Human Relations, 49*(5), 643-676. https://doi.org/10.1177/001872679604900506

Cook, J., & Wall, T. (1980). New work attitude measures of trust, organizational commitment and personal need non-fulfilment. *Journal of Occupational Psychology, 53*(1), 39–52. https://doi.org/10.1111/j.2044-8325.1980.tb00005.x

Cropanzano, R., & Mitchell, M. S. (2005). Social exchange theory: An interdisciplinary review. *Journal of management*, *31*(6), 874-900. https://doi.org/10.1177/014920630527

Davidavičienė, V., Al Majzoub, K., & Meidute-Kavaliauskiene, I. (2020). Factors affecting knowledge sharing in virtual teams. *Sustainability*, *12*(17), 6917. https://doi.org/10.3390/su12176917

DeChurch, L. A., Mesmer-Magnus, J. R., & Doty, D. (2013). Moving beyond relationship and task conflict: toward a process-state perspective. *Journal of Applied Psychology*, *98*(4), 559. https://doi.org/10.1037/a0032896

Dirks, K. T., & Ferrin, D. L. (2001). The role of trust in organizational settings. *Organization Science*, *12*(4), 450–467. https://doi.org/10.1287/orsc.12.4.450.10640

Eshak, E. S., binti Ramdzan, N., bin Masri, M. F. D., bin Saiful Azmi, W. S., & Hanafi, H. L. A. B. M. (2022). FACTORS INFLUENCING KNOWLEDGE SHARING: A SURVEY OF LITERATURE. *International Journal of Accounting*, *7*(42). http://www.ijafb.com/PDF/IJAFB-2022-42-08-04.pdf

Falk, R. & Miller, Nancy. (1992). A Primer for Soft Modeling. The University of Akron Press: Akron, OH.

Ford, D. P. (2004). Trust and knowledge management: the seeds of success. *Handbook on Knowledge Management 1: Knowledge Matters*, 553-575. https://doi.org/10.1007/978-3-540-24746-3_29

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.2307/3151312

Garson, G. D. (2015). *Structural Equation Modeling*. North Carolina: Statistical Publishing Associates.

Gibson, C. B., & Grushina, S. V. (2021). A tale of two teams: Next generation strategies for increasing the effectiveness of global virtual teams. *Organizational Dynamics*, *50*(1), 100823. https://doi.org/ 10.1016/j.orgdyn.2020.100823

Hair, J.F., Black, W.C., Babin, B.J. & Anderson, R.E. (2010) *Multivariate Data Analysis*. 7th Edition, Pearson, New York.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the academy of marketing science*, *43*, 115-135. https://doi.org/10.1007/s11747-014-0403-8

Hinds, P. J., & Pfeffer, J. (2003). *Why organizations don't" know what they know": Cognitive and motivational factors affecting the transfer of expertise* (pp. 3-26). Stanford: Graduate School of Business, Stanford University.

Hu, J., & Liden, R. C. (2011). Antecedents of team potency and team effectiveness: An examination of goal and process clarity and servant leadership. *Journal of Applied Psychology*, *96*(4), 851–862. https://doi.org/10.1037/a0022465

Huysman, M., & Wulf, V. (2006). IT to support knowledge sharing in communities, towards a social capital analysis. *Journal of information technology*, *21*(1), 40-51. https://doi.org./10.1057/palgrave.jit.2000053

Ipe, M. (2003) Knowledge Sharing in Organizations: A Conceptual Framework. *Human Resource Development Review*, *2*, 337-359. https://doi.org/10.1177/1534484303257985

Jarvenpaa, S. L., & Leidner, D. E. (1998). Communication and trust in global virtual teams. *Journal of computer-mediated communication*, *3*(4), JCMC346. https://doi.org/10.1111/j.1083-6101.1998.tb00080.x

Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is anybody out there? Antecedents of trust in global virtual teams. *Journal of management information systems*, *14*(4), 29-64. https://doi.org/10.1080/07421222.1998.11518185

Jarvenpaa, S. L., Shaw, T. R., & Staples, D. S. (2004). Toward contextualized theories of trust: The role of trust in global virtual teams. *Information systems research*, *15*(3), 250-267. https://doi.org/a10.1287/isre.1040.0028

Kanawattanachai, P., & Yoo, Y. (2007). The impact of knowledge coordination on virtual team performance over time. *MIS quarterly*, 783-808. https://doi.org/10.2307/25148820

Kniffin, K. M., Narayanan, J., Anseel, F., Antonakis, J., Ashford, S. P., Bakker, A. B., ... & Vugt, M. V. (2021). COVID-19 and the workplace: Implications, issues, and insights for future research and action. *American psychologist*, *76*(1), 63. https://doi.org/10.1037/amp0000716

Kuo, Y. (2013) Organizational Commitment in an Intense Competition Environment. *Industrial Management and Data Systems*, *113*, 39-56. https://doi.org/10.1108/02635571311289656

Lindsjørn, Y., Sjøberg, D. I., Dingsøyr, T., Bergersen, G. R., & Dybå, T. (2016). Teamwork quality and project success in software development: A survey of agile development teams. *Journal of Systems and Software*, *122*, 274-286. https://doi.org/10.1016/j.jss.2016.09.028

Lurey, J. S., & Raisinghani, M. S. (2001). An empirical study of best practices in virtual teams. *Information & Management*, *38*(8), 523-544. https://doi.org/10.1016/S0378-7206(01)00074-X

Mark, G., Kun, A. L., Rintel, S., & Sellen, A. (2022). Introduction to this special issue: the future of remote work: responses to the pandemic. *Human–Computer Interaction*, *37*(5), 397-403. https://doi.org/10.1080/07370024.2022.2038170

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An Integrative Model of Organizational Trust. *The Academy of Management Review*, *20*(3), 709–734. https://doi.org/10.5465/amr.1995.9508080335

Muqadas, F., Rehman, M., Aslam, U., & Ur-Rahman, U. (2016). Exploring the challenges, trends and issues for knowledge sharing: A study on employees in public sector universities. *VINE Journal of Information and Knowledge Management Systems*, *47*(1), 2-15. https://doi.org/10.1108/VJIKMS-06-2016-0036

Newman, S. A., & Ford, R. C. (2021). Five steps to leading your team in the virtual COVID-19 workplace. *Organizational Dynamics, 50*(1), 100802. https://doi.org/10.1016/j.orgdyn.2020.100802

Ng, P. M., Lit, K. K., & Cheung, C. T. (2022). Remote work as a new normal? The technology-organization-environment (TOE) context. *Technology in Society*, *70*, 102022. https://doi.org/10.1016/j.techsoc.2022.102022

ONS 2020 (Office for National Statistics), (n.d.). https://www.ons.gov.uk/

Ouakouak, M. L., & Ouedraogo, N. (2017). Antecedents of employee creativity and organisational innovation: An empirical study. *International Journal of Innovation Management*, *21*(07), 1750060. https://doi.org/10.1142/S1363919617500608

Panahi, S., Watson, J., & Partridge, H. (2013). Towards tacit knowledge sharing over social web tools. *Journal of knowledge management*, *17*(3), 379-397. https://doi.org/10.1108/JKM-11-2012-0364

Pangil, F., & Moi Chan, J. (2014). The mediating effect of knowledge sharing on the relationship between trust and virtual team effectiveness. *Journal of Knowledge Management*, *18*(1), 92-106. https://doi.org/10.1108/JKM-09-2013-0341

Phang, C. W., Kankanhalli, A., & Sabherwal, R. (2009). Usability and sociability in online communities: A comparative study of knowledge seeking and contribution. *Journal of the association for Information Systems*, *10*(10), 2. https://doi.org/ 10.17705/1jais.00210

Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: a review of current literature and directions for future research. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, *35*(1), 6-36. https://doi.org/10.1145/968464.968467

Reid, F. (2003). Creating a knowledge-sharing culture among diverse business units. Employment Relations Today, *30*(3), 43. https://doi.org/10.1002/ert.10097

Rosen, B., Furst, S., & Blackburn, R. (2007). Overcoming barriers to knowledge sharing in virtual teams. *Organizational dynamics*, *36*(3), 259-273. https://doi.org/10.1016/j.orgdyn.2007.04.007

S. DeOrtentiis, P., K. Summers, J., P. Ammeter, A., Douglas, C., & R. Ferris, G. (2013). Cohesion and satisfaction as mediators of the team trust–team effectiveness relationship: An interdependence theory perspective. *Career Development International*, *18*(5), 521-543. https://doi.org/10.1108/CDI-03-2013-0035

Van den Bosch, F. A., Volberda, H. W., & De Boer, M. (1999). Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. *Organization science*, *10*(5), 551-568. https://doi.org/10.1287/orsc.10.5.551

Wheelan, S. A. (2005). *Group processes: A developmental perspective* (2nd ed.). Pearson Education New Zealand.

Wyld, D. C. (2022). The black swan of the coronavirus and how American organizations have adapted to the new world of remote work. *European Journal of Business and Management Research, 7*(1), 9-19. https://doi.org/10.24018/ejbmr.2022.7.1.1170

Zaheer, A., McEvily, B., & Perrone, V. (1998). Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. *Organization science*, *9*(2), 141-159. https://doi.org/10.1287/orsc.9.2.141

Zaimovic, T., Kozic, M., Efendić, A., & Džanić, A. (2021). Self-Organizing Teams in Software Development–Myth or Reality. *TEM Journal*, *10*(4), 1565. https://doi.org/10.18421/TEM104-10

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STRATEGIC MANAGEMENT, Vol. 30 (2025), No. 4, pp. 032-045

DOI: 10.5937/StraMan2400016N

Received: March 27, 2024
Revised: June 24, 2024
September 15, 2024
December 12, 2024
Accepted: January 06, 2025
Published online: January 20, 2025

Addressing Socio-Economic Drivers of Management Style Evolution: Embracing Complexity Leadership Solutions

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Abstract

Background: The information age has ushered in a novel economic model known as the information economy, challenging traditional bureaucratic mechanisms that were primarily seen as tools to mitigate uncertainty. Within this context, complex leadership emerges as a paradigm that thrives on systemic interactions and intricate dynamics. Here, the onus lies on establishing the framework and conditions that empower the adaptive essence of leadership to flourish.

Purpose: The aim of this research is to establish a framework for optimal leadership management, uncovering previously unexplored factors shaping employee work behavior. By identifying and defining key components within management mechanisms that greatly enhance employee performance, the objective is to cultivate rooted and effective management practices.

Study design/methodology/approach: The research involved 480 respondents from diverse socio-demographic backgrounds and companies. Complexity leadership was assessed using the Complexity Leadership Scale, measuring Generative and Administrative leadership. Employee cooperation was evaluated with the Scala Supportive and Non-Controlling Supervision. Statistical methods included multiple regression, Pearson correlation, t-tests, and MANOVA.

Findings/conclusions: The evaluation shows that both Generative and Administrative leadership are moderately expressed. Generative leadership positively correlates with Supportive and Non-Controlling Supervision, achieving statistically significant results. In contrast, Administrative leadership has negative correlations with these supervisory styles.

Limitations/future research: The limitations of the research are of a methodological nature and refer to the sample of employees, according to demographic characteristics and company characteristics. Also,

questionnaires based on self-assessment most often imply a certain number of socially desirable answers. Future research should include a larger sample to improve external validity and ensure that the empirical evidence obtained is variable across a range of organizational settings.

Keywords
Leadership, Complexity, Employees, Organizations, Socio-economic drivers

Introduction

The requirements for changes in management styles and mechanisms that are imposed on modern organizations relate to the readiness and strength of the organization to prerequisite for survival, in a growing competitive environment. Managing organizations in conditions of complexity and continuous changes requires much more management knowledge, skills, tools, but also personal creativity, initiative, responsibility in order to improve organizational efficiency. The end of the industrial era showed that for the success of the organization, it is of great importance to increase the capacity to accept and use all resources in an adequate way, which above all implies the organization's concern for the continuous development of employees. The reality of the information age actually demanded the definition of new theories of leadership, which is built on the complex foundations of social and economic relations (Khan et al., 2016). It was shown that it is not enough just to improve management, but also, to include organizational learning about new conditions, that necessitate strategies that can adapt to more complex conditions, if it is necessary (Dunn, 2020).

In the new economy based on information technology and knowledge, the requirements have focused on creating an atmosphere in which production costs would be reduced and knowledge accumulation would increase, which would contribute to the development of knowledge-based products, which are unlikely to be replicated with increasing accumulation knowledge (Hager & Beckett, 2022).

Navigating the ever-changing landscape of modern business demands a redefined approach to management, encompassing not only personnel, but also process oversight. Traditional leadership theories predominantly focus on explaining leadership through the lens of individual personality traits or specific behavioral tendencies. While these perspectives offer some insight, they have been found lacking, especially in the context of contemporary organizational environments characterized by rapid change, complexity, and constant development. As a result, these theories have been criticized for their limited scope and inability to fully capture the dynamic nature of leadership. This has paved the way for more intricate and multidimensional frameworks that integrate a broader array of socio-economic, organizational, and personal factors, acknowledging the complexity of leadership in modern management processes (Avotri et al., 2019). Leadership style is one of the most important concepts that determines employees' attitudes and behaviors, which can also influence employees' feelings and thoughts. Leadership management involves a set of activities aimed equally at people and processes, guided by a unifying vision and continuous communication among all participants in the work process. The ability to communicate is one of the main pillars of a leader's potential to leave a positive impact on employees. In that case, leadership style and communication ability can be seen as basic dimensions that influence employee performance, primarily commitment to work and productivity (Dinh et al., 2014).

Such frameworks highlight the need to consider external influences, adaptive capabilities, and the interplay between leaders and their environments in order to provide a more accurate and holistic understanding of effective leadership. Traditional leadership methods have fallen short of anticipated outcomes, failing to deliver the promised results suggested by theoretical frameworks. Practical observations have underscored the deficiencies of existing theories, urging the evolution of new methodologies that harmonize organizational objectives and foster personal growth while achieving and innovating goals (Cort et al., 2018). Theories on leadership have developed significantly in recent years, but a global perspective on leadership reveals a serious lack of contextualization and a more comprehensive understanding. A more cohesive theoretical and empirical model requires insight into context, which is recognized as one of the most important factors (Reiche et al., 2017). Researchers agree that leadership management contributing to success must be adaptable to the

existing context and circumstances (Eva et al., 2019).

One of the theories that has given the most attention to contextual factors is contingency leadership theory, which emphasizes the impact of external influences on management. Contingency theories argue that leadership effectiveness depends on the interaction between a leader's traits or behaviors and situational factors (Amghar, 2022; Subatyarto & Lestari, 2020). This theory has profoundly shaped the evolution of other theoretical frameworks, particularly complexity leadership.

Information economy recognized bureaucratic mechanisms only as a basic tool for reducing uncertainty. Contemporary approaches to management have tried to offer alternatives to the bureaucratic approach to management and to work out ways to put these alternatives into practice, focusing on visible problems of organizational structure, power issues and role of technology, to define uncertainty in organizations and possibility to achieve goals (Wong et al., 2023).

The attitude imposed in the existing Industry 4.0 dominated by mass production, automation and digitization is changing towards the creation of an individual-centered society that is able to balance technological and economic progress with solving social problems. Employees in Industry 5.0 will be focused on training and providing value-added tasks to employees.

As a basis for the beginning of the quantitative draft of the research, and based on the insight into the existing research concepts, the following research questions were asked:

1. to what extent is leadership in organizations based on a complexity approach to management?
2. do organizations have access to supportive behavior for their employees?
3. does a complexity leadership style and a supportive attitude towards employees guide the behavior of employees?

The lack of leadership theories so far is reflected in the absence of a more complex understanding of their impact on employee behavior and results. This is because only personal prerequisites, organizational influences, or cultural influences were emphasized individually. Problems in the interpretation of leadership concepts, terminological interpretations, and defining the importance and role of the scientific approach are reflected in the theoretical approaches to leadership. Although these theoretical approaches were built on each other with a clear goal of improving the understanding of leadership, each approach had its own limitations. These limitations inspired other authors to include new influencing factors

This research addresses the management challenges observed in organizations in Serbia, highlighting a widening gap between the existing management systems and the evolving needs driven by advancements in technology and changes within organizations and society. The paper is structured as follows: the first section introduces the research problem, the second provides a review of relevant literature, the third outlines the research methodology, the fourth presents the research findings, and the fifth discusses the results in the context of prior studies and the proposed hypotheses. The final section offers concluding reflections and implications.

1. Literature review: Complexity leadership

Adequate leadership style is one of the challenges for the best organized business today, where changes are accelerated and the need for continuous development of human resources in the organization is essential.

The existing theories of leadership did not provide enough flexibility and comprehensiveness to explain and predict the management needs in organizations (Lichtenstein et al., 2006). Dominant paradigms in existing theories mainly deal with basic aspects of system stability, such as organizational functioning and their structures with recognizable uncertainty avoidance mechanisms. The vast majority of research on leadership has studied leadership in a formal context, very often through managerial roles (Bedeian & Hunt, 2006; Rost, 1991) and has not adequately addressed leadership that occurs throughout the organization (Schneider, 2002; Callahan, 2019). The study of leadership has long been primarily focused on Western societies, only recently have leaders in developing countries, primarily due to the globalization of the workforce, globalization of markets, increased competition and communications, become aware of the need to develop new styles of organizational management (Damayanti et al., 2021).

Terminologically, it was administrative leadership that refers to formal acts that serve to

coordinate and structure organizational activities, and the conditions in real systems required the introduction of the concept of adaptive leadership based on informal adaptive dynamics in the entire organization (Heifetz & Linski, 2002). Efforts to address shortcomings in current leadership theories are pursued through the concept of complexity leadership (Rosenhead et al., 2019; Johns, 2024). Complexity leadership entails the dynamic collaboration and adaptation of numerous individuals to capitalize on emerging opportunities within both the internal and external milieu (Prescott & Rowe, 2015).

Earlier theories of leadership were mainly focused on leaders, that is, the actions of individuals, the dynamic, complex systems and processes that make up leadership were neglected. Therefore, earlier models have been criticized as being incomplete and impractical (Gronn, 2002; Osborn et al., 2002; Edmonstone, 2016).

Leadership research has revealed a failure to adequately acknowledge social and contextual factors, largely due to the perception that contextualized research is less scientifically rigorous and lacks valuable contextual details (Johns, 2024). Previous theoretical approaches to leadership have exhibited numerous shortcomings, which were manifested in failures to perceive changes in organizational dynamics based on changes in the environment. The development of management involved the application of proven solutions to known problems, whereas the development of leadership requires considering new possibilities for problem-solving (Cilliers, 2001; Dooley, 1996; Marion & Uhl-Bien, 2001). The essence of earlier leadership theories focused on the leader's personality, while neglecting the complex systems and processes that constitute leadership. Therefore, earlier models have been criticized as incomplete and impractical (Gronn, 2002; Osborn et al., 2002).

The complex leadership approach indicates that leadership is too complex a phenomenon to be described solely as the act of an individual or group, without a clear understanding of the complexity of changes in the social and economic environment. Complex adaptive systems, the basic unit of analysis in the science of complexity, represent an essential starting point in modern organizations (Baltaci & Balci, 2017; Shoup, 2016; Turner & Baker, 2017). Baltaci and Balci (2017) described the theory of complexity leadership as a dynamic relationship between employees and managers, based on learning and development, knowledge sharing, but also established on believing that creative problem solving, joint decision-making and process control form, is essential for success of organizations. Conversely, there are also authors who argue that complexity leadership is based on managing unpredictable interactions and recognizing interaction as the most important success factor in a leader's work (Geer-Frazier, 2014; Milch & Laumann, 2016). Leadership, as presented through the lens of complexity theory, addresses an organization's capacity to adapt to conditions characterized by constant change, risk, and pressure. This theory delves into the examination of behavioral patterns that foster psychosocial dynamics among employees, the management mechanisms employed by the social system to transition between stable patterns, and how leaders facilitate or inhibit such contexts (Allen, 2018). Complexity theory provides a scientific basis for organizations to adopt a networked, systems-oriented approach that is attuned to the dynamics of complex adaptive systems. Leaders who establish the conditions for self-organization, foster networked perspectives, cultivate sensitivity to initial changes, and foster an adaptive culture respond to change in non-linear ways that sustain dynamics (Westover, 2024).

The necessity of developing new management styles entails transcending theories rooted in the industrial era and embracing newer paradigms like complexity leadership (Uhl-Bien et al., 2007). Complexity leadership theory directs attention to the perspectives of all actors in business processes, at all organizational levels and at all times (Marion & Uhl-Bien, 2001; Uhl-Bien, et al., 2007). Hazy and Uhl-Bien (2013) believed that the complexity theory of leadership combines generative and administrative functions in community building and the collection and use of significant information for the organization and employees.

The concept is rooted in the development of adaptive systems and interactive dynamics, which give rise to collective momentum for action and change, thereby engendering novel behavioral patterns or operational modalities (Plowman et al., 2007). Complexity leadership theory is a model that underscores the significance of learning, creativity, and adaptability, which is equated to complex adaptive systems. The three interconnected leadership roles: adaptive leadership, administrative leadership, and ——

enabling leadership. These roles acknowledge the dynamic interplay among various organizational components and their relationships (Clarke, 2013). They posits that the interaction of individual and organizational factors engenders a complex system, resulting in leadership at a higher level. Leadership development occurs in response to circumstances and the environment.

The basic components of leadership in complexity theory are communication and cooperation, which increases the adaptability and cooperation of all participants in work processes, as well as increasing organizational knowledge and skills. The merits of complexity leadership theory are evident in its comprehension of organizational processes and the utilization of adaptive problem-solving within organizations (Anderson & Meyer, 2016; Cicmil et al., 2017; Lowell, 2016; Schneider et al., 2017).

A leadership framework called complexity leadership theory seeks to capitalize on dynamic opportunities and focuses on identifying and exploring strategies and behaviors that encourage organizational and subunit creativity, learning, and adaptability when appropriate (Cilliers, 2001; Dooley, 1996; Hosking, 1988). A complexity leadership perspective assumes hierarchical structuring and various adaptive functions that exist only in interaction. As defined by Heifetz and Laurie (2001), adaptive challenges are problems that require new learning, innovation, and new patterns of behavior. The development of various resonant skills is necessary to manage uncertainty without relying on excessive control. At this stage of leadership development, the complexity of leadership implies the creation of administrative synergy with numerous complex powers in the administration, which immediately resonates with the competitive, uncertain conditions required by the new era and a flexible, efficient decision-making process, rather than solely focusing on the members of the organization (Lichtenstein et al., 2006; Warwick, 2023). Complexity leadership is a function of coordination and interaction, emphasizing flexibility, interactivity, dynamism, and hierarchical structuring that can adapt to new conditions across all hierarchical levels of the organization (Uhl-Bien & Marion, 2009). Flexible systems imply high levels of self-coordination arising from informal relationships and structures. Self-coordination develops in good communication and understanding among the members of the organization (Uhl-Bien, 2021). The theory aims to integrate the various roles of leadership and define functions for establishing interactions between complex adaptive systems and bureaucracy. Adaptive leadership is an interactive, dynamic process that focuses on adaptive outcomes, such as ensuring compliance with new, changing organizational conditions (Do & Mai, 2023). Action-oriented leadership aims to activate organizational dynamics, facilitating the optimal utilization of organizational opportunities while mitigating conflicts.

Complexity leadership perspectives were developed to address the limitations of traditional leadership concepts, which often struggled to transcend bureaucratic positions or administrative hurdles. Complexity leaders operate within complex adaptive systems, striving to navigate interactions between the internal and external environment and the organization. The adaptive nature of complexity leadership pertains to authentically influencing interactive, dynamic, and resonant outcomes. Leadership's interactive nature is not grounded in authority or position but in addressing adaptive challenges. In complex adaptive systems, complexity leadership holds greater sway due to their intricate structure, which surpasses that of open systems (Lichtenstein et al., 2006). Leadership, in essence, emerges as a function of evolving situations and interactions between the internal and external environment and the organization. Historically, management primarily involved performance monitoring, comparing actual practices with standards, providing performance feedback, offering guidance and technical updates, identifying improvement opportunities, troubleshooting, and addressing previously identified issues.

Complexity leadership entails the examination of multifaceted social interactions across various strata and their consequential impact on innovation and emergent outcomes. Notably, within the realm of organizational change, complexity leadership has garnered empirical support, particularly in the domain of innovation (Lichtenstein et al., 2006; Hazy, 2007). A comprehensive series of research endeavors spanning from 2007 to 2015, encompassing 30 complex organizations, has yielded substantive evidence elucidating the pivotal role of social dynamics within these systems in fostering innovation and facilitating adaptation—an imperative facet amidst organizational transformations (Arena & Uhl-Bien, 2016).

Complexity leadership offers advantages related to the appreciation of numerous factors that affect employees in the work process, which are very difficult to perceive without an approach based on the scientific application of theoretical assumptions.

2. Methods

The principle driving motive of the research endeavor is an attempt to diagnose and define the most important factors of the management mechanism that would contribute to the improvement of employee performance.

Specifically, apart from the theoretical overview of the scientific achievements so far in the field of leadership and work performance, the aim of the research is to define frameworks for optimal leadership in working conditions in Serbia and to point out the hitherto unexplored factors that determine the work behavior of employees.

The following research hypotheses have been set:

H1: Different aspects of complexity leadership significantly predict the aspects of supervision.

H2: There is a difference in perception of different aspects of complexity leadership in organizations by employees of different gender, age, length of service and education.

H3: There is a difference in different aspects of complexity leadership in organizations of different size, property and sector.

2.1. Sample

The research was conducted on a sample of 480 respondents of different socio-demographic characteristics, employed in companies with different characteristics. The sample was non-representative. The survey included 240 (50%) male respondents and 240 (50%) female respondents. In the context of the company's characteristics, the research included respondents - employees who work in companies of different sizes - small, medium and large. According to the results of the frequency analysis, it was determined that 128 (26.7%) respondents work in small companies, 152 (31.7%) work in medium-sized companies, while 200 (41.7%) respondents work in large companies. The survey did not include respondents who are employed in micro-enterprises. The structure of the sample according to the type of ownership is defined through the categories of private and public companies. The survey included 296 (61.7%) respondents - employees in private companies and 184 (38.3%) employees working in the public sector. The structure of the sample is also defined through employees in relation to the activity of the company where the respondents work. The survey included 231 (48.1%) respondents from companies predominantly engaged in service activities and 249 (51.9%) respondents in companies predominantly engaged in manufacturing activities. The research was conducted through personal contact between the researcher and the employee, as well as through an online questionnaire, during the period from September to December 2023.

Table 1 shows measures of central tendency and measures of variability for the numerical socio-demographic variables age and work experience of the respondents. Based on descriptive statistics, it was determined that the age range ranges from 25 years to 65 years of age with an average age of M = 43.98 (SD = 9.490). Length of service ranged from 1 to 36 years of service with a mean value of M = 16.25 (SD = 8.452). Deviations of the arithmetic mean according to the indicators of skewness (Sk) and kurtosis (Ku) are not significant and therefore it is determined that the data are normally distributed.

Table 1 Descriptive statistics of numerical variants of age and length of work experience of respondents

	Min	Max	M	SD	Sk	Ku
Age	25,00	65.00	43.98	9.409	.313	-.267
Length of work	1.00	36.00	16.25	8.452	.289	-.380

Source: the authors

2.2. Measures

The Complexity Leadership Scale (Hazy & Uhl-Bien, 2013) was used to measure complexity leadership. The scale measures two dimensions: Generative Leadership and Administrative Leadership. The scale consists of 10 items arranged in five-point categories (1 = completely disagree, 3 = not sure, and 5 = completely agree), where each dimension is measured by 5 items. Generative leadership in theoretical foundations improves the resilience of the enterprise and its capacity to respond to changes in the environment. This dimension assesses leadership qualities associated with creativity, innovation and the ability to generate new ideas and solutions. Leaders who rate high on this scale can be seen as visionaries who inspire and empower their team members to think creatively and contribute to the development of new concepts. Interactions within Administrative Leadership are

focused on creating expected value by using known resources and capabilities. This dimension focuses on the traditional aspects of leadership related to administrative and managerial tasks. The dimension includes skills such as: organizing, planning, coordinating and implementing strategy to ensure the smooth functioning of the company's daily activities. Leaders with a high score on Administrative Leadership may excel at overseeing tasks, resources, and processes.

The Supportive and Non-Controlling Supervision Scale developed by Oldham and Cummings (1996) was used to measure employee cooperation. The scale consists of 12 items of five-level arranged categories that describe employees' perception of the extent to which they receive supportive supervision (eight items) or are subject to an uncontrolled supervisory approach (four items). When supervisors are supportive, they show concern for employees' feelings and needs, encourage open communication about concerns, provide positive and informative feedback, and help employees develop their skills (Deci et al., 1989). On the other hand, controlling supervisors closely monitor employee behavior, make decisions without employee input, deliver feedback in a strict, regulated manner, and generally pressure employees to think, feel, or act in a specific way (Oldham & Cummings, 1996).

2.3. Data analysis

Data analysis was performed in Statistical Package for the Social Sciences - SPSS in order to test the hypothesis. The hypothesis were tested by multiple regression analysis, Pearson correlation, Student's t-test and Multivariate Analysis of Variance (MANOVA).

3. Results

The Table 2 below shows descriptive measures for variables included in regression model – Generative leadership, Administrative leadership, Supportive supervision and Non-Controlling supervision. Regarding to the aspects of complexity leadership - Generative (M = 17.93; SD = 4.557) and Administrative (M = 16.18; SD = 3.402) leadership, it is determined that both scores on both aspects of leadership are moderately expressed.

There are no significant deviations in the analyzed data according to the range of skewness and kurtosis, all values are in the range from -2 to +2. Descriptive statistics of numerical variables included in the model are shown in Table 2.

Table 2 Descriptive statistics of numerical variables

	Min	Max	M	SD	Sk	Ku
Generative leadership	5.00	25.00	17.93	4.557	-.490	.134
Administrative leadership	5.00	25.00	16.18	3.402	-.444	1.117
Supportive Supervision	10.00	40.00	30.25	8.061	-.817	.007
Non-Controlling supervision	4.00	20.00	11.70	2.971	.324	1.500

Source: the authors

Before testing the first hypothesis, the correlation between dimension of complexity leadership and supervision was determined. Based on the Pearson correlation results, it is established that Generative Leadership correlates with Supportive Supervision (r=.477; p=.000) and Non-Controlling Supervision (r=.573; p=.000). Therefore, Generative leadership with all assumed correlates achieves statistically significant correlations. On the other hand, Administrative Leadership has negative correlations with Supportive Supervision (r=-.204; p=.012) and Non-Controlling Supervision (r=-.337; p=.000) The Correlation of complex leadership and aspects of supervision is shown in Table 3.

Table 3 Correlation of complex leadership and aspects of supervision

		Supportive Supervision	Non-Controlling Supervision
Generative leadership	r	.477**	.573**
	p	.000	.000
Administrative leadership	r	-,204**	-.337**
	p	.000	.000

Source: the authors

The first hypothesis was tested by multiple regression analysis. Two regression models were set up. Both regression models have the same set of predictors, while the criterion for the first one is Supportive Supervision and for the other one is Non-Controlling Supervision. According to the results of multiple linear regression, it is determined that the set of predictors composed of the variables Generative Leadership and Administrative Leadership according to the obtained coefficient of determination (R^2) explain 54.7% of the variance of the criterion variable - Supportive supervision. The overview of the general model and its parameters is given in Table 4.

Table 4 Overview of the general indicators of the set regression model according to the criterion variable Supportive supervision

R	R^2	Adjusted R^2	S.E
.740a	.547	.537	1.834

Source: the authors

According to the results of the significance testing, it is determined that the regression model is statistically significant. The set of predictors significantly explain the criterion variable.

Based on the partial contributions of each variable from the set of predictors, it is determined that Generative Leadership (β = .112; p = .041) as a positive predictor, and Administrative Leadership (β = -.123; p = .005). The Generative leadership is positive statistically significant predictor of Supportive supervision, while Administrative leadership is negative statistically significant predictor of the criterion variable. The results of the partial predictor contributions regarding to the criterion Supportive super–vision are shown in Table 5.

Table 5 Partial predictor contributions of predictors regarding to the criterion Supportive supervision

Models	Nonstandardized coefficient		Standardized coefficient		
	B	S.E	β	t	p
Generative leadership	.091	.032	.112	1.032	.041
Administrative leadership	-.098	.035	-.123	-2.827	.005

Source: the authors

Second regression model determines Generative Leadership and Administrative Leadership as significant predictors of Non-controlling supervision. According to the results of multiple linear regression, it is determined that the set of predictors Generative Leadership and Administrative Leadership, explain 53.5% of the variance of the criterion variable - Non-controlling supervision. An overview of the general model and its parameters is given in Table 6.

Table 6 Overview of general indicators of the set regression model according to the criterion variant Non-controlling supervision

R	R^2	Adjusted R^2	S.E
.731	.535	.524	2.207

Source: the authors

According to the results of the significance testing of the regression model, it is determined that regression model is statistically significant. The set of predictors significantly explain the criterion variable. Based on the partial contributions of each variable from the set of predictors, it is determined that Generative Leadership (β=.123; p=.005) is statistically significant positive predictor, while the Administrative Leadership (β=.-127; p=.004) is negative predictor. The results of the partial contributions of the predictors are shown in Table 7.

Table 7 Presentation of partial predictor contributions of predictors in relation to the criterion Non-controlling supervision

Models	Nonstandardized coefficient		Standardized coefficient		
	B	S.E	β	t	p
Generative leadership	.116	.039	.123	2.242	.005
Administrative leadership	-.119	.042	-.127	-2.867	.004

Source: the authors

The two multiple regression models presented in this study together contribute to the understanding of the relationship between the dimensions of Complexity leadership – Generative leadership and Administrative leadership – and different aspects of supervision. Each model, which includes Supportive supervision and Non-controlling supervision as criterions, reinforces the importance of leadership in shaping employee perceptions and attitudes in the workplace.

3.1. Complexity leadership research results

The second hypothesis supposes that there is a difference in perception of different aspects of complexity leadership in organizations by employees of different gender, age, length of service and education. The results are provided in the chapters below.

3.1.1. Gender differences

The first part of the results was related to determining gender differences in the perception of different aspects of Complexity leadership. In order to determine the significance of differences in the expression of aspects of Complexity leadership, the Student's t-test was used. Based on the results, it is determined that there are no statistically significant differences in Generative and Administrative leadership regarding the gender of employees. Both aspects of Complexity leadership - Generative and Administrative leadership are equally expressed by the male and female subsamples.

Table 8 Gender differences in perception of aspects of Complexity leadership

Complexity leadership	Gender	N	M	SD	t	p
Generative leadership	Male	80	17.20	4.288	-1.655	.101
	Female	400	18.08	4.600		
Administrative leadership	Male	80	16.00	2.662	-.636	.526
	Female	400	16.22	3.533		

Source: the authors

3.1.2. Age and length of service

The table below represents the results of Pearson's correlation between aspects of Complex leadership, age, and length of service.

Generative Leadership has a statistically significant correlation with age. This indicates a weak negative correlation between these two variables. Similarly, there is a weak negative correlation between Generative leadership and length of service. Administrative Leadership statistically significantly correlates with age. This indicates a moderate negative correlation between Administrative leadership and age. Similarly, there is a moderate negative correlation between Administrative leadership and length of service.

Table 9 Correlation between aspects of Complexity leadership, age and length of service

Complexity leadership		Age	Length of service
Generative leadership	r	-.161**	-.141**
	p	.000	.002
Administrative leadership	r	-.226**	-.239**
	p	.000	.000

Source: the authors

3.1.3. Differences in relation to the level of education

Multivariate tests indicated the significance of differences between groups of education and different aspects of Complexity leadership. Willks' Lambda indicates that there is a statistically significant difference between employees of different level of education in terms of different aspects of Complexity leadership.

Table 10 Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	p
Pillai's Trace	.133	11.266	6.000	952.000	.000
Wilks' Lambda	.871	11.358	6.000	950.000	.000
Hotelling's Trace	.145	11.450	6.000	948.000	.000
Roy's Largest Root	.112	17.795	3.000	476.000	.000

Source: the authors

The results indicate that education is statistically significant for both aspects of Complexity learning – Generative leadership and Administrative leadership, so it can be concluded that education has an impact on the differences in perception of both aspects of Complexity leadership. Tests of Between-Subjects Effects is shown in Table 11 below.

Table 11 Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	p
Education	Generative leadership	705.845	3	235.282	12.115	.000
	Administrative leadership	538.746	3	179.582	17.079	.000

Source: the authors

Based on the results, it is determined that respondents with a higher level of education have a higher preference for Generative leadership compared to respondents with a bachelor's degree. Respondents with completed doctoral studies have a higher tendency to evaluate Generative leadership than employees with a high school education. When it comes to Administrative leadership, respondents with a high school diploma and a doctorate have a higher perception of this aspect of Complexity leadership compared to graduates with a bachelor's degree. Mean scores of Complexity leadership aspects among respondents of different educational backgrounds are shown in Table 12.

Table 12 Mean scores of Complexity leadership aspects among respondents of different educational backgrounds

Complexity leadership	(I) Education	(J) Education	(I-J)	p
Generative leadership	MA (M=18.78)	BA (M=16.80)	1.98*	.000
	PhD (M=22.00)	HS (M=17.25)	4.75*	.007
	HS (M=19.51)	BA (M=16.80)	2.71*	.000
Administrative leadership	HS (M=17.7)	BA (M=15.03)	2.72*	.000
	PhD (M=18.50)	BA (M=15.03)	3.47*	.001

*HS - High School

Source: the authors

The third hypothesis assumes that there is a difference in different aspects of complex leadership in organizations of different size, property and sector. The results are presented in the following chapters.

3.1.4. Differences regarding the size of organizations

Multivariate tests indicate the significance of differences between groups of employees who work in organizations of different sizes. Willks' Lambda indicates that there is a statistically significant difference between employees who work in organizations of different sizes in terms of perception of different aspects of Complexity leadership. The overview of multivariate tests are shown in Table 13.

Table 13 Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	p
Pillai's Trace	.126	16.018	4.000	954.00	.000
Wilks' Lambda	.875	16.505	4.000	952.00	.000
Hotelling's Trace	.143	16.990	4.000	950.00	.000
Roy's Largest Root	.140	33.386	2.000	477.00	.000

Source: the authors

The results indicate that size of organization is statistically significant for only one aspect of Complexity leadership - Generative leadership, so it can be concluded that size has an impact on the differences in perception of one aspects of Complexity leadership. The results of the tests of Between-Subjects Effects are shown in Table 14.

Table 14 Tests of Between-Subjects Effects

Source	Complexity leadership	Type III SS	df	MS	F	p
Size	Generative leadership	1078,224	2	539,112	28,986	,000
	Administrative leadership	62,893	2	31,446	2,737	,066

Source: the authors

In terms of determining the significant effect of the size of the organization on Generative leadership, it can be concluded that small and medium organizations are characterized more by generative leadership interactions opposite to large organizations.

Table 15 Mean scores of Complexity leadership aspects among respondents who work in different size of organization

Complexity leadership	(I) size	(J) size	(I-J)	S.E	p
Generative leadership	small (M=19,18)	large (M=16,16)	3,02	,488	,00
	medium (M=19,21)	large (M=16,16)	3,05	,464	,00

Source: the authors

3.1.5. Differences in type of organizations

To determine the significance of differences in the expression of aspects of Complexity leadership, a Student's t-test was used.

Based on the results in Table 16, it is determined that there are statistically significant differences in Generative and Administrative leadership among the organizations of different type of ownership. Namely, both aspects of Complexity leadership and Generative and Administrative leadership are more pronounced in organizations with private ownership.

Table 16 Differences of Complexity leadership regarding the type of the organization property

Complexity leadership	Type of property	N	M	SD	t	df	p
Generative leadership	Private	296	19.08	3.843	6.947	315.720	.000
	Public	184	16.08	4.999			
Administrative leadership	Private	296	16.51	3.371	2.711	386.405	.007
	Public	184	15.65	3.392			

Source: the authors

3.1.6. Differences of Complexity leadership regarding the sector of organization

To determine the significance of differences in the expression of aspects of Complexity leadership regarding the sector, a Student's t-test was used.

Based on the results in Table 17, it is determined that there are statistically significant differences in the influence of Generative and Administrative leadership on the sector of the organization where the employees work. Namely, Generative leadership is more pronounced in the sector of production.

Table 17 Differences of Complexity leadership regarding the sector of organization

Complexity leadership	Sector	N	M	SD	t	p
Generative leadership	Service	296	17.32	4.773	3.764	.000
	Production	184	18.91	4.009		
Administrative leadership	Service	296	16.35	3.440	1.374	.170
	Production	184	15.91	3.331		

Source: the authors

4. Discussion

In the contemporary context of organizational dynamics, the key role of effective leadership in shaping and improving employee performance is increasingly recognized as a critical determinant (Win & Priyashantha, 2016). This research is driven by the imperative to identify and define fundamental factors within management mechanisms that significantly contribute to improving employee performance, with the aim of building practical frameworks for optimal management rooted in the characteristic working conditions that prevail in the Republic of Serbia.

The results of the assessment of aspects of leadership within the organizational context provide an insight into the dynamics of leadership, by determining the expression of generative and administrative leadership. The moderate expressiveness of the results in both aspects of complexity leadership indicates a balanced approach, suggesting that leaders in the investigated environment show a combination of innovative and administrative qualities. Emphasis on supportive supervision over non-controlling supervision implies a workplace culture that

prioritizes cooperativeness and employee support, aligning with contemporary leadership theories emphasizing the importance of cooperative and empowering leadership styles (Lee et al., 2020; Zhu & Sun, 2020).

In the regression model, in which Supportive Supervision was taken as the criterion variable, according to the results of multiple linear regression, it was determined that the set of predictors composed of the variables Generative Leadership and Administrative Leadership according to the obtained coefficient of determination (R^2) in line with the Supportive Supervision criterion explain statistically significantly 54.7% of the variance of the criterion variable. Based on the partial contributions of each variable from the set of predictors, it is determined that Generative Leadership as a positive predictor and Administrative Leadership as a negative predictor stood out as statistically significant predictors.

Generative leadership was found to be a positive predictor. Generative leaders encourage learning, foster resilience, stimulate meaning-making, continue to reinvent and learn, creating meaning and new value (Gigliotti, 2024), they achieve goals by investing in relationships with people, they are empathetic and give of themselves without any expectations, emphasizing learning and development (Kemer, 2024). This is consistent with research that has determined the positive impact of transformational and generative leadership on fostering supportive and empowering supervisory relationships (Podsakoff et al., 2014). On the other hand, administrative leadership appears as a negative predictor, suggesting that leadership styles that emphasize control, routine, and hierarchical decision-making may decrease the level of supportive organizational behaviors. The absence of significant deviations in the data, as indicated by kurtosis and skewness, suggests a normal distribution of responses. The results of the Pearson correlation analysis provide insight into the relationship between leadership and various organizational variables, focusing on the interaction between generative and administrative leadership and their hypothesized correlates. Generative leadership shows statistically significant correlations with supportive and non-controlling supervision. Leadership in the examined organizations is based on a complex approach, with support provided to employees, confirming the proposed hypotheses.

This indicates that leaders who exhibit generative qualities tend to foster positive organizational outcomes through supportive and non-controlling supervisory practices. This is consistent with the theoretical understanding that leaders who emphasize participative decision making contribute to a positive organizational climate (Podsakoff et al., 2014). The result highlights the potential shortcomings of bureaucratic management in creating a supportive and empowering work environment (Bass & Riggio, 2006). Leadership in organizations in Serbia is still in its early stages, as reflected in the results of this study. Nevertheless, it is crucial for both organizational and employee development to monitor changes in employee behavior and create conditions where leadership can play a dominant role within organizations.

Conclusion

The results indicate the existence of problems in the management of organizations, which are reflected in the answers to individual questions, as well as the absence of a consistent complex approach to management. Understanding and optimizing these factors are essential for companies operating in Serbia in order to effectively navigate the dynamic environment. It is clear that in the future, new approaches to leadership will need to be explored to further advance complexity leadership theory (Tourish, 2019).

Recognizing the importance of interactions and leadership management is key to realizing a quality social and economic environment, showing that effective joint activities between leaders and employees are vital to creating a positive work environment. The development of leaders and leadership that fosters generativity, and therefore social responsibility, will become imperative in preparing for the new reality (Hastings et al., 2024).

The advantage of viewing work performance from the perspective of complexity leadership emerged due to the complexity of working conditions, organizational demands on employees, and employees' need for more comprehensive participation in work processes (Törnblom, 2018). The results of Do and Mai (2023) revealed that both administrative and generative behaviors of complexity leadership have positive relationships with five key factors in high-performance organizations: openness and action orientation, long-term focus, continuous improvement and

renewal, workforce quality, and management quality. This study enriches and expands complexity leadership theory by offering a more nuanced understanding of leadership's impact on high-performance organizations.

The significance of complexity leadership is evident in its identification of key elements crucial for fostering adaptive organizational behavior (Gavalas, 2024). Leadership development is based on increasing other people's sensitivity to the context in which they live and work, establishing and reinforcing simple principles, and facilitating and encouraging constructive dialogue (Bäcklander, 2019; Dollarhide, et al., 2021).

In terms of limitations, the conducted research falls by its nature into cross-sectional studies, which is a common limitaettion in such cases, thereby limiting the valid establishment of cause-and-effect relationships. A specific sample of employees in the Republic of Serbia may be questionable in relation to the question of generalization of the results, not only because of the unevenness according to the demographic characteristics and characteristics of the companies in which the respondents already work, but also because of the existing cultural differences. Self-assessment of claims, as a common method of collecting primary data, opens the possibility for response bias and social desirability. Future research efforts should aim for a larger sample to improve external validity and ensure that the empirical evidence obtained is variable across a range of organizational settings.

Declarations

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding

Not applicable.

Acknowledgements

Not applicable.

References

Allen, W. (2018). Leadership theory: A different conceptual approach. *The Journal of Leadership Education, 17*(2), 149–161. https://doi.org/10.12806/V17/I2/T1

Amghar, A. (2022). Revisiting the contingency theories of leadership: Key features, meanings and lessons. *Revue Marocaine de Gestion et de Société, 1,* 76–93.

Anderson, P. C., & Meyer, A. (2016). Complexity theory and process organization studies. In A. Langley & H. Tsoukas (Eds.), *Sage handbook of process organization studies* (pp. 127–143). Sage. https://doi.org/10.2139/ssrn.3309340

Arena, M., & Uhl-Bien, M. (2016). Complexity leadership theory: Shifting from human capital to social capital. *People and Strategy,* 22–27.

Avortri, G. S., Nabukalu, J. B., & Nabyonga-Orem, J. (2019). Supportive supervision to improve service delivery in low-income countries: Is there a conceptual problem or a strategy problem? *BMJ Global Health, 4*(9), e001151. https://doi.org/10.1136/bmjgh-2018-001151

Baltacı, A., & Balcı, A. (2017). Complexity leadership: A theoretical perspective. *International Journal of Educational Leadership and Management, 5*(1), 30–58. https://doi.org/10.17583/ijelm.2017.2435

Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership* (2nd ed.). Lawrence Erlbaum Associates Publishers. https://doi.org/10.4324/9781410617095

Bäcklander, G. (2019). Doing complexity leadership theory: How agile coaches at Spotify practise enabling leadership. *Creativity and Innovation Management, 28*(1), 42–60. https://doi.org/10.1111/caim.12303

Bedeian, A. G., & Hunt, J. G. (2006). Academic amnesia and vestigial assumptions of our forefathers. *The Leadership Quarterly, 17*(2), 190–205. https://doi.org/10.1016/j.leaqua.2005.12.006

Callahan, J. L., Love, P. K., & Watkins, C. E., Jr. (2019). Supervisee perspectives on supervision processes: An introduction to the special issue. *Training and Education in Professional Psychology, 13*(3), 153–159. https://doi.org/10.1037/tep0000275

Cicmil, S., Gough, G., & Hills, S. (2017). Insights into responsible education for sustainable development: The case of UWE. *The International Journal of Management Education, 15*, 293–305. https://doi.org/10.1016/j.ijme.2017.03.002

Cilliers, P. (2001). Boundaries, hierarchies, and networks in complex systems. *International Journal of Innovation Management, 5*(2), 135–147. https://doi.org/10.1142/S1363919601000312

Clarke, S. (2013). Safety leadership: A meta-analytic review of transformational and transactional leadership styles as antecedents of safety behaviours. *Journal of Occupational and Organizational Psychology, 86*(1), 22–49. https://doi.org/10.1111/j.2044-8325.2012.02064.x

Cort, R., Rauvola, R., & Zacher, H. (2018). Leadership and generations at work: A critical review. *The Leadership Quarterly, 29*(1), 44–57. https://doi.org/10.1016/j.leaqua.2017.09.004

Damayanti, R. W., Hartono, B., & Wijaya, A. R. (2021). Clarifying megaproject complexity in developing countries: A literature review and conceptual study. *International Journal of Engineering Business Management, 13*, 1–25. https://doi.org/10.1177/18479790211027414

Deci, E. L., Connell, J. P., & Ryan, R. M. (1989). Self-determination in a work organization. *Journal of Applied Psychology, 74*(4), 580–590. https://doi.org/10.1037/0021-9010.74.4.580

Dinh, J. E., Lord, R. G., Gardner, W. L., Meuser, J. D., Liden, R. C., & Hu, J. (2014). Leadership theory and research in the new millennium: Current theoretical trends and changing perspectives. *The Leadership Quarterly, 25*(1), 36–62. https://doi.org/10.1016/j.leaqua.2013.11.005

Do, T. T., & Mai, N. K. (2023). Complexity leadership and high-performance organization. *International Journal of Business Performance Management, 24*(2), 212–228. https://doi.org/10.1504/IJBPM.2023.129846

Dollarhide, C. T., Hale, S. C., & Stone-Sabali, S. (2021). A new model for social justice supervision. *Journal of Counseling and Development, 99*, 104–113. https://doi.org/10.1002/jcad.12358

Dooley, K. J. (1996). Complex adaptive systems: A nominal definition. Retrieved September 2006, from http://www.eas.asu.edu/~kdooley/casopdef.html

Dunn, R. (2020). Adaptive leadership: Leading through complexity. *International Studies in Educational Administration, 48*(1), 31–38. http://hdl.handle.net/11343/258917

Edmonstone, J. (2016). Complex adaptive leadership: Embracing paradox and uncertainty. *Action Learning: Research and Practice, 13*(1), 87–89. https://doi.org/10.1080/14767333.2015.1130353

Eva, N., Robin, M., Sendjaya, S., van Dierendonck, D., & Liden, R. C. (2019). Servant leadership: A systematic review and call for future research. *Leadership Quarterly, 30*(1), 111–132. https://doi.org/10.1016/j.leaqua.2018.07.004

Gavalas, A. (2024). Identifying key elements for evaluating organizations' complex adaptive leadership readiness (CAL-R framework): Paving the way for a measurement tool development. *Journal of Management Development, 43*(1), 87–102. https://doi.org/10.1108/JMD-07-2023-0220

Geer-Frazier, B. (2014). Complexity leadership generates innovation, learning, and adaptation of the organization. *Emergence: Complexity and Organization, 16*(3), 105–116.

Gigliotti, R. (2024). Leadership generativity and the social, emotional, and pragmatic pivot from crisis to post-crisis. *Journal of Leadership Studies, 18*(1), 36–41. https://doi.org/10.1002/jls.21889

Gronn, P. (2002). Distributed leadership as a unit of analysis. *The Leadership Quarterly, 13*, 423–451. https://doi.org/10.1016/S1048-9843(02)00120-0

Hastings, L., Sunderman, H., & Knopik, N. (2024). Developmental relationships that encourage generativity. *Journal of Leadership Studies, 18*(1), 42–47. https://doi.org/10.1002/jls.21887

Hazy, J., & Uhl-Bien, M. (2013). Towards operationalizing complexity leadership: How generative, administrative, and community-building leadership practices enact organizational outcomes. *Leadership, 11*, 79–104. https://doi.org/10.1177/1742715013511483

Hazy, J. (2007). Computer models of leadership: Foundations for a new discipline or meaningless diversion? *The Leadership Quarterly, 18*, 391–410. https://doi.org/10.1016/j.leaqua.2007.04.007

Hager, P., & Beckett, D. (2022). Refurbishing learning via complexity theory: Introduction. *Educational Philosophy and Theory, 56*(5), 1–13. https://doi.org/10.1080/00131857.2022.2105696

Heifetz, R. A., & Laurie, D. L. (2001). The work of leadership. *Harvard Business Review, 79*(11), 131–141. PMID: 10174450

Heifetz, R. A., & Linsky, M. (2002). *Leadership on the line: Staying alive through the dangers of leading*. Harvard University Press.

Hosking, D. M. (1988). Organizing, leadership and skillful process. *Journal of Management Studies, 25*, 147–166. https://doi.org/10.1111/j.1467-6486.1988.tb00029.x

Johns, G. (2024). The context deficit in leadership research. *The Leadership Quarterly, 35*(1), 101755. https://doi.org/10.1016/j.leaqua.2023.101755

Khan, Z., Nawaz, A., & Khan, I. (2016). Leadership theories and styles: A literature review. *Journal of Resources Development and Management, 16*, 1–7.

Kemer, G. (2024). Cohesive model of supervision: An empirically based approach. *Counselor Education & Supervision*. Advance online publication, 1–22. https://doi.org/10.1002/ceas.12320

Lee, A., Legood, A., Hughes, D., Tian, A. W., Newman, A., & Knight, C. (2020). Leadership, creativity, and innovation: A meta-analytic review. *European Journal of Work and Organizational Psychology, 29*(1), 1–35. https://doi.org/10.1080/1359432X.2019.1661837

Lichtenstein, B., Uhl-Bien, M., Marion, R., Seers, A., Orton, D., & Schreiber, C. (2006). Complexity leadership theory: An interactive perspective on leading in complex adaptive systems. *Emergence: Complexity and Organization, 8*(4), 2–12. https://digitalcommons.unl.edu/managementfacpub

Lowell, K. R. (2016). An application of complexity theory for guiding organizational change. *The Psychologist-Manager Journal, 19*(3-4), 148–181. https://doi.org/10.1037/mgr0000044

Marion, R., & Uhl-Bien, M. (2001). Leadership in complex organizations. *Leadership Quarterly, 12*, 389–418. https://doi.org/10.1016/S1048-9843(01)00092-3

Milch, V., & Laumann, K. (2016). Interorganizational complexity and organizational accident risk: A literature review. *Safety Science, 82*, 9–17. https://doi.org/10.1016/j.ssci.2015.08.010

Oldham, G., & Cummings, A. (1996). Employee creativity: Personal and contextual factors at work. *The Academy of Management Journal, 39*(3), 607–634.

Plowman, D., Baker, L. T., Beck, T., Kulkarni, M., Solansky, S., & Travis, D. (2007). Radical change accidentally: The emergence and amplification of small change. *Academy of Management Journal, 50*(3), 298–318. https://digitalcommons.unl.edu/managementfacpub

Podsakoff, P. M., Podsakoff, N. P., Mackenzie, S. B., Maynes, T. D., & Spoelma, T. M. (2014). Consequences of unit-level organizational citizenship behaviors: A review and recommendations for future research. *Journal of Organizational Behavior, 35*(S1), S87–S119. https://doi.org/10.1002/job.1911

Prescott, D., & Rowe, M. (2015). Leadership in systems, organizations and cultures. *British Journal of Hospital Medicine (London, England: 2005), 76*(2), 101–104. https://doi.org/10.12968/hmed.2015.76.2.101

Win, K. M., & Priyashantha, K. G. (2016). *The Impact of Leadership Styles on Employee Performance: Analysis of Intervening Effect of Employee Retention to the Relationship of Leadership Styles and Employee Performance* (Master's thesis, Win, KM (Author)). https://doi.org/10.13140/RG.2.2.24206.64327

Reiche, B. S., Bird, A., Mendenhall, M. E., & Osland, J. S. (2017). Contextualizing leadership: A typology of global leadership roles. *Journal of International Business Studies, 48*, 552–572. https://doi.org/10.1057/s41267-016-0030-3

Rost, J. C. (1991). *Leadership for the twenty-first century*. Praeger. https://doi.org/10.1002/hrdq.3920040210

Rosenhead, J., Franco, A., Grint, K., & Friedland, B. (2019). Complexity theory and leadership practice: A review, a critique, and some recommendations. *The Leadership Quarterly, 30*(5), 101304. https://doi.org/10.1016/j.leaqua.2019.07.002

Schneider, M. (2002). A stakeholder model of organizational leadership. *Organization Science, 13*(2), 209–220. https://doi.org/10.1287/orsc.13.2.209.531

Schneider, A., Wickart, E., & Marti, E. (2017). Reducing complexity by creating complexity: A systems theory perspective on how organizations respond to their environments. *Journal of Management Studies, 54*, 62. https://doi.org/10.1111/joms.12206

Shoup, J. (2016). Reconciling and teaching competing perspectives. *Journal of Leadership Education, 15*(4), 167–182. https://doi.org/10.12806/V15/I4/T1

Subatyarto, A., & Lestari, R. (2020). The fall and rise of the contingency theory of leadership. *IAPA Proceedings Conference, 479–496*. https://doi.org/10.30589/proceedings.2020.423

Tourish, D. (2019). Is complexity leadership theory complex enough? A critical appraisal, some modifications and suggestions for further research. *Organization Studies*, *40*(2), 219-238. https://doi.org/10.1177/0170840618789207

Törnblom, O. (2018). Managing complexity in organizations: Analyzing and discussing a managerial perspective on the nature of organizational leadership.*Behavioral Development, 23*(1), 51–62. https://doi.org/10.1037/bdb0000068

Turner, J., & Baker, R. (2017). Pedagogy, Leadership, and Leadership Development. *Performance Improvement, 56*(9), 5-11. https://doi.org/10.1002/pfi.21734

Uhl-Bien, M. (2021). Complexity Leadership and Followership: Changed Leadership in a Changed World. *Journal of Change Management*, *21*(2), 144-162. https://doi.org/10.1080/14697017.2021.1917490

Uhl-Bien, M., & Marion, R. (2009). Complexity leadership in bureaucratic forms of organizing: A meso model. *The Leadership Quarterly*, *20*, 631–650. https://doi.org/10.1016/j.leaqua.2009.04.007

Uhl-Bien, M., Marion, R., & McKelvey, B. (2007). Complexity leadership theory: Shifting leadership from the industrial age to the knowledge era. *The Leadership Quarterly*, *18*(4), 298–318. https://doi.org/10.1016/j.leaqua.2007.04.002

Warwick, L., Beddoe, L., Leigh, J., Disney, T., Ferguson, H., & Cooner, T. S. (2023). The power of relationship-based supervision in supporting social work retention: A case study from long-term ethnographic research in child protection. *Qualitative Social Work*, *22*(5), 879-898. https://doi.org/10.1177/14733250221113015

Westover, J. H. (2024). The Role of Complexity Theory as a Foundation for Taking a Systems Approach in Your Organization**.** *Human Capital Leadership Review***,** *14(2***).** https://doi.org/10.70175/hclreview.2020.14.2.11

Wong, P. Y. J., Wong, K. L., Ghoh, C., & Chiu, M. Y. L. (2023). Supervision of supervisory practice: From idea to practice. *International Social Work*, *66*(6), 1918-1931. https://doi.org/10.1177/00208728211073648

Zhu, R., & Sun, S. L. (2020). Fostering Generative Partnerships in an Inclusive Business Model. *Sustainability*, 12(8), 3230-3250. https://doi.org/10.3390/su12083230

Osborn, R., Hunt, J., & Jauch, L. (2002). Toward a Contextual Theory of Leadership. *The Leadership Quarterly, 13,* 797-837. https://doi.org/10.1016/S1048-9843(02)00154-6

Podsakoff, P. M., Podsakoff, N. P., Mackenzie, S. B., Maynes, T. D., & Spoelma, T. M. (2014). Consequences of unit-level organizational citizenship behaviors: A review and recommendations for future research. *Journal of Organizational Behavior, 35*(S1), S87–S119. https://doi.org/10.1002/job.1911

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STRATEGIC MANAGEMENT, Vol. 30 (2025), No. 4, pp. 046-059

DOI: 10.5937/StraMan2400015V

Received: March 04, 2024
Revised: September 10, 2024
December 18, 2024
Accepted: Decembar 31, 2024
Published online: January 15, 2025

Smart City 4.0 as the concept of strategically managed sustainable urbanism

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Abstract

Background: Smart technologies serve as a bridge between strategic business goals and sustainable development, creating a synergy among the economic, environmental, and social dimensions of business and circular urbanism.

Purpose: The objective of this paper is to analyse the impact of implementing smart technologies on the economic benefits for an urban centre in a Central European Union state.

Study design/methodology/approach: The research employs an econometric model to predict financial savings (30%, 40%, and 55%) resulting from the implementation of smart technologies in waste management within a selected urban centre.

Findings/conclusions: The predictions confirmed the existence of a positive and growing trend in financial savings across all analysed areas, highlighting the economic benefits of smart technology adoption.

Limitations/future research: The limitations of the research consist of inconsistencies in the implementation of smart technologies in waste management across different municipalities within the analysed country. Future research could expand the research sample to multiple urban centres and countries after the introduction of legislation that incentivises the uniform adoption of current smart technologies and the publication of up-to-date implementation data. This would facilitate the development of sustainable strategic plans and decisions that are tailored to both national level and local needs of individual urban centres, offering effective and long-term solutions for sustainable urban development.

Keywords

Smart city 4.0, urbanism, sustainable management, waste management, green economy

Introduction

The current era of growing urbanism and dynamic technological progress poses challenges in the area of sustainable development and the effective management of urban systems. Strategic sustainable management is an essential tool for supporting managerial decisions that not only carefully consider environmental impacts but also enhance the engagement of individuals and enterprises in the area of corporate social responsibility (CSR). CSR is currently focused on environmental concerns and the development of sustainability branding (Pollak, et al., 2021), which

is crucial due to its ability to influence all stakeholders involved (Világi, et al., 2022). Sustainable urbanism, therefore, creates opportunities for innovative enterprises to develop urban areas while simultaneously minimising the ecological impact of urbanisation with an emphasis on improving the quality of life for urban residents (MESR, 2018; MESR, 2019). This endeavour is enhanced within the Smart City 4.0 concept, where technological innovations and effective management contribute to the creation of intelligent solutions for sustainable and resilient urban development (Yigitcanlar et al., 2023). Technologies have become a key instrument in achieving sustainability and gaining a competitive advantage (Abdul et al., 2024). Modern technologies empower smart cities with the potential to enhance the quality of life, streamline service delivery, and support sustainability (Joyce & Javidroozi, 2024). The successful resolution of problems and challenges in urban infrastructure through smart technologies is based on the effective analysis of vast datasets generated by the urban environment (Fedushko, et al., 2020). The value of data trading continues to grow in parallel with the increasing data availability. The use of smart technologies significantly enhances the efficient collection, processing, and interpretation of large data volumes, thereby improving the accuracy and relevance of commercial information (Khurshudov, 2024). This integration of smart technologies with commercial analytical processes opens up new possibilities for enhancing managerial decision-making in commerce, information management, and the strategic management of sustainable development. Consequently, the implementation of smart technologies in industry, particularly in the production sector, is seen as a catalyst for technological development aimed at sustainable production by means of innovative technological procedures (Oláh et al., 2020; Cajková, et al., 2021). One of the key objectives of sustainable business within the Smart City concept is the support of sustainable supply networks. These networks encompass corporate resource management, waste minimisation, and environmentally responsible procurement (green sourcing). The onset of the health-economical coronavirus crisis at the beginning of the 21st century prompted many manufacturing companies to redefine their approach to product supply, integrating servitisation into their business model, which resulted in overall advantages across the whole value chain (Sadjadi, 2024). In general, with few exceptions, the more developed and prosperous a country is, the greater the proportion of its population that lives in urban centres (INESS, 2023) contributes to value creation, and experiences a higher level of urbanisation. In some countries, such as Australia, the Netherlands, and the United Kingdom, the degree of urbanisation reaches as high as 90% (Dzator, et al., 2022). Globally, it is estimated that 68% of the global population will reside in urban areas by 2050 (UN DESA, 2018), driven by the influx of investors and the creation of new jobs with higher value added in cities. The current economy demonstrates that human resources and their expertise are crucial factors significantly influencing innovative potential and thus the long-term business success (Slavkovic & Miric, 2024).

Despite the topicality of urbanisation, there are examples of its decline due to suburbanisation or the preservation of rural character. According to data from the European Commission, the number of Slovaks living in urban centres decreased by a quarter from 1990 to 2014 (INESS, 2023). Although urbanisation is progressing at a slow pace in Slovakia, leading urban centres are increasingly recognizing the potential of technological innovations to address complex challenges. They are investing in projects supporting the Smart City concept, which includes the implementation of intelligent infrastructures, effective transport management, energy sustainability, and digital platforms. Moreover, these projects emphasize the modernisation of waste management with the goal of achieving sustainable, intelligent, and economically viable urban development. Smart urban initiatives are gaining momentum globally, aiming to tackle major urban problems by harnessing the transformative power of digital technologies. However, despite these efforts, the pace of innovation seems to be much slower compared to the rapid changes driven by digital technologies in other industries (Jose & Rodrigues, 2024).

The analysis of scientific literature reveals that previous studies have primarily focused on mapping the knowledge area of the Smart City concept through bibliometric and scientometric analysis (Zhao, et al., 2019), assessing the smartness of cities in accordance with Smart City indexes by means of comparative regional analysis of the Visegrad Group (Neumannova, 2020), and examining the role of macro factors in evaluating the smartness of cities (Alderete, 2020).

Additionally, the research has explored the proposal of the new City 4.0 concept (Yigitcanlar et al., 2023), the technologies used for data collecting in smart cities (Khurshudov, 2024), the impact of Smart City initiatives on green economic efficiency (Chen, et al., 2024), and the impact of the COVID-19 on the realization of the Smart City concept, particularly through innovative procedures in waste management within sustainable intelligent mobility frameworks (Sadjadi, 2024). The aim of this study is to advance the understanding of the requirements for implementing smart technologies in waste management, analyse the outcomes of these technologies, and re-evaluate their cost-effective impact on a selected urban centre in the Slovak Republic, a member of the Visegrad Group.

1. Theoretical background

The strategic management of sustainable urbanism and the use of smart technologies contribute to the transformation of the urban environments towards smarter and more eco-friendly sustainable solutions, which address global challenges related to adaptation to climate change in the 21st century. Global cooperation in the realm of smart technologies is inevitable in the context of current environmental challenges (Fernandez-Anez, et al., 2018) and growing urban populations. According to Shin, Kim and Chun (2021), smart citizens not only comprehend digital technologies but also utilize them effectively to adapt to various systems of modern cities. Smart technologies, as an integral part of Smart Cities concept, encompass technological innovations designed to optimise and improve various aspects of human life and social functioning. Nowadays, the key concepts driving innovation in information systems are 'intelligent', 'open', and 'network', which enhance their potential and improve decision-making processes (Olah et al., 2020). At the beginning of the 20th century, only 13% of the global population lived in cities (Global Education, 2024). By 1950, this proportion increased to approximately 30% (UN DESA, 2014), and currently, it exceeds 50%, specifically 55% (Skills 4 cities, 2021; Global Education, 2024). This percentage is projected to reach 68% by 2050 (UN DESA, 2018). The population is categorized into those living in urban centres, urban clusters, and rural settlements (rural grid cells). According to the EU, urban centres are defined as contiguous areas with a minimum population density of 1,500 persons per square kilometre and a total population of at least 50,000 inhabitants (European Commission, 2016). In Slovakia, there are significant differences between the western and the eastern regions (Dorcak, et al., 2015). The category of urban centre comprises most of the territory of Bratislava, Kosice, Zilina, and Presov, while more than 96% of the population cells fall into the category of rural grid cells (INESS, 2023). Despite this fact, leading Slovak urban centres are investing in sustainable projects supporting the Smart City concept at every stage of its development.

1.1. Generation of smart cities and sustainable urbanism

The Smart Cities concept originated in the 20th century, in a period of significant technological progress in communication technology. The development of the 'Smart Cities' concept emerged from industry initiatives at the European level, leading to the formation of the 'Smart Cities and Communities' industrial activity. This initiative focused on integrating traffic and energy systems to reduce their environmental impact. A year later, the European Innovation Partnership on Smart Cities and Communities was established, incorporating information and communication technologies and providing a basic framework for the Smart Cities concept (Ministry for Regional Development of the Czech Republic, 2018).

Figure 1 presents an overview of the historical development of the Smart City concept in relation to its impact on waste management.

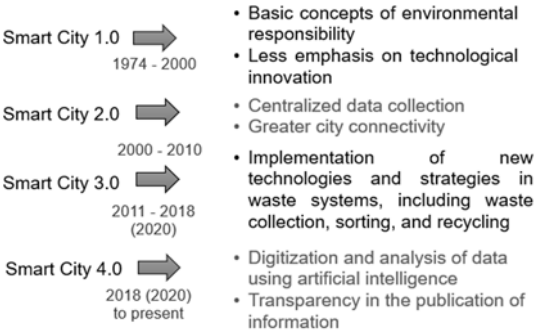

Figure 1 Historical development of Smart City concept in the context of waste management
Source: the authors

The following chapters provide a detailed description of each of the Smart City concepts based on the historical development.

1.1.1. First generation - Smart Cities 1.0

The first generation of smart cities, known as Cities 1.0, spans from 1974 to 2000 (Kumar & Singh, 2022). During this period, initiatives emerged focusing on using information technologies to enhance the quality of urban living conditions. This generation was characterised by the development of technology, data isolation, and decentralised innovation planning. Technology developers urged urban policymakers to adapt urban infrastructures to these technological solutions to achieve higher effectiveness in managing urban processes. Despite these efforts, many cities struggled to effectively use these technologies and correctly assess their impact on residents' quality of life, despite this effort (Human Smart City, 2019). Sustainable management during this early stage primarily focused on fundamental concepts of environmental responsibility with limited emphasis on technological innovations. The corporate sector and municipalities began to deal with issues such as resource efficiency in production and waste minimisation, though they largely relied on traditional methods of management. Municipalities actively tried to secure collection points for residents, where waste was typically transported to landfills or recycling facilities. Cities experimenting with new approaches to urban problems at that time laid the groundwork for the future development of smart cities.

1.1.2. Second generation - Smart Cities 2.0

The second generation of smart cities, known as Smart Cities 2.0, which developed until 2010, emphasized the integration of various information technologies to enhance the interoperability and efficiency of urban systems. Unlike the first generation, this phase was marked by widespread connectivity throughout entire cities and the centralised collection of large volumes of data. In this generation, municipal self-governance took a leading role in shaping the future of cities by implementing intelligent technologies and innovations. Cities actively supported a number of programs and projects integrating modern technologies into various aspects of municipal infrastructure and services (Paetsch et al., 2017; Human Smart City, 2019). The industrial growth of smart cities and urban networks was further driven by initiatives such as Smart City Expo and City Protocol (Fastcompany, 2015). Technologies were regarded as equally important as the human factor at this stage (Human Smart City, 2019). Sustainable management became increasingly focused on technological innovations and the efficient use of resources. Cities started implementing modern technologies and strategies into their waste management systems, including waste collection, sorting, and recycling. Through centralized data collection and enhanced connectivity, cities were better able to understand residents´ needs and optimise waste management systems, leading to more effective operations and reduced environmental impact. In this context, it can be stated that the transition of cities towards a bioeconomy will rely on progress in technology across a wide range of processes, achieving breakthrough in terms of technical performance and cost efficiency (Bikar et al., 2018).

1.1.3. Third generation - Smart Cities 3.0

The third generation, known as Smart City 3.0 (2011 – 2018) placed a significant emphasis on active civic participation in shaping urban environments (Giela, 2023). The development of participative platforms and applications enabled citizens to communicate with municipalities, express their opinions, and take part in decision-making processes. Social initiatives, such as promoting equality, social integration, and affordable housing, were also deemed significant in this period (Human Smart City, 2019). The European migration crisis, which peaked between 2015 and 2019 (Vasic et al., 2023), prompted many European cities to revise their policies and technologies to be able to respond to demographic changes and address problems related to an increase in waste.

The need to secure large volumes of information while protecting personal data became more pressing (Kumar & Singh, 2022). Crowdsourcing and open innovation enhanced participation between citizens and urban authorities, facilitating the development of innovative solutions for smart cities. This generation saw the promotion of sustainable practices among citizens, which enabled monitoring of individual waste habits and accessing information on proper sorting methods. Educational campaigns and events were organised to raise public awareness about environmental challenges and encourage sustainable lifestyles. The managers of sustainable policies focused on reducing the use of disposable products and promoting renewable and recyclable materials within the policies of sustainable shopping. Innovative approaches to managing organic waste,

such as community composting (Alvarez-Alonso et al., 2023) and the adoption of biodegradable packaging materials, were also introduced. Support was extended to local enterprises producing environmentally friendly products and ecological mobility solutions, such as electric vehicles and shared transportation services. Concurrently, efforts were made to expand public green spaces (Gasser, et al., 2024). Cities also supported research and innovation to discover new and more efficient methods of waste processing. Technologies and strategies for collecting, sorting, and recycling waste were implemented together with using information technologies to enhance the efficiency and monitoring of waste management processes.

1.1.4. Fourth generation - Smart Cities 4.0

The generation of Smart City 4.0 (emerging since 2018, though some sources cite 2020) is a significant step in the evolution of smart cities, where technological innovations and digitalisation are seamlessly integrated into everyday life and functioning of cities. The adoption of advanced technologies, such as artificial intelligence analysis and process automation, are the characteristics and an integral part of this generation. Moreover, this generation emphasises transparency, which provides access to data and information for citizens, enterprises, and scientific organisations. Cities are investing in environmental solutions, such as intelligent energy systems, renewable energy sources, green buildings, or autonomous environmentally friendly transportation. The transformation also extends to the workforce, where new types of jobs require a fresh set of managerial competencies within the context of smart cities (Skills 4 cities, 2020). Not only are modern managers expected to possess technological knowledge and the ability to adapt to rapidly changing technological environments but they ought to have skills in data management, digital marketing, and interpersonal communication. This expanded skill set reflects the necessity to address the diverse challenges and tasks arising from the increasing influence of technologies on the workplace and society as a whole.

Rapid technological advancements and the Fourth Industrial Revolution have significantly reduced product life cycles and increased the complexity and unpredictability of consumer behaviour (Ubiparipovic, et al., 2023). This dynamic environment requires waste management companies to continuously adapt and change their practices.

The global health crisis, initiated by the COVID-19 pandemic in 2019, had a significant impact on the development of smart cities within the generation of Smart City 4.0. In response to the challenges posed by the pandemic, many companies decided to diversify their offerings and implement servitisation as an integral part of their business model (Sadjadi, 2024). This step aimed at maintaining sales and delivering added value to customers. New trends brought about by the COVID-19 pandemic, such as changes in customer behaviour, increased business flexibility, the rise of servitisation, remote work, or coworking places have a potential for the whole supply chain. Studies conducted during the lockdown period observed a decrease in air pollution in various cities (Sadjadi & Fernandez, 2023; Venter et al., 2020). However, the pandemic also led to panic purchases (Prentice, et al., 2020) and the closures of a substantial number of enterprises (Markovic et al., 2022), which contributed to a surge in food waste production during the first wave of COVID-19. There was a greater emphasis on hygiene, and the health and safety of the staff in waste collection facilities with the increase in healthcare waste, such as face masks, virus tests, disinfectants, and gloves.

During subsequent waves of the coronavirus pandemic, consumers focused on sustainability and adopted the “less is more” principle in their purchasing decisions (Ferreira et al., 2024), which differs significantly from pre-pandemic consumption patterns and trends (Brydges, et al., 2022).

This period brought significant changes to the business environment, making it ideal for innovation and transformation (Ferreira et al., 2024).

The outbreak of the pandemic underscored the need for the development of decentralised systems of waste disposal (Sadjadi, 2024). The implementation of automation and smart technologies in waste management has catalysed the optimisation of entire waste system and contributed to the development of the current generation of smart cities.

A detailed analysis and diagnosis of a firm´s financial situation serve as a “warning signal” for firms (Grosu et al., 2023) and reveals potential risks and opportunities that are crucial for the effective management of companies operating in waste management.

In the light of these considerations, the aim of this paper is to analyse the impact of implementing smart technologies on the economic benefits of a selected urban centre in one of the European Union countries that invest in smart technologies to promote renewable resources and sustainable urbanism. The focus of the present study will be answering the following research questions based on a literature review: *RQ1: What is the average resale value of selected secondary raw materials within the EU? RQ2: How do selected smart technologies affect the costs of waste management in the selected urban centre? RQ3: What are the projected financial savings in waste management in the selected urban centre?*

2. Methods

The research on waste management will use publicly available data from Eurostat (2022) covering the period 2015-2021 and data obtained from one of the major waste management companies operating in the Slovak Republic. The company operates in the sector classified as E38 - Collection, treatment, and disposal of waste and material recycling according to the SK-NACE sectoral classification. At the request of the analysed company, its name will remain anonymous. The data collected from the company will be analysed on a monthly basis, but for the sake of clarity, the results will be presented as quarterly data. The findings will be illustrated through bar charts, run charts, and tables.

The research will employ a statistical method using an econometric model, which will be processed in the EViews software. This model will be used to forecast the future economic savings resulting from the implementation of smart technologies in waste management in the selected urban centre.

3. Results and Discussion

3.1. Sorted Waste Components as an Exchange Commodity

Sorted waste is becoming an increasingly valuable commodity in the global market, contributing to the sustainable use of energy resources and reducing the environmental burden. Recyclable materials, such as plastics, paper, and glass, are finding new applications across various industries, thereby supporting the circular economy. These separated waste components hold not only environmental significance but also monetary value. The results section provides a summary of the sales value of the most common secondary raw materials, specifically paper, plastics, and glass, over the period from 2015 to 2021. Figure 2 presents the average sales value of sorted paper.

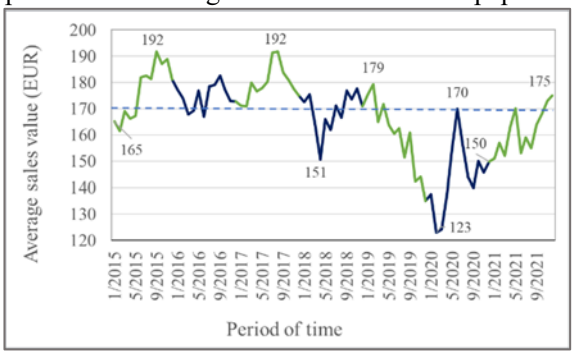

Figure 2 Development of exchange prices of sorted paper per ton
Source: Eurostat, 2022

As shown in Figure 2, the purchase price of recovered paper was EUR 165 per ton in January 2015, rising to EUR 175 per ton in December 2021. The median price over the entire period was EUR 170 per ton.

Figure 3 illustrates the average sales price of sorted plastics.

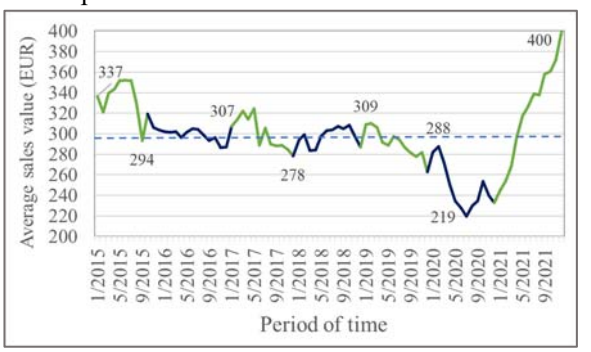

Figure 3 Development of exchange prices of sorted plastics per ton
Source: Eurostat, 2022

As seen from the data in Figure 3, the purchase price of plastics intended for recycling was EUR 337 per ton in January 2015, increasing to EUR 400 per ton by December 2021. The median price throughout the entire monitored period was EUR 298 per ton.

Figure 4 shows the average sales price of sorted glass.

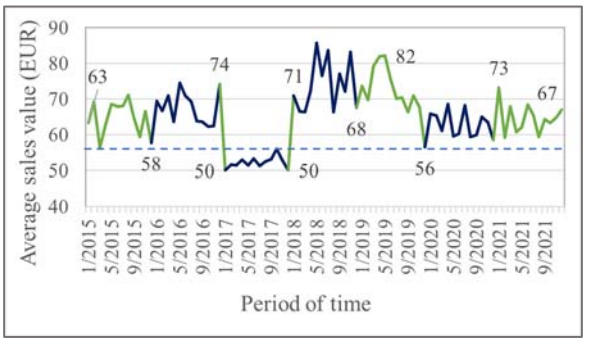

Figure 4 Development of exchange prices of sorted glass per ton
Source: Eurostat, 2022

Figure 4 shows that the average sales price of glass was EUR 63 per ton at the beginning of the monitored period (January 2015). The price increased to EUR 67 per ton in December 2021. The median price for the entire period was EUR 66 per ton.

3.3 Internal and External Cost Drivers of Individual Items in Waste Management

3.3.1 Distribution of Costs in Smart Technologies in the Slovak Republic

According to the study by Fedushko, Ustyianovych and Gregus (2020), the costs associated with implementing smart technologies in waste management can be divided into four categories: hardware, software, connectivity, and operation. Figure 5 illustrates the distribution of these categories in Slovakia in 2021.

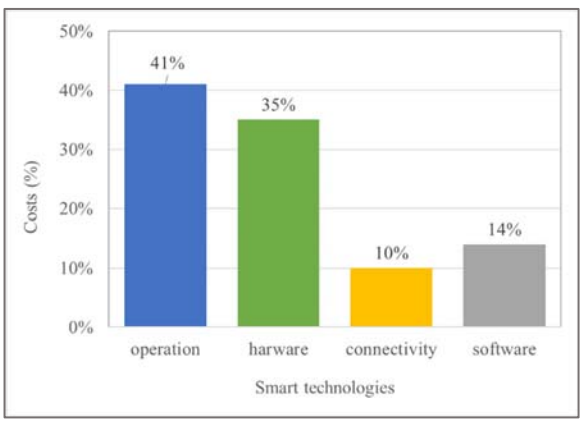

Figure 5 Distribution of Smart technologies by cost contribution in the waste management sector in Slovakia in 2021
Source: the authors

As shown in Figure 4, the largest cost item in the analysed period was the operation of waste management companies, accounting for 41% of the total costs. The second largest expense was cost of hardware (35%), followed by software (14%). The smallest cost item was the cost of network connectivity, which constituted 10% of the total costs.

3.3.2 Landfill Tax Dichotomy

In order to achieve the environmental targets established by the European Union, the Slovak government enacted Regulation 330/2018, which imposes various fees for waste disposal in landfills based on the degree of its sorting.

Figure 6 illustrates the percentage of sorted municipal waste in the period from 2019 to 2021 following the implementation of this regulation.

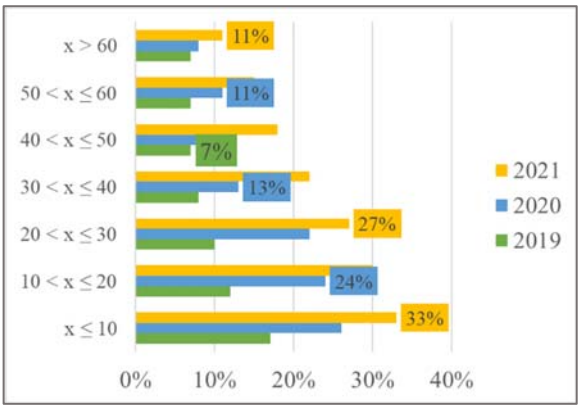

Figure 6 Level of municipal waste sorting
Source: the authors

As shown in Figure 6, the level of municipal waste sorting in 2021 increased compared to the year 2019. The percentage increase is detailed in Table 1.

Table 1 Level of municipal waste sorting

Level of municipal waste sorting in %	Percentage increase between 2019 and 2021
x > 60	157%
50 < x ≤ 60	214%
40 < x ≤ 50	257%
30 < x ≤ 40	275%
20 < x ≤ 30	270%
10 < x ≤ 20	250%
x ≤ 10	194%

Source: the authors

According to the data in Table 1, the average level of municipal waste sorting increased by 202.42% between 2019 and 2021. In 2019, municipalities that sorted 40% to 50% of their waste paid a fee of EUR 7 per ton. This fee rose to

EUR 12 per ton in 2020, and to EUR 18 per ton from 2021 onwards. The total increase in fees over this period was 257.14%. Through this regulation, the Slovak government aims to financially discourage municipalities from landfilling waste while incentivizing improved waste sorting and increased energy recovery.

3.3.3 Savings achieved through smart technologies in waste management

In the city of Nitra, the efficiency of waste collection has been enhanced by optimizing routes and adjusting the frequency of collection as needed. All bins are labelled and equipped with internal filling sensors. Nitra´s municipal services manage over 23,500 containers and handle approximately 49,000 tons of waste per year. The company reports a 30% reduction in waste collection thanks to these smart technologies.

In Šumperk and the adjacent municipality Rapotín, the application of smart sensors in bins and an inventory of collection bins resulted in a total cost saving of 53%. Specifically, the time needed for efficient collection was reduced by 58% due to improved utilization of the collection vehicle and its crew. Additionally, the frequency of collection decreased by 61%, resulting in less wear and tear on the superstructure and collection containers.

In the municipality of Dojč, automatic weighing of bins during waste collection and the implementation of quantitative collection with RFID chips resulted in savings in both main categories of waste. The generation of municipal mixed waste decreased from 250 tons in 2019 (before chips and weighing were implemented) to 179 tons in 2020, which represents a decrease by 28%. The waste sorting rate increased from 22% in 2018 to 36% in 2019 and exceeded 58% in 2020, marking a 36% increase over the three-year period under review.

3.4 Econometric Model and Calculation of Potential Savings with Application of Smart Technologies

3.4.1. Econometric Model

The econometric model calculations were performed using EViews software. The results are presented in Figure 7.

Dependent Variable: SALARIES
Method: Least Squares
Sample: 1 40
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NUMBER_OF_EMPLOYEES	6689.338	164.0790	40.76901	0.0000
QUANTITY_ RESIDUAL_WAST	2.044168	0.602317	3.393839	0.0019
QUANTITY_ SEPARATE_WAST	-20.58769	7.662655	-2.686756	0.0115
SEPARATING_COSTS	0.161492	0.052577	3.071505	0.0044
INFORMATION_SYSTE_COSTS	0.129139	0.182308	0.708360	0.4840
PROFIT_FROM_SORTING	-0.191405	0.096680	-1.979766	0.0567
EMPLOYEES_SMART_TECH	853.4865	2360.736	0.363072	0.7190
FLEET_COSTS	0.007512	0.002641	2.844352	0.0078
C	-781149.5	63052.35	-12.38890	0.0000

R-squared	0.999830	Mean dependent var	2350372.
Adjusted R-squared	0.999786	S_D. dependent var	388573.8
S.E. of regression	5681.182	Akaike info criterion	20.32281
Sum squared resid	1.00E+09	Schwarz criterion	20.70281
Log likelihood	-397.4563	Hannan-Quinn criter.	20.46021
F-statistic	22801.88	Durbin-Watson stat	1.520518
Prob(F-statistic)	0.000000		

Figure 7 Output from the EViews software – sorted data
Source: the authors

The results shown in Figure 7 indicate that the probability (F-statistic) is less than 5 %, which means that the model is statistically significant.

In the econometric model, the variables with the greatest impact on labour costs are the Number of employees (coefficient 6689) and Employees for smart technology (coefficient 854). Other variables influencing labour costs include the Quantity of municipal waste (coefficient 2), Sorting costs (coefficient 0.16), Cost of information systems (coefficient 0.13), and Vehicle cost (coefficient 0.01).

The model´s R^2 value is 0.99983, which is very close to 1. This indicates that the model demonstrates a high level of accuracy, likely due to the limited size of the dataset and its exclusive focus on cost items.

The significant differences in absolute values, sum of labour cost, and the number of employees working with smart technologies are also reflected in the econometric model. The variable Employees working with smart technology shows the highest coefficient, which is nearly double that of the second-highest coefficient (Number of employees). It shall be noted that the wage costs for employees working with smart technologies are not significantly higher than those of service employees.

The variables that negatively affect labour costs include the Quantity of sorted waste (coefficient -21) and Difference between sales and sorting costs (coefficient -0.19).

Subsequently, statistically significant variables with a probability of 5% or less were selected to calculate the resulting econometric model equation, which has the following form:

*Labour costs = 6688.180 * Number of employees + 1.555133 * Quantity of municipal waste – 20.92232 * Quantity of sorted waste + 0.130746 * Sorting costs + 0.008971 * Vehicle costs + C*

In the resulting econometric model, the variable Number of employees had the largest positive impact on Labour costs (coefficient 6688). Other variables influencing labour costs include Quantity of municipal waste (coefficient 1.56), Sorting cost (coefficient 0.13), and Vehicle cost (coefficient 0.01). Conversely, labour costs are negatively influenced by Quantity of sorted waste (coefficient -21).

4 Discussion

In the circular economy, secondary raw materials are essential for minimising waste and maximising resources utilisation, which, in turn, fosters innovation, creates new business opportunities, and drives economic growth. By using secondary raw materials, the EU reduces its dependence on the import of primary resources necessary for industrial production and mitigates related geopolitical risks. The following section of the paper addresses the formulated research questions.

RQ1: What is the average resale value of selected secondary raw materials within the EU?

This question aims to determine the average resale value of secondary raw materials that support the development of the circular economy and enable cities and companies to better plan and make strategic decisions regarding the optimisation of recycling processes and material reuse in waste management. The analysis shows that in 2021, the most valuable secondary raw material was plastic (400 EUR/t), followed by sorted paper (175 EUR/t), and glass (67 EUR/t). As for glass, it shall be noted that the system of returnable beer bottles has been used for several decades in nearly all EU countries, with a recovery rate exceeding 95%. Bottles are reused 22 times on average within six to seven years before being recycled.

RQ2: How do selected smart technologies affect the costs of waste management in the selected urban centre?

The analysis examines the potential of smart technologies to significantly reduce the cost of waste management by increasing the effectiveness of waste collection and treatment, thereby contributing to the modernization of services and the improvement of waste management in urban centres. The analysis focused on the cost-effectiveness of four categories:

Operation of waste management companies accounts for 41% of the total costs, indicating that nearly 50% of all expenses are related to the operation and management of waste management companies.

Hardware accounts for 35% of the total costs and includes all physical components and equipment necessary for operations.

Software accounts for 14% of the total costs and encompasses all programs and applications used in operation.

Network connectivity is the smallest cost item, representing 10% of the total costs and includes the cost of internet connection and network maintenance.

The results indicate that the most significant financial burden is associated with the operation of waste management companies, while network connectivity is the least costly item.

RQ3: What are the projected financial savings in waste management in the selected urban centre?

Forecasting financial savings allows urban centres to better plan budget and allocate resources more effectively. Predictive models highlight opportunities to optimise and improve processes, aiding decision-making on investments in new technologies and infrastructure, and improving overall performance of waste management. Based on the results presented in this section of the paper, the development of financial savings in waste management for one of the selected urban centres in Slovakia were projected for a period of four quarters, i.e., for the whole year 2022.

Table 2 Forecasting financial savings development

30% savings	40% savings	55% savings
Wage		
decrease by EUR 3.8 million	decrease by EUR 5.1 million	decrease by EUR 7 million
labour costs – decrease by EUR 5.8 million	labour costs – decrease by EUR 7.7 million	labour costs – decrease by EUR 9 million

30% savings	40% savings	55% savings
Number of employees		
decrease by 152 employees	decrease by 203 employees	decrease by 279 employees
Cost of vehicle fleet		
decrease by EUR 4 million	decrease by EUR 8 million	decrease by EUR 7.3 million
Vehicle kilometres travelled		
decrease by 0.7 million km	decrease by 0.615 million km	decrease by 0.46 million km

Source: the authors

Labour costs. The cumulative forecast for the year 2022 is projected to be below EUR 12.8 million. A 30% reduction would lead to savings of EUR 3.8 million, bringing total labour costs down to EUR 9 million. A 40% reduction would decrease costs by EUR 5.1 million, resulting in total labour costs of EUR 7.7 million. The largest reduction, 55%, would yield savings of over EUR 7 million, lowering the total wage bill down to just under EUR 5.8 million.

In the category of labour costs, changes in the minimum wage, which affects Saturday and public holiday allowances (especially for service staff), may lead to wage increases beyond those stipulated in the collective agreement.

Number of employees. In calculating potential staff reductions, figures for service staff have been used, as the implementation of smart technologies is expected to have a greater impact in this category. As the adoption of smart technologies increases, there will be a growing need for administrative staff to manage data, ensure its accuracy, and review routes for collecting bins.

The average number of service staff projected for the year 2022 is 508. With a 30% reduction, the number of staff would decrease by 152 (to 356). A 40% reduction would decrease the number of employees by 203, leaving 305 employees. A 55% reduction would lead to a decrease of 279 employees, bringing the total down to 229. The crew typically consists of one driver and two passengers, so the majority of the reductions would occur among the passengers, with fewer cuts among the drivers.

Cost of vehicle fleet. Fleet size, vehicle body size, motorization, and the energy efficiency of vehicles (mild-hybrids or all-electric vehicles in the future) are important factors in calculating projected and potential vehicle cost savings. The working hours of vehicle align with those of the driver – eight hours per day.

The forecast for 2022 is EUR 13.2 million. A 30% reduction would result in savings of just under EUR 4 million, reducing the total fleet cost to EUR 9.2 million. A 40% reduction would save EUR 5.3 million, bringing the total cost down to just under EUR 8 million. The largest saving (55%) would amount to over EUR 7.3 million, lowering total vehicle fleet costs to just under EUR 6 million.

Vehicle kilometres travelled. The number of kilometres travelled by vehicles is directly related to the efficiency of service routes. The more efficiently the routes are planned, the greater the overall efficiency. Currently, routes are planned according to fixed collection days. The application of smart technologies would introduce a dynamic approach, allowing for daily route planning instead of quarterly scheduling.

The total forecast exceeds 1 million kilometres. A 30% reduction would mean a decrease of 0.3 million kilometres, reducing the total distance to over 0.7 million kilometres. A 40% reduction would result in a decrease of 0.4 million km, bringing the total down to 0.615 million kilometres. The largest reduction, 55%, would lower the distance to less than 0.6 million kilometres, resulting in a total of 0.46 million kilometres.

The observed predictions indicate a positive trend across all variables, highlighting the potential benefits of cost savings in each of the areas analysed. This will have a positive impact on the profitability of the company under review. Smart technologies hold significant potential for reducing costs associated with waste collection, transportation, and treatment. Their implementation can bring substantial savings, improved service quality, and reduced environmental impact. However, the success of these technologies depends on their effective implementation, integration into existing systems, and the resolution of potential challenges.

These findings offer several benefits for *waste management professionals*:

- An overview of data on secondary raw material prices enables cities and companies to better anticipate future trends and prepare for potential market fluctuations, aiding more effective planning and sales of recycled materials.
- Monitoring the level of municipal waste sorting provides crucial insights to help meet legislative requirements, enhance waste management efficiency, improve public image and community engagement, thereby fostering trust and support from

residents and customers and promoting the circular economy.
- The proposed predictive model will allow cities and companies to better plan financial budgets and allocate resources efficiently, thereby reducing the overall financial burden associated with waste management.

For *environmental policymakers,* the study highlights the inconsistent implementation of smart technologies in waste management across various municipalities and the delays in reporting on their deployment. Therefore, policymakers are advised to:

- Develop and implement strategic plans tailored to the specific needs of individual municipalities in implementing smart technologies in waste management.
- Establish and promote uniform standards and regulations for the implementation of smart technology.
- Introduce systems of regular monitoring and evaluation of smart technology efficiency to ensure optimal functionality and identify areas for improvement.
- Create mechanisms for the timely and transparent dissemination of information regarding smart technology implementation, ensuring accessibility for all stakeholders.

For researchers, this study contributes to the growing body of knowledge in the area of waste management, recycling, and the circular economy, especially in the context of the transition from Smart City 3.0 to Smart City 4.0. The findings may inspire the development of new technologies and innovative approaches to enhance waste management practices and boost recycling rates.

Conclusion

Smart technologies play a key role in the implementation of sustainable business practices and support of CSR initiatives by helping cities and companies to achieve environmental and social objectives. Integrating these technologies into business and environmental strategies enables companies and cities to effectively respond to contemporary challenges, optimise resource utilisation, reduce environmental impact, and improve quality of life. The concept of Smart City represents a fundamental shift in urban planning, where technology, data, and innovation are combined to create efficient, sustainable, and liveable cities. While this concept has been successfully implemented in multiple countries for several years, the extent and depth of these solutions vary significantly. Therefore, direct comparisons between cities with the implemented Smart City concept are not feasible; instead, individual elements should be compared. Waste management is currently undergoing significant transformations, particularly in terms of standardisation and legislative uniformity across the European Union.

The research aimed to analyse the impact of smart technology implementation on financial savings in a specific urban centre in Slovakia. This objective was achieved through the proposed econometric model, which enabled the forecasting of financial savings in this centre resulting from the adoption of smart technologies in waste management.

The theoretical section provides an overview of the historical development of the Smart City concept in the context of waste management. The empirical section of the research demonstrated that, by comparing the average resale value of selected secondary materials in the EU, plastic emerged as the most expensive secondary material in the analysed period (400 EUR/t). The high price of plastic can be attributed to its complex processing and the growing demand for recycled plastic, which finds its use across many industries throughout the whole European Union, thereby increasing its economic value.

Further research findings revealed that the largest share of the total costs in waste management is attributed to the operation of waste management companies, accounting for 41%. This high percentage is due to the costs associated with day-to-day management and operations, including labour costs, maintenance costs, and other operational expenditures essential for the effective functioning of these companies. The second-largest cost category is hardware, representing 35% of the total costs, encompassing all physical smart devices necessary for operations, such as smart containers, separation machines, and other technical equipment. This share reflects the high costs of purchasing, maintaining, and modernizing hardware, which is crucial for effective waste treatment and management.

The research also focused on forecasting financial savings in waste management for a selected urban centre at savings levels of 30%, 40%, and 55%. The areas analysed were labour

costs, vehicle fleet costs, number of employees, and vehicle kilometres travelled.

This study offers several benefits for researchers, expanding knowledge in the field of waste management within the context of Smart City 4.0. For practitioners in the field of smart city development, the study provides an overview of secondary material prices in the European market, insights into the pricing of municipal waste based on the level of sorting in Slovakia, and the potential for financial savings in waste management using the proposed and tested predictive model. For policymakers, the study advises the implementation of strategic plans that consider the specific needs of various municipalities when adopting smart technologies and the establishment of mechanisms for timely and transparent disclosure of information on the implementation.

The research had several limitations. First, there is a time lag in the public availability of information on the effects of smart technology implementation. Second, the research was not conducted across the entire waste management sector or multiple municipalities; instead, the savings of individual items were analysed in a smaller sample. This is because individual municipalities do not consistently require waste collection companies to implement the smart technologies addressed in this research. Third, there was limited digitization and use of smart technologies in waste management, except in a few cases.

Further research could expand the research sample to include multiple urban centres in Slovakia and other European countries, particularly after the necessary legislation is enacted to encourage companies in waste collection, treatment and disposal to adopt uniform current smart technologies and disclose up-to-date information related to their implementation. Additionally, there should be an obligation to implement automated weighing systems, including the availability of precise pricing for waste collection. This would allow consumers to better understand their waste bin usage and ecological print, thereby encouraging more effective waste sorting and contributing to the recovery of natural capital.

Further research could also focus on marketing communication between waste management companies and the public, with the aim to provide information about new smart solutions and educate and incentivise both the public and the industrial sector to sort waste more effectively and minimise landfill and municipal waste.

Declarations

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Funding

This article is one of the partial outputs of the currently implemented research grant VEGA no. 1/0110/24. This article is one of the partial outputs of the currently implemented research project IVSUPS2302.

Acknowledgements

Not applicable.

References

Abdul, B., Jing, Z., Wang, L., & Rabeeu, A. (2024). Assessing the impact of employee-centric digital transformation initiatives on job performance: The mediating role of digital empowerment. *Strategic Management, 29*(2), 5-18. https://doi.org/10.5937/straman2300057r

Alderete, M. V. (2020). Exploring the Smart City Indexes and the Role of Macro Factors for Measuring Cities Smartness. *Social Indicators Research, 147*(2), 567-589. https://doi.org/10.1007/s11205-019-02168-y

Alvarez-Alonso, C., Perez-Murcia, M. D., Sanchez-Mendez, S., Martunez-Sabater, E., Irigoyen, I., Lopez, M., Nogues, I., Paredes, C., Orden, L., Garcia-Randez, & Bustamante, M. N. (2023). Municipal Solid Waste Management in a Decentralized Composting Scenario: Assessment of the Process Reproducibility and Quality of the Obtained Composts. *Agronomy*, *14*(1), 54. https://doi.org/10.3390/agronomy14010054

Bikar, M., Sedliacikova, M., Vavrova, K., Moresova, M., & Hitka, M. (2018). Does the Combustion of Biomass Increase the Efficiency of Heating Companies? Evidence from Slovakia. *BioRes*, *13*(2), 2452-2472. https://doi.org/10.15376/biores.13.2.2452-2472

Brydges, T., Henninger, C. E., & Hanlon, M. (2022). Selling sustainability: Investigating how Swedish fashion brands communicate sustainability to consumers. *Sustainability: Science, Practice and Policy, 18(1),* 357-370. https://doi.org/10.1080/15487733.2022.2068225

Cajkova, A., Jankelova, N., & Masar, D. (2021). Knowledge management as a tool for increasing the efficiency of municipality management in Slovakia. *Knowledge Management Research & Practice, 21*(2), 292-302. https://doi.org/10.1080/14778238.2021.1895686

Chen, Y., Chen, S., & Miao, J. (2024). Does smart city pilot improve urban green economic efficiency: Accelerator or inhibitor. *Environmental Impact Assessment Review,* 104, 107328. https://doi.org/10.1016/j.eiar.2023.107328

Dorcak, P., Strach, P., & Pollak, F. (2015). Analytical view of the perception of selected innovative approaches in marketing communications. *Quality Innovation Prosperity, 19*(1), 74-84. https://doi.org/10.12776/qip.v19i1.441

Dzator, J., Acheampong, A. O., & Dzator, M. (2022). Urbanisation and Sustainable Development: Econometric Evidence from Australia. In T. Chaiechi, & J. Wood (Eds.), *Community Empowerment, Sustainable Cities, and Transformative Economies* (pp. 95–109). Singapore: Springer. https://doi.org/10.1007/978-981-16-5260-8_7

European Commission (2016, July 6). *Global Human Settlement – Global Visualisation.* https://ghsl.jrc.ec.europa.eu/visualisation.php

Eurostat (2022). Recycling – secondary material price indicator. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Recycling_%E2%80%93_secondary_material_price_indicator#Average_prices_and_trade_volumes

Fastcompany (2015). The 3 Generations Of Smart Cities. https://www.fastcompany.com/3047795/the-3-generations-of-smart-cities

Fedushko, S., Ustyianovych, T., & Gregus, M. (2020). Real-Time High-Load Infrastructure Transaction Status Output Prediction Using Operational Intelligence and Big Data Technologies. *Electronics, 9*(4), 668. https://doi.org/10.3390/electronics9040668

Fernandez-Anez, V., Fernandez-Guell, J. M., & Giffinger, R. (2018). Smart City implementation and discourses: An integrated conceptual model. The case of Vienna. *Cities, 78*, 4-16. https://doi.org/10.1016/j.cities.2017.12.004

Ferreira, A., Pinto, B., Vieira, B., Vieira, E., Rodrigues, P., Lopes, J., & Canavarro, A. (2024). Changes in the fashion industry and consumer choices in the Portuguese context: strategic directions. *Strategic Management, 29*(2), 59-75. https://doi.org/10.5937/straman2300061f

Gasser, L., Le Gall, F., & Abily, M. (2024). Water efficiency in smart cities: optimising irrigation for public green spaces. *LHB: Hydroscience Journal, 110*(1). https://doi.org/10.1080/27678490.2023.2294076

Giela, M. (2023). The Human Element in the Context of Smart Cities. Management Systems in Production *Engineering, 31*(3), 300-305. https://doi.org/10.2478/mspe-2023-0033

Global Education (2024). Inteligentné mestá. https://globalnevzdelavanie.sk/inteligentne-mesta/

Grosu, V., Chelba, A., Melega, A., Botez, D., & Socoliuc, M. (2023). Bibliometric analysis of the literature on evaluation models of the bankruptcy risk. *Strategic Management*, *28*(2), 21-44. https://doi.org/10.5937/straman2200035g

Human Smart City (2019). Smart city Industry. https://smart.przemysl.eu/55927/miasto-inteligentne-czyli-jakie.html

Institute of Economic and Social Studies (2023, November 30). Slovensko v urbanizácii zaostáva, počet Slovákov žijúcich v mestských centrách sa znížil o štvrtinu. https://www.iness.sk/sk/slovensko-v-urbanizacii-zaostava-pocet-slovakov-zijucich-v-mestskych-centrach-sa-znizil-o-stvrtinu

Jose, R., & Rodrigues, H. (2024). A Review on Key Innovation Challenges for Smart City Initiatives. *Smart Cities, 7*(1),141-162. https://doi.org/10.3390/smartcities7010006

Joyce, A., & Javidroozi, V. (2024). Smart city development: Data sharing vs. data protection legislations. *Cities, 148*, 104859. https://doi.org/10.1016/j.cities.2024.104859

Khurshudov, A. (2024). The smart city conundrum: technology, privacy, and the quest for convenience. *Smart and Sustainable Built Environment*. https://doi.org/10.1108/sasbe-12-2023-0377

Kumar, M., & Singh, A. (2022). Probabilistic data structures in smart city: Survey, applications, challenges, and research directions. *Journal of Ambient Intelligence and Smart Environments, 14*(4), 229-284. https://doi.org/10.3233/ais-220101

Markovic, P., Pollak, F., Vavrek, R., & Kostiuk, Y. (2022). Impact of Coronavirus Pandemic on Changes in e-Consumer Behaviour: Empirical Analysis of Slovak e-Commerce Market. *Ekonomický Časopis, 70*(4), 368-389. https://doi.org/10.31577/ekoncas.2022.04.04

Ministerstvo životného prostredia SR (2018). Program predchádzania vzniku odpadov Slovenskej republiky na roky 2019–2025. https://www.minzp.sk/files/sekcia-enviromentalneho-hodnotenia-riadenia/odpady-a-obaly/registre-a-zoznamy/ppvo-sr-19-25.pdf

Ministerstvo životného prostredia SR (2019). Greener Slovakia: Strategy of the Environmental Policy of the Slovak Republic until 2030. https://www.minzp.sk/files/iep/greener_slovakia-strategy_of_the_environmental_policy_of_the_slovak_republic_until_2030.pdf

Ministerstvo pro místní rozvoj ČR (2018). Metodika Smart Cities: Metodika pro přípravu a realizaci konceptu Smart Cities na úrovni měst, obcí a regionů. https://mmr.gov.cz/getmedia/f76636e0-88ad-40f9-8e27-cbb774ea7caf/metodika_smart_cities.pdf.aspx?ext=.pdf

Neumannova, M. (2020). Měření chytrosti měst dle indexů smart city: komparativní regionální analýza Visegrádské skupiny. In V. Klímová, & V. Žítek (Eds.) *23rd International Colloquium on Regional Sciences* (pp. 230–235). Brno: Nakladatelství Masarykovy univerzity. https://doi.org/10.5817/cz.muni.p210-9610-2020-29

Olah, J., Aburumman, N., Popp, J., Khan, M. A., Haddad, H., & Kitukutha, N. (2020). Impact of Industry 4.0 on Environmental Sustainability. *Sustainability, 12*(11), 4674. https://doi.org/10.3390/su12114674

Paetsch, M., Dorcak, P., Pollak, F., Strba, U., & Krsak, B. (2017). Developing a Framework for Future Mobile Data Pricing. *Quality Innovation Prosperity, 21*(2), 84-108. https://doi.org/10.12776/qip.v21i2.759

Pollak, F., Dorcak, P., & Markovic, P. (2021). Corporate Reputation of Family-Owned Businesses: Parent Companies vs. Their Brands. *Information, 12*(2), 89. https://doi.org/10.3390/info12020089

Prentice, C., Quach, S., & Thaichon, P. (2020). Antecedents and consequences of panic buying: The case of COVID-19. *International Journal of Consumer Studies, 46*(1), 132-146. https://doi.org/10.1111/ijcs.12649

Sadjadi, E. N. (2024). The recovery plans at the time of COVID-19 foster the journey toward smart city development and sustainability: a narrative review. *Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-023-04314-6

Sadjadi, E. N., & Fernández, R. (2023). Challenges and Opportunities of Agriculture Digitalization in Spain. *Agronomy, 13*(1), 259. https://doi.org/10.3390/agronomy13010259

Shin, S. Y., Kim, D., & Chun, S. A. (2021). Digital Divide in Advanced Smart City Innovations. *Sustainability, 13*(7), 4076. https://doi.org/10.3390/su13074076

Skills 4 cities (2021). Skills for smart cities. https://www.skills4cities.eu/the-project.html

Slavkovic, M., & Miric, M. (2024). Do employees benefit from employer branding strategy? The mediator role of affective commitment. *Strategic Management, 29*(2), 32-47. https://doi.org/10.5937/straman2300051s

Ubiparipovic, B., Matkovic, P., & Pavlicevic, V. (2023). Key activities of digital business transformation process. *Strategic Management, 28*(1), 33-40. https://doi.org/10.5937/straman2200016u

United Nations, Department of Economic and Social Affairs. (2018, May 16). *68% of the world population projected to live in urban areas by 2050, says UN*. https://bit.ly/3TPiztq

United Nations, Department of Economic and Social Affairs. (2014, July 10). *2014 revision of the World Urbanization Prospects*. https://www.un.org/en/development/desa/publications/2014-revision-world-urbanization-prospects.html

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Vasic, M., Duica, M., Berber, N., Enukidze, N., Vasic, S., & Weis, L. (2023). Migrant workers and workforce integration: Challenges for managers in European companies. *Strategic Management, 28*(2), 64-77. https://doi.org/10.5937/straman2200027v

Venter, Z. S., Aunan, K., Chowdhury, S., & Lelieveld, J. (2020). COVID-19 lockdowns cause global air pollution declines. *Earth, Atmospheric, and Planetary Sciences, 117*(32), 18984-18990. https://doi.org/10.1073/pnas.2006853117

Vilagi, R., Konecny, M., & Ruschak, M. (2022). Impact of selected financial indicators on a company's reputation. *Entrepreneurship and Sustainability Issues, 10*(2), 408-417. https://doi.org/10.9770/jesi.2022.10.2(25)

Yigitcanlar, T., Xia, B., Cortese, T. T. P., & Sabatini-Marques, J. (2023). Understanding City 4.0: A Triple Bottom Line Approach. *Sustainability, 16*(1), 326. https://doi.org/10.3390/su16010326

Zhao, L., Tang, Z. Y., & Zou, X. (2019). Mapping the Knowledge Domain of Smart-City Research: A Bibliometric and Scientometric Analysis. *Sustainability, 11*(23), 6648. https://doi.org/10.3390/su11236648

STRATEGIC MANAGEMENT, Vol. 30 (2025), No. 4, pp. 060-070

DOI: 10.5937/StraMan2300041P

Received: September 20, 2022
Revised: December 04, 2022
December 06, 2022
Accepted: December 10, 2022
Published online: March 20, 2023

Profitability determinants of life insurance companies in the Republic of Serbia

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Abstract

Background: Based on the results of research on the influence of certain internal and external factors on the profitability of insurance companies in the countries in Europe, America, Asia and Africa in the 21st century which were published in a significant number of scientific and professional papers, the present study analyses insurance companies in Serbia in the period from 2015 to 2021. We chose this analysis bearing in mind the previous negative experiences and expressed distrust in the financial system, which greatly affected the readiness of policyholders to invest in life insurance products, as well as affecting significantly the development of life insurance in Serbia.

Purpose: The aim of the paper is to present the business results of the insurance companies on the Serbian market in the analysed period and to determine which business performance the management of an insurance company should pay attention to in order to ensure positive business results.

Study design/methodology/approach: We applied a fixed effects model on the nine selected variables. In the model, return on assets (ROA) is used as a dependent variable, while operating margin, expense ratio, investment ratio, growth rate of written premium of a company, company size, log (financial leverage), log (liquidity ratio), and market share are independent variables.

Findings/conclusions: The results of the research indicate that there is a statistically significant and positive impact of operating margin and liquidity ratio on ROA, and statistically significant but negative impact of expense ratio and financial leverage on ROA.

Limitations/future research: The limitation of our profitability analysis is that we were unable to analyse the impact of individual life insurance products on profitability. Bearing in mind numerous and significant social and economic changes over the last two years, the directions of our future research will be focused on their impact on the business operation of insurance companies.

Keywords

life insurance; profitability; insurance companies; fixed effects model

Introduction

In the paper, we examine the impact of market share as an external factor and selected internal factors listed in annual financial statements on the profitability of business operations of companies dealing with life insurance in Serbia. This topic is especially relevant when taking into account the research related to the mutual connection between the development of the insurance market and economic growth, including Mitrašević, Pjanić & Novović Burić (2022), and the fact that the offer of

life insurance products is a significant factor in the development of the insurance market conditioned by the profitability of the business. The significance of the topic is also confirmed by the observed trend of the development of the life insurance market in Serbia shown in the research Ostojić (2014) and Pjanić, Kalaš, Vasić (2016), covering the period before and after the outbreak of the global economic crisis.

A large number of scientific papers have analysed the impact of specific business factors on the profitability of insurance companies expressed through return on assets (ROA). In the literature review we have selected the papers that use correlation and regression analysis on panel data in some countries in Europe, America, Asia and Africa in the 21st century. The indicators that can negatively affect business results are profitability decline, sales volume decline, increase in indebtedness, liquidity decline, decease in market share, and company size. The aforementioned analysis, combined with the analysis of economic and social factors (Cicea et al., 2019), can serve as a part of a systematic process for obtaining valid information on the performance of the organization and the factors that influence performance, which is explained in more detail in Heather & Brian (2021). The research of Ahmed, Xie & Issam (2021) proves its importance from the aspect of life insurance companies, in which it is claimed that lower investor confidence has a negative impact on the demand for life insurance. Actually, one should bear in mind the advantage of modern information technologies to provide data and data processing and, as Norikumo (2021) emphasises, to increase customer satisfaction as well.

In most papers, return on assets (ROA) indicator is used as a measure of profitability calculated as the ratio of net results (profit/loss) and average assets in the observed year. Return on equity (ROE) indicator is often used as well and it represents the ratio of net profit in a certain period and the equity of insurers.

Operating ratio is often used as a measure of the profitability of business operations of insurance companies, which expresses the amount of profit from insurance and investment business activities that a company realizes per premium. The results of Hussanie & Bashir (2019) show that this ratio had a statistically significant positive impact on life insurance companies in India in the period 2005-2015. The profitability of insurers is determined by the performance of insurance business (claims ratio and expense ratio) and investment performance. Expense ratio is obtained as the ratio of operating expenses and premium retention. Operating expenses include acquisition costs, administration costs, and other transaction-related costs. Small expense ratio does not always mean that a company has good business performance. In some cases, this may indicate that small amount of resources is allocated to the expenses which can lead to negative selection and result in high insurance premiums (Mitrašević, 2010).

Due to this time lag between the receipt of premiums and the payment of insured amounts, an insurer creates technical reserves, which it invests in various types of assets, earning return on investment. A longer time lag between the collection of insurance premiums and the payment of claims enables the growth of investment results. Extremely low interest rates have caused a number of undesirable consequences to a large number of industries, especially life insurance companies which invest a significant part of technical reserve funds in bonds and deposits. The impact of changes in interest rates on the balance sheet and income statement depends on the extent to which this type of assets has been used to cover liabilities, as well as on the quality of cash flow and the maturity of assets and liabilities. Regardless of the fact that Serbia has switched to a market-oriented economic system, it has failed to sufficiently develop its capital market (Leković et al., 2020). The results of the research of Kočović et al. (2014) indicate that the investment ratio had a statistically significant positive effect on non-life insurance companies in Serbia.

The growth of premiums affects the market share of insurance companies and also enables the reduction of the relative share of fixed costs and thus achieves the benefits of economies of scale. In the papers by Pjanić et al. (2018) and Kočović et al. (2014), the positive impact of premium growth on ROA in non-life insurance companies in Serbia is illustrated. Unlike the aforementioned papers that dealt with the profitability of non-life insurance companies in Serbia, in our research, we will examine the key profitability factors of life insurance companies. In doing so, we focused on the factors of the internal environment. This research is immensely important both from the perspective of the managers and persons who have a stake in the ownership of the companies that operate in still underdeveloped Serbian life insurance market, as well as from the perspective of the persons who are interested in investing in life insurance products.

Numerous empirical studies show that large companies are better positioned in the market and have a greater impact. In accordance with the Law on Accounting ("Official Gazette of RS", no. 73/2019 and 44/2021 - other law) the average number of employees, operating income and total assets are used as criteria for classification of legal entities. A positive statistically significant impact of company size on ROA is also shown in Meher & Zewud 2020.

Financial leverage reflects the ability of an enterprise to have impact on the size of its profits by changing its long-term capital structure. It involves selecting and balancing the proportion between equity and borrowed funds, taking into account the degree of risk to ensure an acceptable level of return on equity. When observing this indicator, insurance companies should have regulatory capital requirements aimed at reducing the probability that an insurer will not be able to meet its obligations to policyholders. Moreover, the specificity of the business operations of insurance companies is reflected in the fact that the largest items of liabilities are technical reserves generated to settle liabilities to policyholders. The results of Meher & Zewudu (2020) in the Ethiopian market in the period from 2002 to 2016 showed that financial leverage has a significant negative impact on ROA.

For an insurance company to provide liquidity, i.e. to be able to meet liabilities on time, it is necessary to take into account the structure and quality of assets and the maturity of assets and liabilities. The liquidity of an insurance company is determined as the ratio between liquid assets and liabilities. While Pjanić et al. (2018) prove that liquidity ratio does not have a statistically significant impact on ROA in the non-life insurance market in Serbia, Hussanie & Bashir (2019) claim that this impact is statistically significant but negative.

Market share is the company's position in the market in relation to its competitors and is determined as the share of gross premiums in the total premium of the market as a whole. The research by Meher & Zewudu (2020) indicated that market share has a statistically significant positive impact on ROA.

After reviewing the literature, we are going to define the methodology and describe the used variables, and then the empirical results are going to be presented and discussed at the end of the paper followed by concluding remarks.

1. Literature review

The analysis of the influence of certain internal and external factors on the profitability of insurance companies is presented in a large number of scientific papers. In the following table, we have selected the papers coming from a large number of countries that use correlation and regression analysis on panel data.

Table 1 Analysis of previous literature

Authors/ Paper	Sample/ Countries	Variables	Method
NON-LIFE INSURANCE COMPANIES			
Pjanić et al. (2018)	Serbia (2010-2015)	**Dependent Variable:** ROA **Independent Variables:** Asset growth (Log of total assets), Company growth (Assets growth), Premium growth (Premium t – premium t-1)/ premium t-1, Liquidity ratio (Current assets/Current liabilities), Debt ratio (Total equity/Total assets), Operating costs (Salary costs/Written premium), Underwriting risk (Gross (net) premiums/Equity), Financial leverage (Total debt/Equity) Profit growth (Net result/ Total revenue), Constant, Error –	Multiple linear regression without panel analysis
Olarewaju& Msomi, (2021).	South African Development Community (2008 -2019) 56 companies	**Dependent Variable:** ROA **Independent Variables:** Business's Value Added ((Operating Profit, Employee Cost, Depreciation And Amortisation Cost)/Capital), Total Employee Cost, Value Creation Process, Underwriting Risk, Leverage Ratio (Total Debt/ Total Asset), Size (Logarithm Of Total Assets)	Static (two stage least square, fixed and random effect) and dynamic panel regression analysis (two step system generalised method of moments)
Zhao et al. (2021)	China (2013-2017) 53 companies	**Dependent Variable:** Profit Ratio Efficiency (PE) **Independent Variables:** Asset (Natural Logarithm Of The Total Asset), Product Diversification, Firm Age	Tobit regression analysis
Ofori-Boateng et al. (2022)	Ghana (2008–2019) 29 companies	**Dependent variable:** ROA **Independent variables:** market structure, efficiency scores (DEA methodology), GDP growth, inflation, Size, Risk, Leverage	Least Squares Panel-Corrected Standard Errors (OLS-PCSE)

Authors/ Paper	Sample/ Countries	Variables	Method
Bhattar (2020)	Nepal (2012- 2017) 10 companies	**Dependent variable:** ROA **Independent variables:** Expenses Ratio, Financial Leverage and Size of Company	Multiple regression analysis
Kočović et al., (2014)	Serbia (2006-2013) 12 insurance companies	**Dependent variables:** ROA **Independent variables:** number of years the company has operated in the Serbian insurance market, combined ratio of the company, percentage growth rate of written premium of company, Hirschman index, investment ratio, leverage of company (percentage ratio of technical reserves and capital), liquidity ratio (percentage ratio of current assets less inventories and current liabilities), retention rate (percentage ratio of net earned premium and gross earned premium of the company), size of the company.	Multiple linear regression
Kaya (2015)	Turkey (2006–2013) 24 companies	**Dependent variables:** technical profitability ratio, sales profitability ratio; **Independent variables:** size of the company; age of the company; loss ratio; insurance leverage ratio; current ratio; premium growth rate; motor insurance (including land vehicle and land vehicle liability branches); premium retention ratio	Fixed effects models
LIFE and NON-LIFE OR COMPOSITE INSURANCE COMPANY			
Pavić Kramarić et al. 2017	Croatia, Slovenia, Hungary and Poland (2010 – 2014)	**Dependent variables:** ROA and ROE, **Independent variables:** a) insurance company - specific factors (size (total gross written premium), type, share of reinsurance (share of premium ceded to reinsurance in total gross written premium), combined ratio, age, organizational form); b) structural factors (ownership) and, c) macroeconomic factors (real GDP per capita growth).	Static unbalanced panel data analysis
Camino-Mogro, &Bermúdez-Barrezua. (2019)	Ecuador 2001 to 2017 29 life and 38 non-life	**Dependent variable:** ROA, investment income, profit-after-taxes **Independent variables:** Net premium, technical reserves, Liquidity (current assets/current liabilities), Liabilities/Equity, Equity/Assets, Capital intensity, Labor intensity, Claims, Technical efficiency (DEA), Size, HHI Herfindahl−Hirschman index, Market share, credit volume, Cyclical output, Annual inflation, Annual placement interest rate, Control (Multinational, Bank related)	Panel corrected standard errors regression
Meher and Zewudu (2020)	Ethiopia (2002 to 2016) 17 companies	**Dependent variable:** ROA **Independent variables:** Company Size (total assets), Asset growth rate (Percentage change in total assets between the current year and previous year to the previous year), Underwriting risk (The ratio of net claims incurred to net premium earned), Volume of capital (total capital to total assets) Leverage (Total debts to total capitals) Liquidity (Current assets to current liabilities), Market share (Total gross written premium of an insurance company to total gross written premium of the industry at a given period), Gross domestic product per Capita, Annual inflation rate	Pearson's correlation and OLS regression model
Muchie & LiJuan (2021).	Ethiopia (2005 to 2020) 17 companies	**Dependent variable:** ROA **Independent variables:** Age, Size, Leverage, Asset Tangibility, Liquidity, Premium Growth, Loss Ratio, Reinsurance Dependence, GDP Growth, Inflation, Education, Trade Openness, Government Effectiveness, Monetary Freedom, And Exchange Rate	Fixed-effect model
Brogi et al. (2022)	SAD (2010–2018) 107 companies	**Dependent variable:** ESG (Environmental, social, and governance)scores **Independent variables:** Return on Assets; Solvency Ratio; Total Assets	Scoring and regression models
Morara& Sibindi (2021)	Kenya (2009-2018) 37 non-life and 16 life	**Dependent variable:** ROA and ROE **Independent variables:** Debt ratio, Reinsurance ratio, Investment ratio, Size of insurer, Age	Pooled ordinary least squares (POLS), fixed effects and random effects models.
Dorofti & Jakubik (2015)	30 European countries (2005-2012)	**Dependent variable:** ROA, ROE **Independent variables**: real GDP growth, unemployment rates, the stock market index, long-term interest rates, inflation rates and alternatively real interest rates calculated by the Fisher equation.	Dynamic panel estimation

Authors/ Paper	Sample/ Countries	Variables	Method
LIFE INSURANCE			
Shieh, Hu, & Ang (2020)	Mainland China and Taiwan (2005-2011)	**Input variables:** Total asset, Employee, Total equity **Output variables:** Insurance revenues, Investment revenues	Metafrontier and four-stage data envelopment analysis (DEA)
Ishtiaq and Siddiqui (2019)	Pakistan (2008 – 2017) 9 companies	**Dependent variables:** ROA **Independent variables**: Liquidity, Tangibility, Equity ratio (investment leverage), Debt to Equity Ratio, Insurance Leverage, Size, Premium Growth, Underwriting Risk, Capital adequacy ratio, External Variable, Gross Domestic Product, Inflation, Market Share	Panel ordinary least square regression and Panel generalized method of moment regression method

Source: the authors

Analysing the profitability of non-life insurance companies in the Republic of Serbia in the period from 2010 to 2015, by using multiple linear regression and independent variables: asset growth, company growth, premium growth, liquidity ratio, debt ratio, operating costs, underwriting risk, financial leverage and profit growth, Pjanić et al. (2018) indicated that premium growth, debt ratio, operating cost and profit growth positively and statistically significantly affected the profitability of non-life insurance companies.

Olarewaju & Msomi (2021) analyse the impact of intellectual capital on the financial performance of the insurance companies in the South African Development Community for the period 2008 to 2019. Their results indicate that intellectual capital, human capital and structural capital have a statistically significant and direct relationship with ROA. The selected control variables – underwriting risk, insurer size and leverage – have a statistically significant and inverse effect on ROA.

Zhao, Pei, & Pan (2021) use profit ratio efficiency calculated using DEA methodologies as a measure of profitability. The application of the Tobit regression method shows that company size has a U shaped relationship with profitability, and that product diversification has a positive effect on profitability. Additionally, the length of company's operation has a negative impact on profitability, which gives an advantage to newly established companies.

In the case of 29 non-life insurance companies in Ghana in the period 2008-2019, Ofori-Boateng, Ohemeng, Boro, & Agyapong (2022) apply Panel Corrected Standard Error and Random Effect techniques showing that leverage, inflation and underwriting risk have a statistically significant impact on profitability while company size does not have a statistically significant impact.

Based on the panel data of 10 Nepalese insurance companies in a five-year period using ordinary least square regression, Bhattar (2020) shows that expense ratio does not have a statistically significant influence on ROE, as a chosen indicator of profitability, while the influence of financial leverage and company size is statistically significant.

By applying multiple linear regression, Kočović et al. (2014) analysed the impact of independent variables, such as number of years of operating in the Serbian insurance market, combined ratio of a company, percentage growth rate of written premiums of company, Hirschman index, investment ratio, leverage of company, liquidity ratio, retention rate, size of a company on the profitability of non-life insurance companies in Serbia from 2006 to 2013. The results of this study indicated a statistically significant but negative impact of combined ratio, financial leverage and retention rate on the profitability of non-life insurance companies. Moreover, the results indicated that there was a statistically significant and positive impact of written premium growth rate, return on investment and company size on the profitability of non-life insurance companies in Serbia.

In the period from 2006 to 2013, by using fixed effects model, Kaya (2015) examined the impact of independent variables: the size of a company, the age of a company, loss ratio, insurance leverage ratio, current ratio, premium growth rate, motor insurance (including land vehicle and land vehicle liability branches), premium retention ratio on the profitability of non-life insurance companies in Turkey. Empirical results showed that the size of a company, the age of a company, loss ratio, current ratio, and premium growth rate affected the profitability of non-life insurance companies. At the same time, there was a statistically significant and positive relationship between the size of a company and premium growth rate and profitability. On the other hand, there was a statistically significant but negative relationship between the age of a company, loss ratio, current ratio, and profitability.

Analysing the profitability of insurance companies in the selected countries of Central and Southeast Europe (Croatia, Poland, Hungary, and Slovenia) in the period from 2010 to 2014, by using panel analysis and variables of a) insurance company-specific factors (size (total gross written premium), type, share of reinsurance (share of premium ceded to reinsurance in total gross written premium), combined ratio, age, organizational form); b) structural factors (ownership) and, c) macroeconomic factors (real GDP per capita growth), Pavić Kramarić et al. (2016) outlined that the variable age and GDP positively affected the profitability of insurance companies.

A similar study using panel analysis was conducted in Ecuador in the period from 2001 to 2017 by using a large number of micro and macro variables, where the obtained results indicated that micro variables net premiums, technical reserves, capital ratio and score efficiency had a significant impact on business insurance companies, while in non-life insurance companies claim level and liquidity ratio had a significant impact on business performance. Out of macro variables, interest rate had a significant impact on the operations of both life and non-life insurance companies, while Herfindahl–Hirschman concentration index had a significant impact on the profitability of life insurance companies (Camino-Mogro & Bermúdez-Barrezueta, 2019).

In Ethiopia in the period from 2002 to 2016, while analysing the impact of both micro and macro variables, Meher & Zewudu (2020) indicated that size, market share, GDP per capita and asset growth had a positive and statistically significant impact on the profitability of insurance companies, and underwriting risk had a negative and statistically significant impact on profitability. The volume of capital, liquidity, and inflation showed a positive relationship with profitability that was not statistically significant, while leverage showed a negative relationship with profitability that was not statistically significant as well.

As for 17 insurance companies in Ethiopia in the period 2005-2020, by using the regression analysis, Muchie & LiJuan (2021) conclude that leverage ratio, liquidity ratio and the tangibility of assets have a negative impact on ROA, while company's age and market share premium growth have a positive impact. Moreover, their results display that capital adequacy ratio and reinsurance dependency do not have a statistically significant impact on profitability.

Based on 107 large, listed US insurance companies for the period 2010–2018, Brogi et al. (2022) find a connection between profitability and solvency of insurance companies and environmental, social, and governance awareness.

Morara & Sibindi (2021) investigate the determinants of profitability of 37 general insurers and 16 life insurers for the period running from 2009 to 2018 in Kenya. The results of pooled OLS, fixed effects and random effects models demonstrate a positive influence of company size and leverage on insurer financial performance and a negative influence of a company's length of business operation.

The specificity of the research conducted by Dorofti & Jakubik (2015) on a sample of 30 European countries was reflected in the analysis of the impact of only macroeconomic variables on the profitability of insurance companies. The empirical results indicated that low interest rates with limited economic growth, poor capital market performance and high inflation negatively affected the profitability of insurance companies.

Applying the metafrontier and four-stage data envelopment analysis (DEA) on life insurance companies in mainland China and Taiwan from 2005 to 2011, Shieh, Hu, & Ang (2020) come to the conclusion that environmental factors have a statistically significant influence on the efficiency of the analysed insurance companies.

Ishtiaq and Siddiqui (2019) apply regression analysis on 9 life insurance companies in Pakistan in the period from 2008 to 2017, and their results show a positive influence of liquidity, insurance risk, equity capital and inflation, as well as negative influence of market share, insurance leverage and GDP on the financial performance of the life insurance companies in Pakistan.

2. Methodology and data

The first phase of our research involved analysing the features of the Serbian insurance market in order to choose the time frame within which we will examine the influence of internal and external factors on the profitability of the life insurance companies. In 2021, 4 reinsurance companies and 16 insurance companies operated on the insurance market of Serbia. The research will focus on the business results of 4 insurance companies that were exclusively engaged in life insurance and 6 composite companies, i.e. the companies that performed both life and non-life insurance in 2021 not including the company that in the chosen period 2015- 2021 ceased to operate.

In the second phase of the analysis, we selected the variables that we would use in the analysis of the impact on return on assets, as the selected indicator of profitability. For this purpose, based on the previous researches in this area, in addition to operating margin, expense ratio and investment ratio, we chose the indicators of liquidity, indebtedness, company size and market share, as well as growth rate of written premium. As a secondary source of data, we used the balance sheets and income statements of the companies listed on the website of the National Bank of Serbia (www.nbs.rs) which also supervises the insurance sector in Serbia.

The description of the variables that we will use in the research is shown in the following table.

Table 2 Dependent and independent variables

Acronym	Variable	Calculation method
ROA	Return on assets (%)	(Profit after tax $_t$ /Total assets $_t$)•100
OM	Operating margin (%)	(Net Operating Income $_t$ / Net earned premium $_t$)•100
ER	Expense ratio (%)	(Operating expenses $_t$ / Net earned premium $_t$)•100
IR	Investment ratio (%)	(Investment return $_t$ /Net earned premium $_t$)•100
GR	Growth rate of written premium of company (%)	(Life premiums written$_t$ / Life premiums written $_{t-1}$-1)•100
S	Company size	Log (Total Assets $_t$)
FL	Log (Financial leverage)	Log (Total debt $_t$ /Equity $_t$)
L	Log (Liquidity ratio)	Log (Current Assets $_t$ / Current Liabilities $_t$)
Ms	Market share (%)	(Life premiums written$_t$ /Total Life premiums written $_t$)•100

Source: the authors

In the previous table, net earned premium in composite companies also includes non-life insurance premiums.

Before we move on to the third phase of the research in which we select the appropriate panel model, after the descriptive analysis, the correlation analysis will be presented to establish the presence of multicollinearity and detect whether the selected variables are suitable for conducting regression analysis.

Afterwards, we will conduct tests aimed at choosing between three panel models: pooled model, fixed effects model, and random effect model. By using F-test we are going to check whether pooled model or fixed effects model is more suitable while using the software package R. The test will confirm whether there are fixed effects. In the case of rejecting null hypothesis, we can conclude that fixed effects model is more adequate.

In order to make a choice between fixed model and random effect model, Hausman test along with EViews software package will be used. If the test shows that we should reject null hypothesis, we can conclude that fixed effects model is a better choice (Gujarati, 2004).

We base our research on the following hypotheses:

Hypothesis 1: Growth of operating ratio has a positive impact on ROA

Hypothesis 2: Growth of expense ratio has a negative impact on ROA

Hypothesis 3: Growth of investment ratio has a positive impact on ROA

Hypothesis 4: Growth of gross written premium has a positive impact on ROA

Hypothesis 5: Growth of an insurance company has a positive impact on ROA

Hypothesis 6: Growth of debt-to-equity ratio has a negative impact on ROA

Hypothesis 7: Growth of liquidity ratio has a positive impact on ROA

Hypothesis 8: Growth of market share has a positive impact on ROA

Linear panel model used in this paper has the following form:

$$ROA_{it} = \alpha_{it} + \beta_1 OM_{it} + \beta_2 ER_{it} + \beta_3 IR_{it} + \beta_4 GR_{it} + \beta_5 Sit + \beta_6 FL_{it} + \beta_7 L_{it} + \beta_8 MS_{it} + u_{it}:$$

α_{it}- intercept,

β_{1it} – regression coefficient of explanatory variable,

u_{it} – stochastic error term,

$i = 1, M$ (M=10 of life insurance companies,

$t = 1,n$ (N=7- the period from 2015 to 2021.

The assumptions on which fixed individual effects model is based are, among others, that there is no autocorrelation in random errors model and that they are homoskedastic. We will check whether the basic assumptions of the model are violated on the basis of Breusch-Godfrey/Wooldridge test of serial correlation in

panel models and Breusch-Pagan heteroskedasticity test by using software package *R*. The results of the applied tests on selected life insurance companies in the insurance market in Serbia in the observed period 2015-2021 are presented in the following part of the paper.

3. Empirical results

The analysis of the relationship between insurance profitability and selected business indicators of life insurance companies begins with a descriptive analysis whose results are shown in Table 3. The table shows mean, standard deviation, minimum and maximum value of the selected variables for 10 insurance companies in the period from 2015 to 2021.

Table 3 Descriptive analysis

	ROA	OM	ER	IR	GR	S	FL	L	MS
Mean	1.103286	2.205638	39.55491	11.91745	41.58612	13.41182	1.273194	22.19524	10.00000
Median	1.592213	2.489411	35.94491	9.963648	20.76854	15.26928	1.193195	11.27269	7.098833
Maximum	13.26718	4.153030	114.8512	37.36123	387.1430	18.11191	2.791235	126.1142	34.39680
Minimum	-18.16738	-4.014795	17.60218	-0.292514	0.499759	5.681417	-0.569844	1.143963	0.409846
Std. Dev.	4.405601	1.626335	16.60188	9.889086	59.46194	4.302621	0.707574	29.30909	9.290285

Source: the authors' calculation

The following table displays Pearson's correlation coefficients which are used to identify the problem of multicollinearity in empirical papers based on panel models.

Table 4 Pearson's correlation coefficients

Correlation/ Probability	ROA	S	OM	L	IR	GR	ER	FL	MS
ROA	1.000000								

S	0.006367	1.000000							
	0.9583	-----							
OM	0.280439	-0.053888	1.000000						
	0.0187	0.6577	-----						
L	0.080076	0.040791	0.014745	1.000000					
	0.5099	0.7374	0.9036	-----					
IR	0.238687	-0.176479	0.085445	0.652315	1.000000				
	0.0466	0.1439	0.4819	0.0000	-----				
GR	0.197578	0.086978	0.014956	-0.093876	-0.004406	1.000000			
	0.1011	0.4740	0.9022	0.4395	0.9711	-----			
ER	-0.606388	-0.198861	-0.236786	-0.235041	-0.404715	-0.077440	1.000000		
	0.0000	0.0989	0.0484	0.0502	0.0005	0.5240	-----		
FL	0.221171	0.043419	0.490726	-0.115348	0.217512	0.116894	-0.545870	1.000000	
	0.0658	0.7212	0.0000	0.3417	0.0705	0.3352	0.0000	-----	
MS	0.395836	0.194234	0.351110	0.228856	0.359400	0.156634	-0.541321	0.317218	1.000000
	0.0007	0.1071	0.0029	0.0567	0.0022	0.1954	0.0000	0.0075	-----

Source: the authors' calculation

The previous results demonstrate that none of the variables used in the analysis is strongly correlated, i.e. correlation coefficients are less than 0.7 indicating the absence of multicollinearity. Asteriou & Hall (2007) and Hair et al. (2006) in the research imply that a serious problem of multicollinearity does not exist if correlation coefficient is less than 0.9, while in Malhotra (2007) the threshold is 0.75.

We will check the suitability of fixed effects model compared to pooled model on the basis of F-test determining the existence of fixed (individual) effects. Using R statistical software we get:

F= 4.5734, df1= 9, df2 = 52, p-value = 0.0001818

Since the obtained *p* value is less than 0.01, we reject the null hypothesis, leading to the conclusion that fixed effects model is more adequate. Hausman test with Eviews statistical software, whose results are shown in the following table, will be used to choose between fixed and random effects models.

Table 5 Hausman test results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	33.801419	8	0.0000

Source: the authors' calculation

The test shows that we should reject null hypothesis, i.e. random effects model is not a good choice and it is better to opt for fixed effects model shown in Table 6.

Table 6 Results of the fixed effects model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OM	1.150812	0.371803	3.095220	0.0032
ER	-0.254043	0.051713	-4.912522	0.0000
IR	0.051642	0.055601	0.928793	0.3573
GR	0.006130	0.006323	0.969368	0.3368
S	-0.041144	0.088303	-0.465937	0.6432
FL	-2.300934	1.013142	-2.271088	0.0273
L	2.183144	0.647975	3.369178	0.0014
MS	0.113027	0.088828	1.272421	0.2089
C	4.486157	2.826356	1.587258	0.1185
R-squared	0.714154			
Adjusted R-squared	0.620704			
F-statistic	7.642122			
Prob (F-statistic)	0.000000			

Source: the authors' calculation

Based on the coefficient of determination of 0.714154, it can be concluded that 71.42% of the variations in ROA can be explained by the selected variables in the model. The values of F-statistics show the existence of a statistically significant linear relationship between dependent and independent variables.

The results show a statistically significant positive impact of operating ratio and liquidity ratio on ROA, and a statistically significant negative impact of expense ratio and financial leverage on ROA. The other variables were not statistically significant to explain ROA size.

In the following part of the paper, we are going to test the assumptions of non-existence of autocorrelation and homoskedasticity of random error model.

The results of the Breusch-Godfrey/Wooldridge test, whose task is to detect serial correlation in panel models, are as follows:

chisq = 4.464463, df = 3, p-value = 0.2155

We can conclude that there is no serial correlation in the model at the significance level of 5%. The results of Breusch-Pagan test used to establish the presence of heteroskedasticity are as follows:

BP = 4.7266, df = 2, p-value = 0.09411

Based on the previous results, null hypothesis of the presence of homoskedasticity cannot be rejected at the significance level of 5%.

Discussion and concluding remarks

The aim of this study was to examine the impact of the selected independent variables on ROA of the companies that performed life insurance business operations in the territory of the Republic of Serbia in 2021, and we excluded from the analysis the companies that ceased their operations in the period from 2015-2021. After the correlation analysis showed that there was no problem of multicollinearity and that the selected variables were suitable for conducting the regression analysis, we proceeded to create a linear panel model. To this end, based on the results of F-test, whose task was to indicate whether pooled model or fixed effects model was more adequate along with Hausman test which served to make a choice between fixed and random effects models, we applied fixed effects model on the selected variables. Fixed effects model was also used in Kočović et al. (2014) with the aim to describe the impact of internal factors on ROA on the sample of 12 non-life insurance companies that operated in the territory of the Republic of Serbia in the period 2006-2013. This model was also chosen by Olarewaju & Msomi (2021) for analysing 56 non-life companies in South African Development Community in the period from 2008 to 2019, Muchie & LiJuan (2021) in case of 17 insurance companies in Ethiopia in the period from 2005 to 2020, Morara & Sibindi (2021) on a sample of 37 non-life and 16 life insurance companies in Kenya in the period 2009-2018, and Kaya (2015) who researched the non-life insurance market in the period 2006-2013 in Turkey.

In our study, the coefficients obtained using fixed effects model show that the growth of operating ratio has a statistically significant

positive impact on ROA, while the growth of expense ratio has a statistically significant negative impact on ROA; therefore the first and second hypotheses cannot be rejected. The results of Bhattarai (2020) confirmed a positive impact of the operating ratio on ROE indicator.

As assumed by the third and fourth hypotheses, the growth of investment ratio and gross written premiums has a positive impact on ROA; however, the regression coefficients are not statistically significant. Contrary to the expectation that the size of insurance companies has a positive impact on ROA (hypothesis 5), negative regression coefficient was obtained, but it is not statistically significant.

The results show that the growth of debt-to-equity ratio has a negative statistically significant impact on ROA, while the growth of liquidity ratio has a positive impact on ROA; thus the sixth and seventh hypotheses cannot be rejected. In addition, the size of regression coefficient indicates that ROA is most sensitive to changes in these two ratios. The results of Olarewaju & Msomi (2021) also showed that financial leverage had a negative impact on ROA. In contrast to our results, Ishtiaq & Siddiqui (2019) indicated a positive impact of liquidity ratio on ROA, while the results of Muchie & LiJuan (2021) show a negative impact, yet not statistically significant.

Applying the chosen model in the observed period, we have realised that the growth of market share has a positive impact on ROA (hypothesis 8), but it is not statistically significant. The results of Camino-Mogro & Bermúdez-Barrezueta (2019) which analysed the life and non-life insurance market of Ecuador in the period 2001-2017, showed that the life insurance market had a statistically significant negative effect on the profitability of insurance companies.

We can conclude that insurance companies that conducted life insurance business activities in the Serbian market, which in the observed period were able to manage operating costs, debt-to-equity ratio and liquidity well, were more profitable. Regardless of the fact that our results do not show that the growth of insurance premiums is an important factor for profitability, bearing in mind that the life insurance market in Serbia is still underdeveloped, special attention should be paid to the growth potential of this market in the modern market conditions characterized by numerous demographic, political, social, and economic changes.

The limitations of our profitability analysis can be seen in the fact that we base it on the entire portfolio of life insurance products, while due to the non-transparency of data on the characteristics of life insurance products, we were unable to analyse the profitability of individual life insurance products and the risks characteristic of these products, as Sakálová and Krčová (2016) had done on the example of Loan protection insurance as a type of term insurance product.

References

Ahmed, D., Xie, Y., & Issam, K. (2021). Investor confidence and life insurance demand: can economic condition limit life insurance business? *International Journal of Emerging Markets*. https://doi.org/10.1108/IJOEM-06-2020-0650

Asteriou, D., & Hall, S. G. (2007). *Applied econometrics: a modern approach using EViews and Microfit*, revised edition. Hampshire: Palgrave Macmillan.

Bhattarai, B. P. (2020). Factors influencing profitability of insurance companies in Nepal. *International Journal of Management*, *11*(9). 9-14. https://doi.org/10.34218/IJM.11.9.2020.002

Brogi, M., Cappiello, A., Lagasio, V., & Santoboni, F. (2022). Determinants of insurance companies' environmental, social, and governance awareness. *Corporate Social Responsibility and Environmental Management 29* (5), 1357-1369. https://doi.org/10.1002/csr.2274

Camino-Mogro, S., & Bermúdez-Barrezueta, N. (2019). Determinants of profitability of life and non-life insurance companies: evidence from Ecuador. *International Journal of Emerging Markets*, *14*(5), 831-872. https://doi.org/10.1108/IJOEM-07-2018-0371

Cicea, C., Popa, I., Marinescu, C., & Cătălina Ștefan, S. (2019). Determinants of SMEs' performance: evidence from European countries. *Economic research-Ekonomska istraživanja*, *32*(1), 1602-1620. https://doi.org/10.1080/1331677X.2019.1636699

Dorofti, C., & Jakubik, P. (2015). Insurance Sector Profitability and the Macroeconomic Environment. *EIOPA Financial Stability Report - Thematic Articles 4*, 56-71.

Gujarati, D.N. (2004). *Basic econometrics*. New York: Tata McGraw Hill.

Hair, J., Black, W., Babin, B., Anderson, R. & Tatham, R. (2006). *Multivariate Data Analysis (6th ed.)*, New York: Pearson Prentice Hall.

Ishtiaq, N., & Siddiqui, D. A. (2019). Factors affecting financial performance of life insurance sector in Pakistan, *International Journal of Social and Administrative Sciences, 4(2),* 178-199. http://dx.doi.org/10.2139/ssrn.3400728

Kaya, E.Ö. (2015). The effects of firm-specific factors on the profitability of non-life insurance companies in Turkey. *International Journal of Financial Studies 3 (4),* 510-529. https://doi.org/10.3390/ijfs3040510

Kočović, J., Paunović, B., & Jovović, M. (2014). Determinants of business performance of non-life insurance companies in Serbia. *Ekonomika preduzeća*, *62*(7-8), 367-381. https://doi.org/10.5937/ekopre1408367K

Leković, M., Jakšić, M., Gnjatović, D. (2020). Portfolio performance evaluation of mutual funds in the Republic of Serbia. *Serbian Journal of Management*, *15 (2)*, 295-318. https://doi.org/10.5937/sjm15-21145

Malhotra, N. (2007). *Marketing research; an applied orientation (5th ed.)*, New Jersey: Pearson/Prentice Hall.

McGee, H. M., & Crowley-Koch, B. J. (2021). Performance assessment of organizations. *Journal of Organizational Behavior Management*, 41(3), 255-285. https://doi.org/10.1080/01608061.2021.1909687

Meher, K. C., & Zewudu, T. (2020). Determinants of firms' internals & macroeconomic factors on financial performance of Ethiopian insurers. *DLSU Business & Economics Review 29 (2),* 71-80.

Mitrašević, M. (2010). *Actuarial and financial analysis of capital adequacy of non-life insurance companies*, Unpublished doctoral dissertation, Faculty of Economics Belgrade, Belgrade.

Mitrašević, M., Pjanić, M., Novovic Burić, M. (2022). Relationship between insurance market and economic growth in the European Union, Politická ekonomie, 70 (4), 395-420. https://doi.org/ 10.18267/j.polek.1358

Morara, K., & Sibindi, A. B. (2021). Determinants of financial performance of insurance companies: empirical evidence using Kenyan data. *Journal of Risk and Financial Management*, *14*(12), 566. https://doi.org/10.3390/jrfm14120566

Muchie A. Z., LiJuan S. (2021). The microeconomic determinants of insurance profitability in Ethiopian insurance industry—evidenced from life and non-life insurance products. *Journal of Insurance and Financial Management, 5(1)*, 87-123

Norikumo, S. (2021). Informatization of Life Insurance Companies and Organizational Decision Making (Case of Nippon Life Insurance Company). In: Czarnowski, I., Howlett, R.J., Jain, L.C. (eds) *Intelligent Decision Technologies. Smart Innovation, Systems and Technologies, vol 238 (pp. 649-657)* Springer, Singapore. https://doi.org/10.1007/978-981-16-2765-1_54

Ofori-Boateng, K., Ohemeng, W., Ahawaadong Boro, E., & Kwame Agyapong, E. (2022). Efficiency, market structure and performance of the insurance industry in an emerging economy. *Cogent Economics & Finance*, *10*(2068784), 1-14. https://doi.org/10.1080/23322039.2022.2068784

Olarewaju, O. M., & Msomi, T. S. (2021). Intellectual capital and financial performance of South African development community's general insurance companies. *Heliyon*, *7*(4), 1-10. https://doi.org/10.1016/j.heliyon.2021.e06712

Ostojić, S. (2014). Global trends in the insurance market and the functioning of the insurance market in Serbia. *Strategic Management*, *19 (3),* 18-30.

Pavić Kramarić, T., Miletic, M., & Pavić, I. (2017). Profitability determinants of insurance markets in selected Central and Eastern European countries. *International Journal of Economic Sciences, International Institute of Social and Economic Sciences*, 6 (2), 100-123. https://doi.org/10.52950/ES.2017.6.2.006

Pjanić M., Kalaš B., Vasić N. (2016). Analysis of life insurance market in Serbia and countries in the region. *Anali Ekonomskog fakulteta u Subotici*, *36*, 145-160.

Pjanić, M., Milenković, N., Kalaš, B., & Mirović, V. (2018). Profitability determinants of non-life insurance companies in Serbia. *Ekonomika preduzeća*, 66 (5-6), 333-345. https://doi.org/10.5937/EKOPRE1806333P

Sakálová, K., Ondrejková K. I. (2016). Measures of profitability in life insurance product management, *Strategic Management, 21(1),* 8-15.

Shieh, H.-S., Hu, J.-L., & Ang, Y.-Z. (2020). Efficiency of Life Insurance Companies: An Empirical Study in mainland China and Taiwan. *SAGE Open*, 10(1). https://doi.org/10.1177/215824402090206

Zhao, T., Pei, R., & Pan, J. (2021). The evolution and determinants of Chinese property insurance companies' profitability: A DEA-based perspective. *Journal of Management Science and Engineering*, *6*(4), 449-466. https://doi.org/10.1016/j.jmse.2021.09.005

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STRATEGIC MANAGEMENT, Vol. 30 (2025), No. 4, pp. 071-082

DOI: 10.5937/StraMan2300045Z

Received: September 15, 2022
Revised: December 20, 2022
January 16, 2023
Accepted: February 28, 2023
Published online: May 05, 2023

Application of financial innovations in the banking sector of Serbia

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Abstract

Background: Innovations in the domain of banking services in the household sector are primarily related to easier access to a current account and new payment methods, which are practical and simple for the consumer. Financial innovation and financial development are positively related, and their impact grows over time. Constant changes in client demands, and constant pressure to reduce costs and increase efficiency leave banks with no choice but to apply modern technology.

Purpose: This is to point out the importance of financial innovations and their application in the banking market of Serbia. This is all the more so, as the level and growth of real wages in Serbia, as well as the increased inflationary pressure since the time of COVID-19, make these services for bank clients in Serbia much more expensive and inaccessible, due to differences from clients in developed markets.

Methodology/approach: Materials from scientific journals and primary sources were used in the presented research, using the method of content analysis. The presented research was done on the basis of official data available on the National Bank of Serbia's website, which cover a time series of five years. An appropriate statistical regression method was applied.

Findings/conclusions: The conducted research showed that financial innovations have adequate application in Serbia as a developing market**.** The Covid-19 pandemic forced the process of digitization and the adoption of financial innovations to accelerate, and judging by the results of the research, this process is irreversible.

Limitations/future research: Future research could address the value of the transactions made in the same period. Is the increase in the value of financial transactions due to an increase in the number of users or an increase in the volume of transactions? Another question would be whether the inflation factor is noticeable in the increase in the financial value of transactions.

Certain limitations may appear in future research, related to a real reduction in wages, or even job loss, and that is to what extent are bank clients ready to continue using existing financial innovations, i.e. buy new innovations, at the expense of this reduction.

Keywords

financial innovation, bank, emerging markets, Serbia

Introduction

The financial sector plays a key role in economic growth, dealing with the distribution of scarce economic resources where needed. Financial development can be described in terms of financial policy, all those factors and institutions, which,

through financial intermediation, influence the increase of effectiveness and efficiency in business operations on the financial market. Financial innovations can serve to improve the financial system, as well as all necessary institutional and organizational improvements. Thus, financial innovations together with quality improvement have a driving role in financial development.

Interest in financial innovation has been growing in recent years, for the simple reason that more innovative companies have a higher growth rate. The main role of innovation is to help financial institutions to improve their business efficiency, increase their market share, and maintain a leadership position in accordance with market requirements (Alawi et al., 2022). The fact is that many successful and modern companies, such as Apple and Uber, have completely restructured their businesses by applying advanced innovation, and it can be said that their innovations are portrayed as disruptive because they affect the system where the development system exists (Palmié et al., 2020). Various methods based on IT technologies and financial innovations are used to manage systemic financial risk, all in the function of controlling all other risks that banks face in their work (Rehman et al., 2019).

The continuous improvement of financial innovations also leads to an increase in the wealth of the bank's shareholders. It is the world economic crisis of 2007/2008 that made global financial stability fragile, precisely because of the risky innovations that had a comprehensive application in banks. Like innovations in the industrial sector, financial innovations are characterized by high risk, accompanied by expensive investments, specific assets for companies, and long-term returns. All of the above is one of the reasons for the disagreement between shareholders and stakeholders on the one hand and managerial ambitions on the other, which are focused on maximizing the bank's profits (Zouari & Abdelmalek, 2020). A question that is constantly on the agenda of academics and managers is how to value innovation, especially when it comes to the very beginning of development, either of a product or a service. The basic motive lies in the fact that any improvement in decision-making regarding innovation affects the company's performance (Dziallas & Blind, 2019).

Investing in financial innovation puts financial risk management in the focus of banking activities. An essential part of the innovation life cycle is risk management, which helps banks to face uncertainty.

Regarding the relationship of ownership and innovation, banking entities maintain trade relations with the companies in which they invest, approving activities and loans. This puts banks in an uncertain situation when it comes to the potential gain from investing in research and development. In addition, the presence of banks encourages companies to increase their capital through debt, so the greater the debt, the greater the risk and the greater the importance of current debt in investment decisions. One of the risks when it comes to innovation is short-term investments, which can slow down investments in research and development that are mostly long-term (Asensio-López et al., 2019).

In the global market, financial innovation represents a strategic challenge for banks that want to maintain their competitive position. This very fact confirms the key role that financial innovations play in achieving economic growth and creating new value, by influencing the change in the structure of existing financial products or creating new products and services (Zouari-Hadiji, 2021).

1. Literature review

Innovation is the engine that drives companies and gives them a comparative advantage in the competitive market environment (Dani & Gandhi, 2022).

Banks are trying to reduce costs and increase revenues and operational efficiency to maintain their competitive position. They are also very interested in maintaining relationships with their customers through CRM (Rahman et al., 2021). A significant role in all of this is played by financial innovations, which are precisely the function of realizing and improving the aforementioned.

By developing financial innovations, banks influence the improvement of the quality of their work, which improves their position. For example, banks innovate new financial instruments, such as new types of securities, new forms of mortgage lending, new tools when it comes to processing financial transactions, or new organizational forms in banking, such as Internet banks. The diffusion of financial innovation is of great importance for ensuring corporate returns when investing in innovation (Khraisha & Arthur, 2018).

According to Wang and Tan (2021), the positive effects of financial innovation and institutional progress make the financial system

reduce the number of asymmetric information, which affects the strengthening of market compliance, helps intermediaries who deal with monetary operations through agreements, simplify business and work on improving market competitiveness.

Regardless of how widespread financial innovation is at banks, most of them still have very limited knowledge of the risks involved in launching new products and services. Some banks, mostly smaller ones, do not express their willingness to adopt new mechanisms for risk management, which would enable them to adequately monitor, evaluate and manage them when it comes to financial innovations (Zouari-Hadiji, 2021). Lotto (2019) pointed out that the capital adequacy ratio has a positive correlation with the operational efficiency of banks and reduces the risk of moral hazard between shareholders and debt holders.

When it comes to developing economies, they are characterized by insufficient institutional development, developed environmental awareness that is still in its infancy, but also great market uncertainty, constant legislative changes, as well as a rapidly developing business environment, which gives the governments of those countries greater discretionary power (Wu et al., 2022). All these mentioned characteristics can be fertile ground for the development and application of innovations.

As Khan et al. (2020) stated in their research on China, the government has focused on financial innovation in its activities, which would overcome the challenges it faces, all in the function of developing a strong financial market, with the aim of encouraging economic growth. The authors further state that technological innovation is a leading factor driving development in the financial sector, as well as technological inventions, which should be far more efficient because they could subsidize the future development of the financial sector. It can rightly be stated that financial innovations are closely related to financial development and that this relationship is positive and its influence increases over time.

In the work of another group of authors (Wang et al., 2020), it is believed that advanced technologies and their development significantly worsen the level of risk that banks assume. The deterioration effect is primarily related to the decrease in asset quality. This effect is especially noticeable in banks with larger assets, banks with low operational efficiency, as well as those banks where income is primarily based on interest.

According to the research (Yao & Song, 2021), it was determined that during the observed period, there was a reduction in costs related to information, for all participants in the transfer, all thanks to the application of advanced technology. There has also been an increase in transparency when it comes to market information and a reduction in EC (economic capital).

Looking strictly theoretically, the characteristics of the financial market, such as information asymmetry, transaction costs, but also market segmentation, mean that access to financial markets is limited for poor people. This is precisely the key imperfection of the financial market. However, with the emergence of fintech in finance, it has become possible to overcome this imperfection and enable financial inclusion for the poor and give them a chance to get out of poverty (Demir et al., 2022).

In the research of the European Central Bank (2021), it was shown that especially those over 65 years of age use a limited number of payment methods, with preferences for more traditional means such as cash and debit cards. Younger participants use mobile payment methods more often than older ones. There are also geographical differences, with the more widespread use of mobile payment options in technologically mature markets, particularly in Estonia, Finland, and Ireland. Participants had different reasons for not having enough bank funds. The main reason is usually related to unfavourable life circumstances, lack of permanent income, reluctance to take on debt when it comes to finances, personal bankruptcy, emotional barriers when it comes to trusting banks, reluctance to use the internet and digital banking tools, as well as negative past banking experience and lack of technical skills.

Research conducted in Turkey (Gündoğdu & Taşkin, 2017) aimed to examine the relationship between the profitability of the Turkish banking system and financial innovations: online banking, telephone banking, and credit cards. The total net profit in the Turkish banking system is considered as an independent variable by quarter, and online banking, telephone banking, and credit cards are considered as dependent variables, while the regression method was used.

Also, another study (Kamau & Oluoch, 2016) dealt with the effect of innovations - mobile payments, the Internet, ATMs, credit cards, and agency banking on the performance of commercial banks in the period from 2012 to 2015, using research correlations.

From the aspect of using the Internet and mobile phones, prerequisites for financial innovations, the most represented are students, who are mostly without income RZS (2022), and as such, they are not the primary focus of banks. On the other hand, according to Laukkanen (2010), the financially desirable target group faces various types of resistance to financial innovation, such as usage, value, risk, tradition, and prior experience.

One study, (Frame et al., 2018) gave a chronological account of the application of financial innovations, where it was stated that debit cards were implemented in the nineties, and online banking in the two thousandths, which is characteristic of developed markets. In another study, Iman (2018) dealt with the application of mobile banking, based on the use of modern mobile devices, with the help of wireless internet. Innovation in emerging markets often blurs the line between process innovation and product innovation (Anand et al., 2021). Mtar & Belzreg (2021) showed in their research that there is a linear relationship between economic growth and financial development, as well as between innovation and financial development. Research conducted in Turkey (Gündoğdu & Taşkin, 2017) aimed to examine the relationship between the profitability of the Turkish banking system and financial innovations: online banking, telephone banking and credit cards. Another study (Kamau& Oluoch, 2016) dealt with the effect of innovations - mobile payments, the Internet, ATMs, credit cards, and agency banking on the performance of commercial banks.

2. Financial innovation in banking

Financial intermediation has undergone dramatic changes in the last 30 years, which have been mainly influenced by technological changes, as a direct consequence of advances in telecommunications, information technology, and financial practices. Such progress influenced the development of financial innovations, which in turn influenced changes in financial products and services, as well as production processes and organizational structures. Financial innovations as such have greatly influenced the reduction of costs and risks, and led to the improvement of social welfare. This, of course, does not mean that every financial innovation proves to be successful in the market, as many fail due to fundamental flaws, be it in design or simply being replaced by better alternatives. Innovations in the domain of banking services in the household sector are primarily related to easier access to a current account and new payment methods, which are practical and simple for the consumer. Debit cards, which work on the principle of connecting an ATM to a bank account, from which payment can be made, were widely distributed during the 1990s. The 2000s brought online banking, which offered clients a wide range of possibilities, such as checking account balances and the ability to pay using an electronic bill, which contributed to its widespread use. Debit cards are attractive financial instruments that operate on the principle of "pay now" and are linked to a current account, whereby transactions are carried out using online (PIN-based) methods (Frame et al., 2018).

As companies and individuals quickly embraced the Internet in the late 1990s, banks followed suit by quickly providing them with online access to their accounts. DeYoung (2005) believes that the first banking websites started operating in 1995 and that by 2002, almost half of the total number of American banks were transacting through websites. Today, practically all commercial banks in the USA operate in this way.

The advent of smartphones has allowed mobile banking and shopping to increase, and financial innovations based on information and communication technologies (ICT) have become an integral part of our lives (Dahlberg et al., 2015).

A mobile payment method is any payment that uses any mobile device (phone, tablet, laptop etc.) to pay or transfer money. Its key advantage is that it has the ability to use wireless infrastructure, and the way of use makes the factor of space and the factor of time become irrelevant (Iman, 2018). An increase in the number of users of mobile payment services leads to an increase in the reliability of service use (direct network externality). Increasing the number of sellers available through the mobile payment service will have a direct, positive consequence, that consumers value the mobile platform more (Leeet al., 2019). The combination of data with digital innovations opens up opportunities for new business opportunities, especially when it comes to financial services, where clients are the focus of all business decisions, and all available information serves to improve clients' knowledge (Grassiet al., 2022). Databases and modern IT technology have become the most important comparative advantage of banks in the financial environment (Li & Xu, 2021). Traditional banks were forced to respond to growing competition by accelerating the adoption of digital technologies. This resulted in

the opening of its own digital banks, in order to keep pace with the growing expectations of clients (Stulz, 2019). Every successful company will be a digital company one day.

Since the end of the 90s, financial institutions have offered internet banking, which provides access to their product portfolio. In addition to the continuous modernization of internet platforms, banks are also focusing their efforts on opening new channels of access and distribution of their products and services through mobile devices. New applications for smartphones or tablets with an attractive interface and simple designs, based on user experiences from social networks, make banking transactions very simplified and accessible to every client (Cuesta et al., 2015). Digital transformation is conditio sine qua non for banks. Constant changes in client demands, and constant pressure to reduce costs and increase efficiency, leave banks with no choice but to apply modern technology.

The COVID-19 pandemic has had a decisive impact on the digital transformation in banks, creating the necessity for banks to communicate with their customers through digital channels, via platforms and applications, which has enabled social distancing to be respected. Thanks to this, the number of digital users in the EU has increased by 23% since the beginning of the pandemic (Fernandez et al., 2020).

3. Research methodology

The subject of research in this paper is modern financial innovations and their application in the banking sector of Serbia. The application of financial innovations lags in developing markets compared to developed financial markets. The reason should be sought not only in the level of development of the financial markets, but also in very low wages, specifically in Serbia, and therefore the willingness of bank clients to withdraw money for specific bank service. It is not only about the service, but also access to the Internet and the possession of mobile phones, and later smartphones, which are necessary tools in order to use some of the financial innovations offered by banks. Also, in our country, the internet and mobile phones were first accepted by younger generations, and only later by the age group who de facto have financial resources at their disposal.

The purpose of the research is to point out the importance of financial innovations and their application in the banking market of Serbia. This is all the more so, as the level and growth of real wages in Serbia, as well as the increased inflationary pressure since the time of corona, make these services for bank clients in Serbia much more expensive and inaccessible, due to differences from clients in developed markets.

The problem that this research wants to point out is that the very small average nominal wages, expressed in euros in this research, are a major limiting factor for the adoption of new financial innovations. Also, the reduction of real wages under the pressure of inflation and increasingly difficult living conditions can lead to a slowdown in the acceptance of existing financial innovations in the portfolio of banks.

The following hypotheses were tested in the paper:

H1: There is a relationship between wages and e-money account number of users

H2: There is a relationship between wages and online payments – number of users

H3: There is a relationship between wages and telephone payments – number of users

H4: There is a relationship between wages and mobile payments – number of users

The presented research was done on the basis of official data available on the National Bank of Serbia (hereinafter NBS) website, which covers a time series of five years and two quarters from the current year, 2022. An appropriate statistical regression method was applied in this research, which was applied to investigate the relationships between the mentioned financial innovations and the average salary in Serbia. Generally speaking, the rise of knowledge-based economies presents challenges to the development of local markets. The pace of the emergence of new technologies requires lifelong learning. Those regions that fail to create an environment that helps their citizens connect and adapt will end up in a situation where their population is economically and socially disconnected. Innovation in emerging markets often blurs the line between process innovation and product innovation (Anand et al., 2021). Mtar and Belzreg (2021) have shown in their research that there is a linear relationship between economic growth and financial development, as well as between innovation and financial development.

The situation is similar in the banking market of Serbia. Relatively slow economic growth, as a result of ten-year sanctions in the nineties, at the beginning of the twenty-first century brought about a complete restructuring of the country. Independent development of the financial market,

and especially banking market, was not possible, so the state opened the door wide to foreign capital. This was supposed to mean an accelerated modernization of the country, but it was impossible to catch up with the developed markets in terms of time, technology, and finance. Hence, the application of modern financial innovations in banking has a decades-long delay.

From the perspective of legislation in the Republic of Serbia, progress has been made when it comes to financial innovations in banking, with the adoption of a specific law in the field of digital identities. It is the Law on Electronic Documents, Electronic Identification and Trust Services in Electronic Business, which entered into force on October 27, 2017. The new law is a direct consequence of the digitization process in Serbia, with the aim of enabling and encouraging faster and more efficient business and reducing business costs, developing a market of trusted services, modernizing, and thereby facilitating the work of public authorities and business entities, including banks. This law regulates matters in accordance with the provisions of the European Union Regulation on Electronic Identification and Trust Services in Electronic Transactions (eIDAS).

The basic condition for the adoption of financial innovations in Serbia is access to the Internet by the banks' clients.

When it comes to the number of computers in households, according to the Republic Bureau of Statistics of Serbia (hereinafter RZS) (2022) there is a large gap in terms of having internet connection according to the level of household income. Internet access is mostly owned by households with a monthly income exceeding 90,000 RSD (99.6%), while the share of households with an income of up to 30,000 RSD is only 33.1%. Regarding the method of accessing the Internet (types of connection), of the total number of households that have an Internet connection, 90.9% of households, have a fixed broadband connection, while 74.4% of households have a mobile broadband Internet connection.

In accordance with the NBS (2019) research for other access channels, in Serbia, there has been a continuous growth in the volume and value of payment transactions via the Internet, especially in local currency. The largest number of such payments are made via cards, an indication that consumers are increasingly feeling confident in using this type of payment instrument and access channel.

Table 1 shows the most represented financial innovations when it comes to banking products and services in the Serbian financial market. We see that the expansion of the application of banking innovations intensified in 2017, when certain legal regulations were adopted, with the aim of faster digitalization of the country. Each of the presented innovations shows a growth trend, from the aspect of the number of users, except when it comes to electronic money, which has had a downward trend since 2019.

Table 1 E-money account, telephone payment, online payment, mobile payment and wages from 2017 to 2022.

Year	E-money account - number of users	Telephone payment - number of users	Online payment - number of users	Mobile payment - number of users	Wages (average for the period, in EUR)
2017	35.533	201.143	1.935.687	1.126.930	394,5
2018	45.833	224.970	2.465.904	1.426.825	419,8
2019	48.604	264.226	2.748.395	1.702.767	466,0
2020	46.155	304.124	3.156.041	2.162.362	510,9
2021	45.448	356.151	3.493.020	2.840.518	562,2
2022-I	44.589	365.085	3.568.783	3.129.600	612,7
2022-II	43.803	381.181	3.624.525	3.224.993	627,9

Source: the authors based on the NBS statistics

4. Results and discussion

It is visible from Figure 1 that until 2019, the electronic money account had a growing trend, but after that period it would have a continuous decline. The reason should be sought in new financial innovations, which have proven to be more operative in practice, and which clients have accepted at the expense of electronic money accounts.

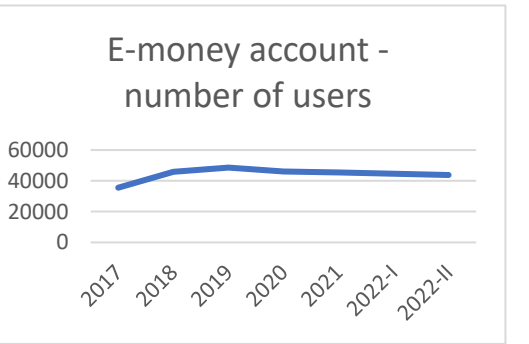

Figure 1 Number of electronic money users
Source: the authors

As for telephone payments, Figure 2 shows a growing trend from year to year. A particularly large jump in the number of users was recorded in the year of corona, 2020 and a year later, 2021. The growth trend continued in the first two quarters of 2022, but not with such a pronounced increase in the number of users.

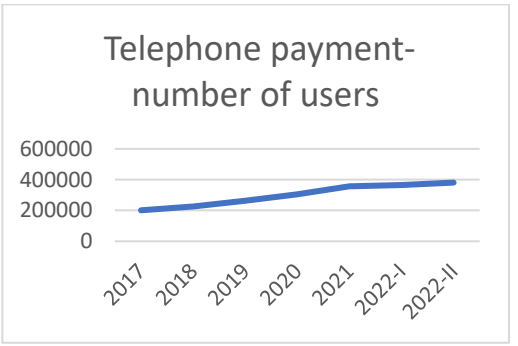

Figure 2 The trend in the number of telephone payment users
Source: the authors

Online payment, shown in Figure 3, which uses the Internet as a channel, has provided users with wide opportunities for contactless payment, so its growth trend is quite understandable. This type of payment has its full affirmation, which results in a large increase in the number of users, in the year of corona 2020 and the year after. The growth trend continued during the first two quarters of 2022.

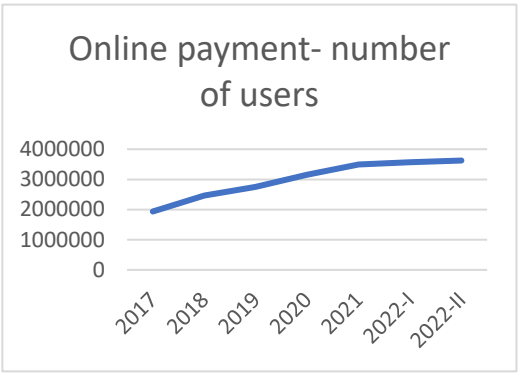

Figure 3 Number of online payment users
Source: the authors

When it comes to financial innovations, mobile payment, as shown in Figure 4, as the most advanced form of payment, offering the possibility of using all mobile devices (phones, tablets, laptops) as well as wireless internet, has a certain growth trend of its users. After the rapid growth during the time of corona, as this form of payment makes the time factor and the space factor irrelevant, the number of users continues to grow during the first two quarters of 2022.

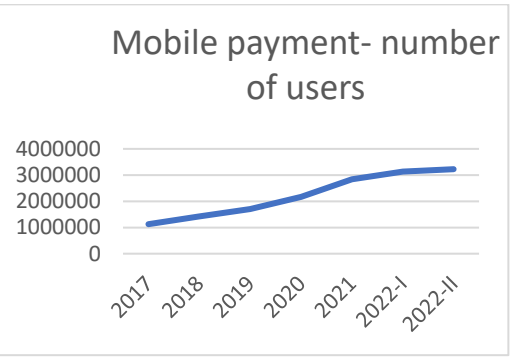

Figure 4 Number of mobile payment users
Source: the authors

Figure 5 represents the relationship between electronic payment and estimated earnings. The ratio is important because it shows how many bank clients in Serbia are ready to allocate money for this banking service, in an already small consumer basket. We see that this ratio shows a decline from 2020, although the average nominal salary expressed in euros has an upward trend. It just means that bank clients preferred to turn to other banking innovations, which they considered to be more operational and efficient.

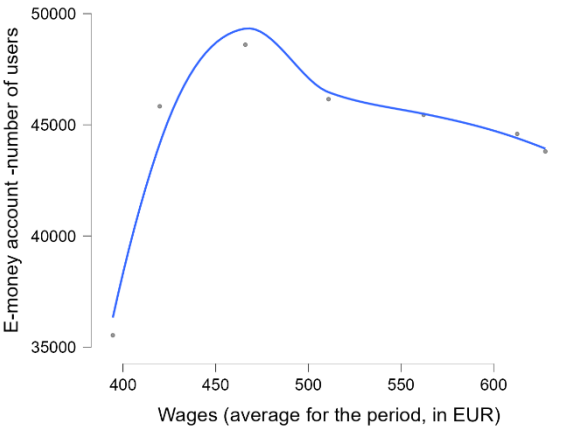

Figure 5 Relationship between e-money and wages
Source: the authors

Figure 6 shows the relationship between mobile phone payments and the average nominal salary. We can see that the curve shows continuous growth, which continues even after the time of the corona, which means that the banks' clients are ready for this service to allocate additional funds from their inflation-affected average salary and to set aside money not only to pay for the service to the bank but also to buy a mobile phone.

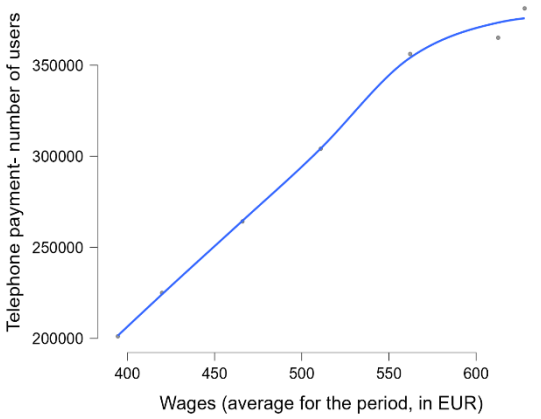

Figure 6 The relationship between mobile phone payments and wages
Source: the authors

Figure 7 shows the relationship between online payments and earnings. The trend is continuous growth, the banks' clients are ready to pay for this service to the bank, which enables them to deal with payment transactions themselves, without going to the bank, regardless of the real decrease in wages due to inflationary pressure.

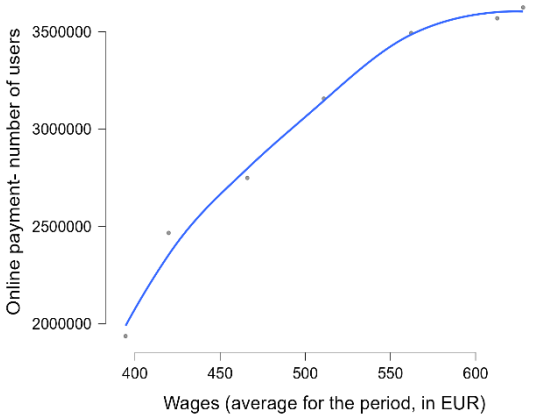

Figure 7 Relationship between online payment and wages
Source: the authors

Figure 8 shows the relationship between mobile payments and earnings, with a steadily increasing trend over the observed period. Clients obviously believe that this payment service, which assumes the possession of a mobile device (smartphone, tablet, laptop) and wireless internet, perfectly suits their needs, and regardless of the continuous decrease in real earnings, (regardless of the fact that nominal earnings are increasing), they are ready to allocate money for this type of service.

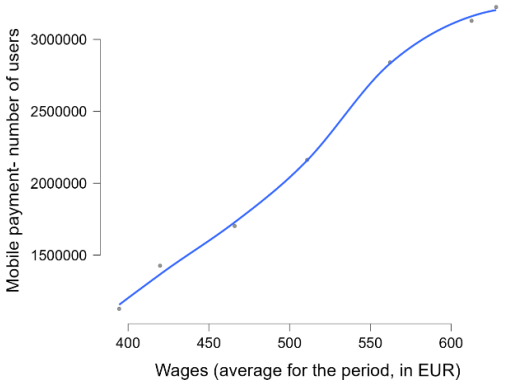

Figure 8 Relationship between mobile payment and wages
Source: the authors

In the tables that follow, a statistical presentation is given, through regression, which investigated and showed the relationship between wages and the presented indicators: e-money account number of users, online payments- number of users, telephone payments- number of users, and mobile payments- number of users.

Table 2 Relationship between wages and e-money account number of users

	E-money account number of users				
	Beta Coefficient	R^2	F	*t*	*p*
Wages	14.218	0.099	0.551	0.742	0.491

Source: the authors

The regression was used to test if wages carry an impact on the e-money account number of users. The variable wages were regressed on the variable e-money account number of users. Wages predicted e-money account number of users F (5, 1) = 0.551, p= 0.491, which indicates that wages do not play a significant role in shaping the e-money account number of users. Moreover, the R^2 = 0.099 depicts that the model explains only 9.9% of the e-account users.

This proves hypothesis H1.

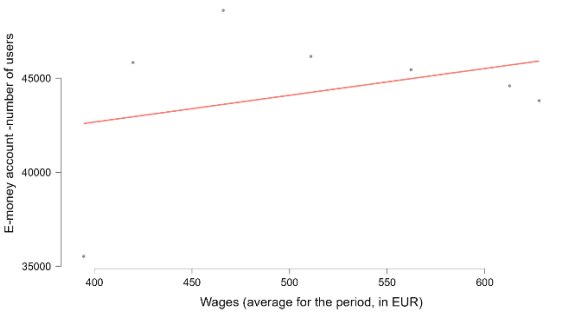

Figure 9 Relationship between wages and e-money account number of users
Source: the authors

Graphical representation of the same parameters from the previous table is presented in Figure 9.

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Table 3 Relationship between wages and online payments-number of users

	Online payments- number of users				
	Beta Coefficient	R^2	F	*t*	*p*
Wages	6734.642	0.930	66.711	8.168	<0.001

Source: the authors

The regression was used to test if wages carry an impact on online payments-number of users. The variable wages were regressed on variable online payment users. Wages predicted online users F (5, 1) = 66.711, p< 0.001, which indicates that wages play a significant role in shaping the number of users for online payments. The R^2 = 0.930 depicts that the model explains as much as 93% of the variance in the number of online users.

This proves hypothesis H2.

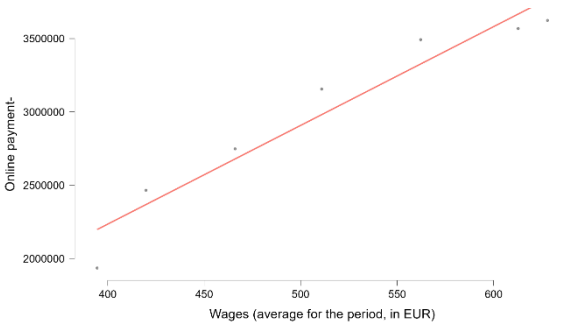

Figure 10 Relationship between wages and online payments- number of users
Source: the authors

Graphical representation of the same parameters from Table 3 is presented in Figure 10.

Table 4 Relationship between wages and telephone payments- number of users

	Telephone payments- number of users				
	Beta Coefficient	R^2	F	*t*	*p*
Wages	771.448	0.980	242.078	15.559	<0.001

Source: the authors

The regression was used to test if wages carry an impact on telephone payments-number of users. The variable wages were regressed on variable telephone payment users. Wages predicted telephone users F (5, 1) = 242.078, p< 0.001, which indicates that wages play a significant role in shaping the number of users for telephone payments. The R^2 = 0.980 depicts that the model explains as much as 98% of the variance in the number of telephone users.

This proves hypothesis H3.

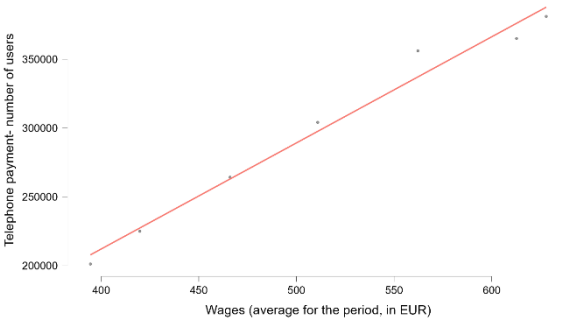

Figure 11 Relationship between wages and telephone payments- number of users
Source: the authors

Graphical representation of the same parameters from Table 4 is presented in Figure 11.

Table 5 Relationship between wages and mobile payments-number of users

	Mobile payments- number of users				
	Beta Coefficient	R^2	F	*t*	*p*
Wages	9198.246	0.990	491.712	22.175	<0.001

Source: the authors

The regression was used to test if wages carry an impact on mobile payments-number of users. The variable wages were regressed on variable mobile payment users. Wages predicted telephone users F (5, 1) = 491.712, p< 0.001, which indicates that wages play a significant role in shaping the number of users for mobile payments. The R^2 = 0.990 depicts that the model explains as much as 99% of the variance in the number of mobile users.

This proves hypothesis H4.

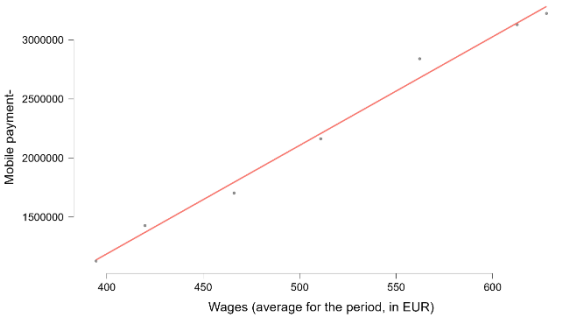

Figure 12 Relationship between wages and mobile payments- number of users
Source: the authors

Graphical representation of the same parameters from Table 5 is presented in Figure 12.

Conclusion

Together with advanced financial institutions, financial innovations play a decisive role in the financial development of emerging markets. The conducted research showed that financial

innovations have adequate application in Serbia, a developing market. The reasons for the decade-long delay when it comes to the application of certain innovations should be sought in the insufficient development of the financial market on the one hand, but also the very low standard of people, given that financial innovations have as prerequisites for wide and profitable applications, from the point of view of banks, the existence of the Internet, and then mobile telephony, later smartphones and other mobile devices, all of which represent limiting factors when it comes to innovation.

The Covid-19 pandemic forced the process of digitization and the adoption of financial innovations to accelerate, and judging by the results of the research, this process is irreversible.

The present research, which also uses the same indicators and regression model, differs from the mentioned sources of literature in the fact that they all looked at the relationship between financial innovations and bank performance, considering where the bank's benefits are. The research conducted had a perspective from the viewpoint of the bank's clients, how much the average wage affects the purchase and use of the bank's financial innovations. This fact can be very encouraging for bank managers, to decisively start digitizing all banking services, which the financial market of Serbia can adopt, given that the pandemic and the time after it showed that bank clients are ready to permanently accept banking innovations, regardless of the trend of decreasing real wages**.** This conclusion is supported by the fact that even after the end of the pandemic, the process of accepting financial innovations did not slow down, on the contrary, the number of users continued to grow. This is despite the fact that after the pandemic, inflationary pressure began to increase in Serbia, which had a particular impact on the reduction of real wages, regardless of the average nominal growth of the same in the observed period. The clients of the banks have shown their readiness to allocate the necessary financial resources from the already reduced consumer basket for the use of innovations, estimating that they have certain benefits from it. This is supported by the proven hypotheses in this paper.

Future research could deal with the value of the transactions made in this same period, and whether the growth in the number of users of financial innovation is accompanied by an increase in the value of those transactions. Is the inflation factor also noticeable in the increase in the financial value of transactions, could be another question for future research.

Certain limitations may appear in future research, related to a real reduction in wages, or even job loss, and that is to what extent bank clients are ready to continue using existing financial innovations, i.e. buy new innovations, at the expense of this reduction.

References

Alawi, M., Wajih, A., Rukhma, S., & Madeeha, S. (2022). Impact of financial innovation and institutional quality on financial development in emerging markets. *Journal of Risk and Financial Management*,15(3), 115. https://doi.org/10.3390/jrfm15030115

Asensio-López, D., Cabeza-García, L., & González-Álvarez, N. (2019). Corporate governance and innovation: a theoretical review. *European Journal of Management and Business Economics*, 28(3), 266-284. https://dx.doi.org/10.1108/EJMBE-05-2018-0056

Anand, J., McDermott, G., Mudambi, R., &Narula, R. (2021). Innovation in and from emerging economies: new insights and lessons for international business research. *Journal of International Business Studies 52*(4), 545–559.

Cuesta, C., Ruesta, M., Tuesta, D. & Urbiola, P. (2015). The digital transformation of the banking industry. *Digital Economy* Watch. Retrieved November 11, 2022. from https://www.researchgate.net/publication/291357544_The_digital_transformation_of_the_banking_industry

Dani, V.,& Gandhi, V.(2022). Understanding the drivers of innovation in an organization: a literature review. *International Journal of Innovation Science*, *14*(3/4), 476-505. https://doi.org/10.1108/IJIS-10-2020-0201

Dahlberg, T., Gio, H., & Ondrus, J. (2015). A critical review of mobile payment research. *Electronic Commerce Research and Applications, 14*(5), 265-284. https://doi.org/10.1016/j.elerap.2015.07.006

Demir, A., Pesque-Cela, V., Alltunbas, Y., & Murinde, V.(2022). Fintech, financial inclusion and income inequality: a quantile regression approach. *The European Journal of Finance,* 28(1), 86-107. https://doi.org/10.1080/1351847X.2020.1772335

DeYoung, R. (2005). The performance of internet-based business models: evidence from the banking industry. *Journal of Business, 78*(3), 893-947.

Dziallas, M., & Blind, K. (2019). Innovation indicators throughout the innovation process: An extensive literature analysis. *Technovation*, *80*, 3-29. https://doi.org/10.1016/j.technovation.2018.05.005

European Central Bank (2021). *The Study on New Digital Payment Methods*. Retrieved December 15, 2022, from https://www.ecb.europa.eu/paym/digital_euro/investigation/profuse/shared/files/dedocs/ecb.dedocs220330_report.en.pdf

Fernandez, S., Jenkins, P., & Vieira, B. (2020). Europe's digital migration during COVID-19: getting past the broad trends and averages. *McKinsey Digital*. Retrieved November 7, 2022, from https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/europes-digital-migration-during-covid-19-getting-past-the-broad-trends-and-averages

Frame, S., Wall, D., & White, L. (2018). Technological change and financial innovation in banking: some implications for fintech. *FRB Atlanta Working Paper* No. 2018-11. Retrieved November 1, 2022. from https://www.atlantafed.org/-/media/documents/research/publications/wp/2018/11-technological-change-and-financial-innovation-in-banking-some-implications-for-fintech-2018-10-02.pdf

Grassi, L., Figini, N., & Fedeli, L. (2022). How does a data strategy enable customer value? The case of fintech and traditional banks under the open finance framework. *Financial Innovation,* 8(75). https://doi.org/10.1186/s40854-022-00378-x

Gündoğdu, A., & Taşkin, D. (2017). Analysis of the relationship between financial innovation and the performance of turkish banking system. International Review of Economics and Management*, 5*, 16-32. https://doi.org/10.18825/iremjournal.280341

Iman, N. (2018). Is mobile payment still relevant in the fintech era? *Electronic Commerce Research and Applications,* 30, 72-82. https://doi.org/10.1016/j.elerap.2018.05.009

Kamau, D., & Oluoch, J.(2016). Relationship between financial innovation and commercial bank performance in Kenya. *International Journal of Social science and Information technology,* 2(4). Retrieved December 15, 2022, from https://www.ijssit.com/main/wp-content/uploads/2016/06/RELATIONSHIP-BETWEEN-FINANCIAL-INNOVATION-AND-COMMERCIAL-BANK-PERFORMANCE-IN-KENYA.pdf

Kiambati, K. (2020). Influence of credit risk on shareholder market value of commercial banks listed in Nairobi Securities Exchange. *International Journal of Research in Business and Social Science*, *9*(2), 107-117. https://doi.org/10.20525/ijrbs.v9i2.613

Khan, H., Khan, S., & Zuojun, F. (2020). Institutional Quality and Financial Development: Evidence from Developing and Emerging Economies. *Global Business Review,* 1, 1–13. https://doi.org/10.1177/0972150919892366

Khraisha, T., & Arthur, K. (2018). Can we have a general theory of financial innovation processes? A conceptual review. *Financial Innovation*, *4*(4), 1-27. https://dx.doi.org/10.1186/s40854-018-0088-y

Laukkanen, T. (2010). The role of information in mobile banking resistance. *International Journal of Bank Marketing, 28* (5), 372-388. https://doi.org/10.1108/02652321011064890

Lorenzen, M., Mudambi, R., & Schotter, A. (2020). International connectedness and local disconnectedness: MNE strategy, city-regions and disruption. *Journal of International Business* Studies, *51*(8), 1199–1222. https://doi.org/10.1057/s41267-020-00339-5

Lee, J., Ryu, M.,& Lee, D. (2019). A study on the reciprocal relationship between user perception and retailer perception on platform-based mobile payment service. *Journal of Retailing and Consumer Service*, 48, 7-15. https://doi.org/10.1016/j.jretconser.2019.01.007

Li, B., & Xu, Z. (2021). Insights into financial technology (FinTech): a bibliometric and visual study. *Financial Innovation*, *7*(1), 1–28. https://doi.org/10.1186/s40854-021-00285-7

Lotto, J.(2019). Evaluation of factors influencing bank operating efficiency in Tanzanian banking sector. *Cogent Economics & Finance*, *7*(1), 1–14. https://doi.org/10.1080/23322039.2019.1664192

Mtar, K., & Belzreg, W. (2021). On the nexus of innovation, trade openness, financial development and economic growth in European countries: New perspective from a GMM panel VAR approach. *International Journal of Finance & Economics*. https://doi.org/10.1002/ijfe.2449

NBS (2019). Serbia National Retail Payments Strategy 2019-2024. Retrieved December 12, 2022, from https://www.nbs.rs/export/sites/NBS_site/documents-eng/platni-sistem/payments_strategy_2019_2024.pdf

Palmié, M., Wincent, J., Parida, V., & Caglar, U. (2020). The evolution of the financial technology ecosystem: An introduction and agenda for future research on disruptive innovations in ecosystems.*Technological Forecasting and Social Change, 151*(C). https://doi.org/10.1016/j.techfore.2019.119779

Rahman, S., Chowdhury, M., & Tania, T.(2021). Nexus among Bank Competition, Efficiency and Financial Stability: A Comprehensive Study in Bangladesh, *Journal of Asian Finance, Economics and Business,* 8(2), 317-328. https://doi.org/10.13106/jafeb.2021

Rehman, Z., Muhammad, N., Sarwar, B., & Raz, M. (2019). Impact of risk management strategies on the credit risk faced by commercial banks of Balochistan*, Financial Innovation, 5*(1), 1-13. https://doi.org/10.1186/s40854-019-0159-8

RZS (2022). Use of information and communication technology in the republic of serbia, 2022. Retrieved December 3, 2022, from https://www.stat.gov.rs/sr-Latn/oblasti/upotreba-ikt

Stulz, P. (2019). FinTech, BigTech, and the future of banks. *Journal of Applied Corporate Finance 31*(4) 86-97. https://doi.org/10.1111/jacf.12378

Wang, R., & Tan. J. (2021). Exploring the coupling and forecasting of financial development, technological innovation, and economic growth. *Technological Forecasting and Social Change*,*163*(C), 1–11. https://doi.org/10.1016/j.techfore.2020.120466

Wang, R., Liu, J., & Luo,R. (2020). Fintech development and bank risk taking in China. *The European Journal of Finance, 27*(4). https://doi.org/10.1080/1351847X.2020.1805782

Wu. L., Wei, Y., Wang, C., McDonald, F.& Han, X. (2022). The importance of institutional and financial resources for export performance associated with technological innovation. *Technological Forecasting & Social Change,* 185(C). https://doi.org/10.1016/j.techfore.2022.122040

Yao,T., & Song, L. (2021). Examining the differences in the impact of fintech on the economic capital of commercial banks' market risk: evidence from a panel system GMM analysis. *Applied Economics, 53*(23), 2647-2660. https://doi.org/10.1080/00036846.2020.1864275

Zouari, G., & Abdelmalek, I. (2020). Financial innovation, risk management, and bank performance. *Copernican Journal of Finance & Accounting,* 9(1), 77–100. http://dx.doi.org/10.12775/

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International Journal of Strategic Management and
Decision Support Systems in Strategic Management

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ISSN: 1821-3448
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> Ljubojević, T.K. (1998). Ljubojević, T.K. (2000a). Ljubojević, T.K. (2000b). Ljubojević, T.K., & Dimitrijević, N.N. (1994).

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> Author, A. A., Author, B. B., & Author, C. C. (Year). Title of article. *Title of Periodical, volume number* (issue number), pages.

➲ **Journal article, one author, paginated by issue.**

Journals paginated by issue begin with page 1 in every issue, so that the issue number is indicated in parentheses after the
volume. The parentheses and issue numbers are not italicized, e.g.

> Seliverstova, Y. (2021). Workforce diversity management: A systematic literature review. *Strategic Management*, *26*(2), 3–11. https://doi.org/10.5937/StraMan2102003S

➲ **Journal article, one author, paginated by volume.**

Journals paginated by volume begin with page 1 in issue 1, and continue page numbering in issue 2 where issue 1 ended, e.g.

> Perić, O. (2006). Bridging the gap: Complex adaptive knowledge management. *Strategic Management, 14*, 654–668.

➲ **Journal article, two authors, paginated by issue.**

Dakić, S., & Mijić, K. (2020). Regression analysis of the impact of internal factors on return on assets: A case of meat processing enterprises in Serbia. *Strategic Management*, *25*(1), 29–34. https://doi.org/10.5937/StraMan2001029D

➲ **Journal article, two authors, paginated by volume.**

Ljubojević, K., & Dimitrijević, M. (2007). Choosing your CRM strategy. *Strategic Management, 15*, 333-349.

➲ **Journal article, three to six authors, paginated by issue.**

Marić, S., Uzelac, O., & Strugar-Jelača, M. (2019). Ownership structure as a measure of corporate performance. *Strategic Management*, *24*(4), 28–37. https://doi.org/10.5937/StraMan1904028M

➲ **Journal article, three to six authors, paginated by volume.**

Boškov, T., Ljubojević, K., & Tanasijević, V. (2005). A new approach to CRM. *Strategic Management, 13*, 300-310.

➲ **Journal article, more than six authors, paginated by issue.**

Ljubojević, K., Dimitrijević, M., Mirković, D., Tanasijević, V., Perić, O., Jovanov, N., et al. (2005). Putting the user at the center of software testing activity. *Management Information Systems, 3*(1), 99-106.

➲ **Journal article, more than six authors, paginated by volume.**

Strakić, F., Mirković, D., Boškov, T., Ljubojević, K., Tanasijević, V., Dimitrijević, M., et al. (2003). Metadata in data warehouse. *Strategic Management, 11*, 122-132.

➲ **Magazine article.**

Strakić, F. (2005, October 15). Remembering users with cookies. *IT Review*, *130*, 20-21.

➲ **Newsletter article with author.**

Dimitrijević, M. (2009, September). MySql server, writing library files. *Computing News, 57,* 10-12.

➲ **Newsletter article without author.**

VBScript with active server pages. (2009, September). *Computing News,57,* 21-22.

B. BOOKS, BROCHURES, BOOK CHAPTERS, ENCYCLOPEDIA ENTRIES, AND BOOK REVIEWS

Basic format for books

Author, A. A. (Year of publication). *Title of work: Capital letter also for subtitle*. Publisher.

➲ **Book, one author.**

Ljubojević, K. (2005). *Prototyping the interface design*. Faculty of Economics in Subotica.

➲ **Book, one author, new edition**

Dimitrijević, M. (2007). *Customer relationship management* (6th ed.). Faculty of Economics in Subotica.

➲ **Book, two authors.**

Ljubojević, K., Dimitrijević, M. (2007). *The enterprise knowledge portal and its architecture*. Faculty of Economics in Subotica.

➲ **Book, three to six authors.**

Ljubojević, K., Dimitrijević, M., Mirković, D., Tanasijević, V., & Perić, O. (2006). *Importance of software testing*. Faculty of Economics in Subotica.

➲ **Book, more than six authors.**

Mirković, D., Tanasijević, V., Perić, O., Jovanov, N., Boškov, T., Strakić, F., et al. (2007). *Supply chain management*. Faculty of Economics in Subotica.

➲ **Book, no author or editor.**

Web user interface (10th ed.). (2003). Faculty of Economics.

➲ **Group, corporate, or government author.**

Statistical office of the Republic of Serbia. (1978). *Statistical abstract of the Republic of Serbia.* Ministry of community and social services.

➲ **Edited book.**

Dimitrijević, M., & Tanasijević, V. (Eds.). (2004). *Data warehouse architecture*. Faculty of Economics.

➲ **Chapter in an edited book.**

Repa, V. (2019). Deriving Key Performance Indicators from Business Process Model. In M. Pańkowska & K. Sandkuhl (Eds.), *Perspectives in Business Informatics Research. BIR 2019. Lecture Notes in Business Information Processing, vol 365.* (pp. 148–162). Springer. https://doi.org/10.1007/978-3-030-31143-8_11

➲ **Encyclopedia entry.**

Mirković, D. (2006). History and the world of mathematicians. In *The new mathematics encyclopedia* (Vol. 56, pp. 23-45). Faculty of Economics.

C. UNPUBLISHED WORKS

➲ **Paper presented at a meeting or a conference.**

Ljubojević, K., Tanasijević, V., Dimitrijević, M. (2003). *Designing a web form without tables*. Paper presented at the annual meeting of the Serbian computer alliance, Beograd.

➲ **Paper or manuscript.**

Boškov, T., Strakić, F., Ljubojević, K., Dimitrijević, M., & Perić, O. (2007. May). *First steps in visual basic for applications*. Unpublished paper, Faculty of Economics Subotica, Subotica.

➲ **Doctoral dissertation.**

Strakić, F. (2000). *Managing network services: Managing DNS servers*. Unpublished doctoral dissertation, Faculty of Economics Subotica.

➲ **Master's thesis.**

Dimitrijević, M. (2003). *Structural modeling: Class and object diagrams.* Unpublished master's thesis, Faculty of Economics Subotica.

D. ELECTRONIC MEDIA

The same guidelines apply for online articles as for printed articles. All the information that the online host makes available must be listed, including an issue number in parentheses:

Author, A. A., & Author, B. B. (Publication date). Title of article. *Title of Online Periodical, volume number* (issue number if available). https://www.anyaddress.com/full/url/

➲ **Article in an internet-only journal**

Tanasijević, V. (2003, March). Putting the user at the center of software testing activity. *Strategic Management*, *8* (4). https://www.ef.uns.ac.rs/sm2024

➲ **Document from an organization**

Faculty of Economics. (2008, March 5). *A new approach to CRM*. https://www.ef.uns.ac.rs/papers/acrm.html

➲ **Article from an online periodical with DOI assigned.**

Jovanov, N., & Boškov, T. A PHP project test-driven end to end. *Management Information Systems*, 2 (2), 45-54. https://doi.org/10.5937/StraMan213302003S

➲ **Article from an online periodical without DOI assigned.**

Online journal articles without a DOI require a URL.

Author, A. A., & Author, B. B. (Publication date). Title of article. *Title of Journal, volume number*. https://www.anyaddress.com/full/url/

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➲ **Quotations**

If a work is directly quoted from, then the author, year of publication and the page reference (preceded by "p.") must be included. The quotation is introduced with an introductory phrase including the author's last name followed by publication date in parentheses.

According to Mirković (2001, p. 201), "The use of data warehouses may be limited, especially if they contain confidential data".

Mirković (2001, p. 201), found that "the use of data warehouses may be limited". What unexpected impact does this have on the range of availability?

If the author is not named in the introductory phrase, the author's last name, publication year, and the page number in parentheses must be placed at the end of the quotation, e.g.

He stated, "The use of data warehouses may be limited," but he did not fully explain the possible impact (Mirković, 2001, p. 201).

➲ **Summary or paraphrase**

According to Mirković (1991, p. 201), limitations on the use of databases can be external and software-based, or temporary and even discretion-based.

Limitations on the use of databases can be external and software-based, or temporary and even discretion-based (Mirković, 1991, p. 201).

➲ **One author**

Boškov (2005) compared the access range…

In an early study of access range (Boškov, 2005), it was found...

➲ When there are **two authors**, both names are always cited:

Another study (Mirković & Boškov, 2006) concluded that…

➲ If there are **three or more authors** the abbreviation "et al." (Latin for "and others") is employed in APA in-text citations when referencing works with three or more authors. The format is to include only the first author's last name, followed by "et al.," a comma, and the year of publication. For instance, (Dakic et al., 2024) would be used as an example.

➲ **Unknown author**

If the work does not have an author, the source is cited by its title in the introductory phrase, or the first 1-2 words are placed in the parentheses. Book and report titles must be italicized or underlined, while titles of articles and chapters are placed in quotation marks:

A similar survey was conducted on a number of organizations employing database managers (Limiting database access, 2005).

If work (such as a newspaper editorial) has no author, the first few words of the title are cited, followed by the year: (The Objectives of Access Delegation, 2007)

Note: In the rare cases when the word "Anonymous" is used for the author, it is treated as the author's name (Anonymous, 2008). The name Anonymous must then be used as the author in the reference list.

➲ **Organization as an Author**

If the author is an organization or a government agency, the organization must be mentioned in the introductory phrase or in the parenthetical citation the first time the source is cited:

According to the Statistical Office of the Republic of Serbia (1978), …

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The overview is limited to towns with 10,000 inhabitants and up (Statistical Office of the Republic of Serbia [SORS], 1978).

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(Bezjak, 1999; Griffith, 2004)

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If two or more sources used in the submission were published by the same author in the same year, the entries in the reference list must be ordered using lower-case letters (a, b, c…) with the year. Lower-case letters will also be used with the year in the in-text citation as well:

Survey results published in Theissen (2004a) show that…

➲ To **credit an author for discovering a work** when you have not read the original:

Bergson's research (as cited in Mirković & Boškov, 2006)…

Here, Mirković & Boškov (2006) will appear in the reference list, while Bergson will not.

➲ When **citing more than one author**, the authors must be listed alphabetically:

(Britten, 2001; Sturlasson, 2002; Wasserwandt, 1997)

➲ When there is **no publication date**: (Hessenberg, n.d.)

➲ **Page numbers must always be given for quotations**:

(Mirković & Boškov, 2006, p.12)

Mirković & Boškov (2006, p. 12) propose the approach by which "the initial viewpoint…

➲ **Referring to a specific part of a work**:

(Theissen, 2004a, chap. 3) (Keaton, 1997, pp. 85-94)

➲ **Personal communications, including interviews, letters, memos, e-mails, and telephone conversations**, are cited as below. (These are *not* included in the reference list.)

(K. Ljubojević, personal communication, May 5, 2008).

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A few footnotes may be necessary when elaborating on an issue raised in the text, adding something that is in indirect connection, or providing supplementary technical information. Footnotes and endnotes are numbered with superscript Arabic numerals at the end of the sentence, like this.1 Endnotes begin on a separate page, after the end of the text. However, *Strategic Management* **does not recommend the use of footnotes or endnotes.**

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STRATEGIC managament : international journal of strategic managament and decision support systems in strategic managament / editor-in-chief Lazar Raković. - Vol. 14, no. 1 (2009) - . - Subotica: University of Novi Sad, Faculty of Economics, 2009-. - 30 cm

Tromesečno. - Nastavak publikacije: Strategijski menadžment = ISSN 0354-8414
ISSN 1821-3448

COBISS.SR-ID 244849927

Rešenjem Ministarstva za informisanje Republike Srbije, časopis "Strategijski menadžment" upisan je u registar javnog informisanja pod brojem 2213, od 7. avgusta 1996. Rešenjem Ministarstva za nauku i tehnologiju Republike Srbije br. 413-00-435/1/96-01 časopis je oslobođen opšteg poreza na promet proizvoda kao publikacija od posebnog interesa za nauku.

ISSN 1821-3448